L: India's Mangalayaan probe is on its way to Mars **R: China's Yutu "Jade Rabbit" Rover is on the Moon**

INDEX

NOTE - with this issue,
To The Stars International Quarterly replaces older sister publication Moon Miners' Manifesto India Quarterly
This is logical as TTSIQ #s 2-5 and M3IQ #s 18-21, except for the first 2 and last 2 pages,
Included the same news reports, the same essays and articles, and the same layout.

TTSIQ Sponsor Organizations

About The National Space Society – http://www.nss.org/

The National Space Society was formed in March, 1987 by the merger of the former L5 Society and National Space institute. NSS has an extensive chapter network in the United States and a number of international chapters in Europe, Asia, and Australia. NSS hosts the annual International Space Development Conference in May each year at varing locations. NSS publishes **Ad Astra** magazine quarterly. NSS actively tries to influence US Space Policy.

About The Moon Society – http://www.moonsociety.org

The Moon Society was formed in 2000 and seeks to inspire and involve people everywhere in exploration of the Moon with the establishment of civilian settlements, using local resources through private enterprise both to support themselves and to help alleviate Earth's stubborn energy and environmental problems. The Society has a network of chapters in the US and has been an affiliate of NSS since 2005.

About Space Renaissance Initiative – http://www.spacerenaissance.org/

SRI's focus is on use of space resources to address the challenges of runaway population growth and increasing use of Earth resources at a non-sustainable pace. "The settlement of space would benefit all of humanity by opening a new frontier, energizing our society, providing room and resources for the growth of the human race without despoiling Earth, and creating a lifeboat for humanity that could survive even a planet-wide catastrophe."

About The Mars Foundation – http://marsfoundation.org/ – http://marshome.org/

The Foundation seeks to involved interested persons in the design of Mars outposts and settlements, maximizing use of building materials that can be produced on Mars, to illustrate the near-term feasibility of establishing a permanent human presence on Mars.

About Open Luna Foundation – http://openluna.org/missions

The OpenLuna Foundation aims to return to the moon through private enterprise. Astepped program of robotic missions, thena short series of manned missions to construct a small, approximately 8 person outpost .

About SEDS: Students for the Exploration and Development of Space – http://www.seds.org/

SEDS is an independent, student-based organization which promotes the exploration and development of space by educating people about the benefits of space, through a network of interested students, providing an opportunity

About Moon Miners' Manifesto – http:www.MMM-MoonMinersManifesto.com

MMM, has been published 10 times a year since issue #1 December 1986 by the Milwaukee Lunar Reclamation Society chapter of the **National Space Society**. It has also served **the Moon Society** and its predecessor, Artemis Society International, since October 1995.

Most issues deal with the **opening of the Lunar frontier**, suggesting how pioneers can make best use of **local resources** and learn to **make themselves at home.** This will involve psychological, social, and physiological adjustment**.** Much of what will hold for the **Moon**, will also hold true for **Mars** and for space in general. There is one Mars theme issue each year, and occasionally **other space destinations** are discussed: the asteroids, Europa (Jupiter), Titan (Saturn), even the cloud tops of Venus, and interstellar destinations beyond.

This issue is online at: www.moonsociety.org/international/ttsiq/ **and at:** www.nss.org/tothestars/

[The articles below have been summarized by the editor. For the full text, see the links cited.]

SPACEPORT NEWS

India/ISRO to decide on 2nd Launch Site

www.space-travel.com/reports/Second_rocket_launch_site_depends_on_satellite_size_cost_benefit_999.html

Second rocket launch site depends on satellite size, cost-benefit

Chennai, India (Nov 28, 2013 -The Indian space agency, will decide on the need for a 2nd rocket launch site after a detailed study on the cost-benefit and other aspects like the trend in remote sensing satellites.

One option is to place a second rocket launch site **at Kulasekarapattinam in Tamil Nadu's Tuticorin district**, as it is an ideal location and could save rocket fuel or increase the rocket's carrying capacity, and it is a better location from which to launch to the south (polar trajectories). It is also nearer the equator and better for launching to the East as well. But Sriharikota would be maintained for that.

Left: view of Sriharikhotra **Right:** orange trajectories from present site; black from proposed site

ISRO does not want to fly over Sri Lankha (Island, formerly Ceylon)

ISRO sends remote sensing (earth observation) satellites southwards. The global trend in the remote sensing over the poles satellites is reduction in their size, while that of communication satellites launched eastward is going up. So for these launches, the Sriharikota site is the better location

A new rocket launch site for remote sensing satellites, normally launched southwards, has to take into account the capital expenditure involved and the savings in fuel burnt by the rocket. For launching communication satellites the current site is the best, and the new site better for Communications satellites.

ISRO is weighing the costs of building a new site or improving the present site, constructing a new rocket assembly building and a third launch pad at Sriharikota capable of launching upgraded geosynchronous satellite launch vehicle (GSLV) Mark III. Currently launches must be a minimum of one month apart. The new construction would allow more frequent launches.

At the moment, it seems more likely that ISRO will improve the current site as opposed to building new site to the south.

The US, Russia, Europe, and China all have multiple launch sites. For India, it seems that cost must be the deciding factor rather than ideal location. ##

ANALOG FACILITY TRAINING

ESA Astronauts Emerge from Cave After Underground Spaceflight Training

http://www.space.com/23090-**astronauts-caves-mock-space-mission**.html


'Cavenauts' during ESA's 2013 underground astronaut training course

October 8, 2013 - Six astronauts emerged from a cave in Italy after six days underground, spent getting a taste of the isolation and danger that will confront them on a space mission. Their expedition was part of the European Space Agency's two-week CAVES exploration course, which trains astronauts to work together in multicultural teams under difficult conditions.

CAVES — short for **C**ooperative Adventure for **V**aluing and **E**xercising human behavior and performance **S**kills — is designed to be as similar to spaceflight as possible. The 2013 CAVES astronauts spent some time in training to make sure they were familiar with the procedures they need before entering the darkness of **Sa Grutta cave**, on the Italian island of **Sardinia**, with a list of science tasks to accomplish.

In the cave, the team followed a daily plan, as do astronauts on the International Space Station, working long days to push the survey forward and document the topography of the cave. "As we extended our survey, samples were taken for later analysis of water chemistry, microbiology of soil and surfaces, and atmosphere for CO2 [carbon dioxide], temperature and humidity," team members reported..

To keep astronauts healthy, CAVES organizers posted a schedule, chose food that isn't apt to spoil and plotted the safest routes possible through the subsurface. This year's crew also got several upgrades from previous expeditions to improve safety including new helmet lights, specially adapted shoes and a portable carbon dioxide monitor. Science findings are still being analyzed, but some interesting carbon dioxide variations were found through the cave.

Crew members also took several videos underground examining strong analogies between speleology and spaceflight. ##

Also see the **Mars Society Announcement** and call for volunteers for a 365 day program at the Flashline Mars Arctic Station under the **MARS SECTION** below.

NEW TECHNOLOGY

NASA Looking to Commercial Sector for New Technology and Materials

http://www.spacedaily.com/reports/prnewswire-space-news.html

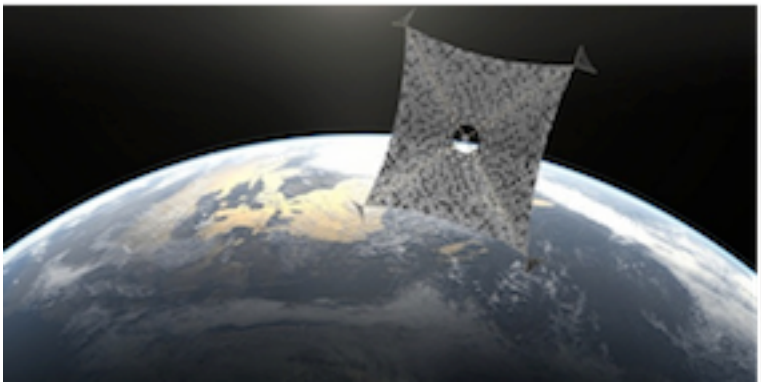
October 15, 2013 - Space activities are extremely expensive. It costs $50,000 to launch a gallon of water into space. To reduce costs, NASA is partnering with the private sector for specialized research to develop new materials. NASA is sharing insights on the roadmap for upcoming space projects to guide companies interested in supporting future projects.

NASA wants to develop new technologies and extend existing ones by partnering with the commercial sector to advance long-range missions to lower the cost of operating in space and of sustaining operations, as well as to increase the performance of space hardware.NASA seeks fresh perspectives to its daily challenges from all types of organizations. Where possible, it uses items that are commercially available and have been well researched and tested.

For more information, click on the link above.

Sunjammer, World's Largest Solar Sail, Passes Key Test for 2015 Launch

http://www.space.com/23162-**nasa-sunjammer-solar-sail-test-complete**.html
http://www.space.com/23167-**deploying-sunjammer-s-massive-solar-sail-video**.html
http://www.space.com/23172-**sunjammer-solar-sail-photos**.html




October 11, 2013: A NASA plan to launch the world's largest solar sail into space and unfurl it like a giant parasol has passed a major test as the mission moves closer to a planned January 2015 launch. The Sunjammer mission successfully deployed part of its huge solar sail in a test on Sept. 30, indicating that the craft should be ready to function successfully after its January 2015 launch.

The giant Sunjammer solar sail, cleared a successful design test, deploying a beam to stretch a quarter of the sail completely open. Actually, the Sept. 30 test took place on Earth where both gravity and atmosphere made conditions more challenging than they will be in the vacuum of space, giving NASA great confidence that everything will work well in space. When Sunjammer launches in 2015, it will be the largest solar sail ever flown. Covering an area of almost 1,200 square meters (13,000 square feet), the full sail will span approximately a third the length of an American football field. Despite its size, the enormous sail will be only about five millionths of a meter thick, keeping its weight down to 31 kg (70 lbs) The lightweight, reflective material will use the pressure generated by sunlight to maneuver it through space. Smaller sails at the end of each of four booms will act as rudders to help the craft navigate.

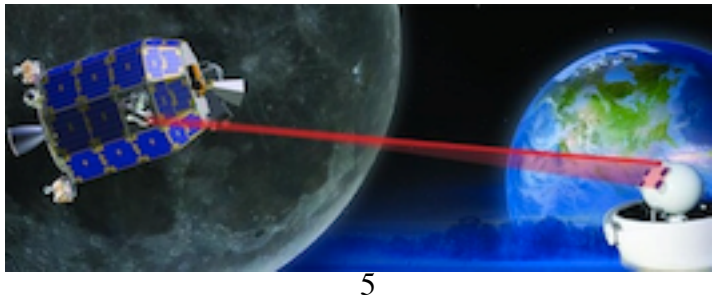
Once in space, Sunjammer will monitor the Sun's activity, while also demonstrating the validity of relying solely on low-cost, fuel free solar winds for spacecraft navigation. Ultimately, Sunjammer type craft could form a network providing an early warning system for space weather. Other sun-powered craft could travel completely out of the solar system.

Successful deployment of Sunjammer's solar sail s a key feat, bring us one step closer to realizing NASA's vision of a propellantless spacecraft and introduce the exciting potential of solar sails to the world," L'Garde's Space Services CEO Charles Chafer said. ##

NASA Laser Test breaks Earth<-->Moon Communications Record "622 megabits per second" (0.622 gigabits)

http://www.space.com/23308-**nasa-moon-laser-communications-record**.html
http://www.spaceflight101.com/**ladee-mission-updates**.html
http://www.spaceflight101.com/**ladee-lunar-laser-communication-demonstration**.html
http://www.space.com/22680-**nasa-lunar-laser-communications-experiment-infographic**.html
www.space.com/22575-**super-fast-data-transmission-tech-hitches-ride-on-moon-mission-video**.html

October 23, 2013 - The **L**unar **L**aser **C**ommunications **D**emonstration or **LLCD** — a technology test flying on NASA's **L**unar **A**tmosphere and **D**ust **E**nvironment **E**xplorer spacecraft, or **LADEE** — has set a record for the fastest download rate between the Moon and Earth.



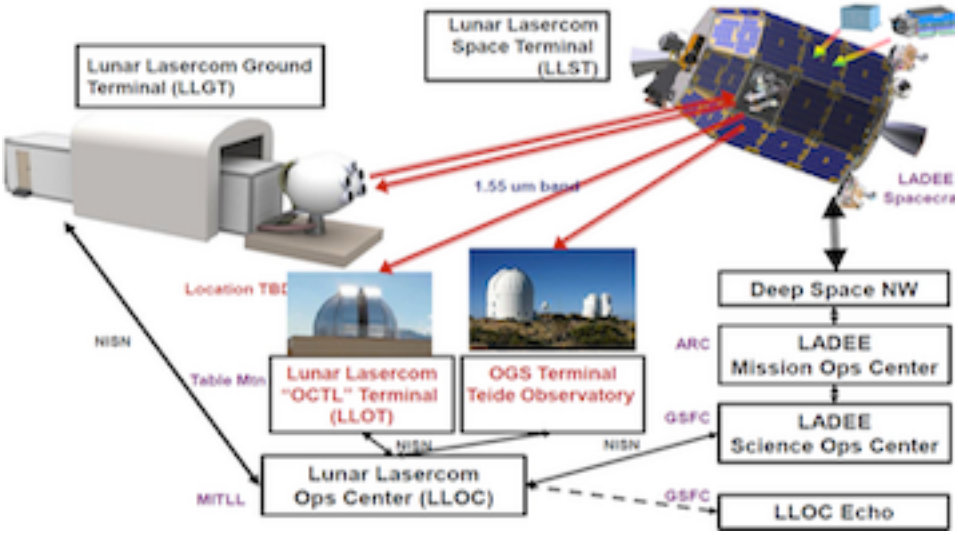
LADEE began a month-long checkout period upon reaching orbit around the Moon that included testing the communications demonstration, using laser technology instead of radio wave transmissions. A pulsed laser beam sent data 384,633 kilometers (239,000 miles) home to Earth at the relatively speedy download rate of 622 megabits per second. The test also showed an "error-free upload rate" of 20 megabits per second from the primary ground station at White Sands, New Mexico, US.

The goal of LLCD is to validate and build confidence in this technology for future missions. Developed by the Massachusetts Institute of Technology's Lincoln Laboratory, this technology has incredible application possibilities. It could help scientists communicate with distant spacecraft or outposts with rapid and **high-fidelity downloads of 3D images and high-definition video** from distant parts of the solar system. This would be an enormous improvement over the very low resolution telecasts from the Moon back to Earth during the Apollo manned landing missions.

More importantly, this technology may make teleoperation of robotic equipment on the Moon a real possibility, despite the **3 second** time delay imposed by the speed of light. (The Moon is about 1.5 light seconds away from Earth.) This in turn will allow a greater portion of construction and operation tasks to be done with only human supervision, requiring less man hours to accomplish more, making construction an operation of a moon base much less expensive.

The new laser-based technology would not, however, allow teleoperation of equipment on Mars, where the lag imposed by the speed of light varies from 6-20 **minutes.**

The LLCD is not the first space laser communication to be attempted. NASA had earlier used a laser to send a picture of the Mona Lisa to the Lunar Reconnaissance Orbiter circling the Moon.



Full size image: http://www.spaceflight101.com/uploads/6/4/0/6/6406961/9273747_orig.png
More illustrations at: http://www.spaceflight101.com/ladee-mission-updates.html

The system demonstrated variable data rates, switching from 622 to 311 Mbit/s when the Moon is low on the horizon requiring the laser to penetrate more of Earth's atmosphere. According to LLCD team members, the first series of tests was absolutely flawless and needed less time for communications lock-up and high data rates were achieved from the start.

While LLCD accomplished most of its goals during this first demo session, tests will continue, putting the system through its paces to assess its performance and learn about long-range laser communications in preparation for use on missions to Mars and beyond.

Possible applications may well transform Geostationary Communications Satellite high-rate communications between ground terminals or low-orbiting spacecraft.

"LLCD is the first step on our roadmap toward **building the next generation of space communication capability**," said Badri Younes, NASA's deputy associate administrator for space communications and navigation (SCaN). " ##

Video Update Dec. 24, 2013 - http://www.space.com/24071-**first-hd-video-to-moon-and-back-at-622-megabits-per-second**.html

Robonaut-2 aboard the International Space Station to get legs

December 10. 2-13 - http://www.space.com/23901-**space-station-robonaut-to-get-legs-video**.html
http://www.space.com/23906-**nasa-humanoid-robonaut-legs-video**.html
http://www.space.com/23929-**nasa-valkyrie-humanoid-robot**.html (with **video**)

Japanese Humanoid Robot Dominates DARPA Challenge

December 22, 2013 – http://www.space.com/24060-**darpa-robotics-challenge-winner**.html
http://www.space.com/24045-**darpa-robotics-challenge-robot-designs**.html

Above: Some of the contenders – http://www.livescience.com/41904-**darpa-robotics-challenge-images**.html

HOMESTEAD, Fla. — A Japanese robotics team dominated the field after an ambitious two-day competition at the Homestead Miami Speedway that saw robots driving cars, climbing ladders & wielding power tools.

A two-legged robot built by engineers at **SCHAFT** Inc., a Japanese robotics firm, won the DARPA (US **De**fense **A**dvanced **R**esearch **P**rojects **A**gency) Robotics Challenge Trials Dec. 21, scoring the most points across tasks that tested the robots' mobility, dexterity, perception and autonomous operations. Florida-based **IHMC Robotics**' humanoid robot claimed second place in the competition, with **Carnegie Mellon** University's Team Tartan Rescue rounding out the top three. Travel issues prevented one team from China from making it to Florida in time for the competition. During the Trials, the robots were evaluated based on their performance in eight physical tasks. These included

- Driving a vehicle through a designated course;
- Traversing across uneven terrainand piles of rubble;
- Removing debris from a doorway;
- Climbing an industrial ladder;
- Retrieving and connecting a hose;
- Opening three different types of doors;
- Using tools to cut through drywall; and
- Closing a series of valves to demonstrate dexterity.

Team SCHAFT's robot, S-One, scored 7 points in the competition. The 95 kg (209 lb) two-legged robot excelled at most of the tasks that emphasized mobility and dexterity.

Team IHMC Robotics' 2-legged humanoid robot navigated through 43 different types of doorways.
Team Tartan Rescue, (NEW)engineers from Carnegie Mellon University and the National Robotics Engineering Center in Pittsburgh, Penn., designed a 400-pound (181 kg) robot, dubbed CHIMP, resembles a human, but rolls around on rubberized tracks like a tank to give it more stability on uneven terrain.
Here were the final standings of the competition:

- Team SCHAFT (SCHAFT Inc.): 27 points
- Team IHMC Robotics (Florida Institute for Human & Machine Cognition): 20 points
- Team Tartan Rescue (Carnegie Mellon U. and National Robotics Engineering Center): 18 points
- Team MIT (MIT): 16 points
- Team RoboSimian (NASA Jet Propulsion Laboratory): 14 points
- Team TRACLabs (TRACLabs, Inc.): 11 points
- Team WRECS (Worcester Polytechnic Institute): 11 points
- Team Trooper (Lockheed Martin Advanced Technology Labs): 9 points
- Team THOR (Virginia Tech College of Engineering, Robotics & Mechanisms Laboratory): 8 points
- Team KAIST (Rainbow Co.): 8 points
- Team ViGIR (TORC Robotics): 8 points
- Team HKU (University of Hong Kong): 3 points
- Team DRC-Hubo (Drexel University): 3 points
- Team Chiron (Kairos Autonomi): 0 points
- Team Mojavaton (Mojavaton, LLC): 0 points
- NASA-JSC Team Valkyrie (NASA Johnson Space Center): 0 points ##

COMMERCIAL SPACE SYSTEMS

SpaceX Hit Huge Reusable Rocket Milestone with Falcon 9 Test Flight (Video)

http://www.space.com/23230-**spacex-falcon9-reusable-rocket-milestone**.html

http://www.space.com/22994-**spacex-falcon-9-rocket-launch-test-photos**-california.html

December 2, 2013 SpaceX took some steps toward developing a fully reusable rocket during the maiden flight of its new and improved Falcon 9 launch vehicle late last month. SpaceX managed to re-light the next-generation Falcon 9's nine-engine first stage twice during the September 29th test flight of its "**grasshopper** system" from Vandenberg Air Force Base in California, easing the stage's return to Earth over the Pacific Ocean.



"For the first restart burn, we lit three engines to do a supersonic retro propulsion, which we believe may be the first attempt by any rocket stage," SpaceX officials wrote in an update Monday (Oct. 14). "The first restart burn was completed well and enabled the stage to survive re-entering the atmosphere in a controlled fashion." ##

SpaceX Launches Falcon 9 Rocket On First Commercial Satellite Mission

http://www.space.com/23744-**spacex-rocket-launches-landmark-commercial-satellite**.html

http://www.space.com/23820-**spacex-launches-satellite-to-geostationary-orbit-for-first-time-video**.html

SpaceX's first entry into the large commercial satellite market and its first launch into a geostationary transfer orbit

December 3, 2013: An upgraded SpaceX Falcon 9 rocket carries a communications satellite to orbit, the first launch by a commercial launch provider. The launch was from SpaceX's pad at Cape Canaveral Air Force Station in Florida. The payload was a 3.2-ton SES-8 communications satellite

Ths mission marked SpaceX's first entry into the large commercial satellite market and its first launch into a geostationary transfer orbit needed for such a mission.

Above center: The black outline box in the middle image shows two workers to scale of satellite

Another major milestone for SpaceX occurred 27 minutes after liftoff, when the two-stage Falcon 9 rocket reignited its second stage for a maneuver that delivered the SES-8 satellite into its intended orbit. "Spacecraft separation confirmed!" SpaceX officials wrote in a Twitter post 33 minutes after launch. "SES-8

The 6,918-lb. (3,138 kilograms) SES-8 satellite was placed in a transfer orbit that ranges between 183 miles (295 kilometers) above Earth at its nearest point and 49,709 miles (80,000 km) at its highest point. The satellite is a hybrid Ku-and Ka-band spacecraft built to provide high-definition telecommunications services to SES World Skies customers across the South Asia and Pacific region.

The Hawthorne, Calif.-based company has a $1.6 billion deal with NASA to launch its unmanned Dragon capsule on 12 cargo delivery missions to the International Space Station; two such missions have already flown. The company is also developing a manned version of Dragon to ferry astronauts to and from the Station.

But to launch commercial satellites, SpaceX upgraded the 68.4 m (224.4-ft) Falcon 9 rocket to boost its capabilities. The rocket's nine-engine first stage was modified with new SpaceX Merlin 1D engines that provide more thrust than their predecessors. The rocket has a larger 17-foot (5.1 m) payload fairing to fit even the largest satellites inside, and boasts a triple redundant avionics system for reliability, company officials said.

The first Falcon v1.1 launched on Sept. 29 from SpaceX's pad at Vandenberg Air Force Base in California on a mission that successfully carried the CASSIOPE space weather tracking satellite into orbit for the Canadian Space Agency.

Improving the Falcon 9

SpaceX engineers also changed the configuration of the first-stage engines, which were in a three-by-three block, into a **circular "Octaweb"** pattern with eight engines encircling the ninth to increase reliability and streamline its manufacturing process.

SpaceX has also **outfitted the upgraded Falcon 9's first stage with heat shielding** and a **restart capability** as part of its ongoing project to develop a completely reusable rocket launch. Trathe real game changer on the horizon will be demonstration of first stage recovery after launch, with Space-X "Grasshopper" System, already demonstrated from low altitudes.

Introducing a new, real space age

The new space age will be upon us when all commercial space payloads are launched by competing commercial launch companies, reserving national space agency launches to science and military payloads. A commercial company, United Space Alliance, already operates the US Cape Kennedy spaceport.

SpaceX's Falcon 9 rockets are named after the fictional Millennium Falcon spaceship from the "Star Wars" films. The Dragon spacecraft are named after the fictional Puff the Magic Dragon.##

SpaceX buys more land in Cameron County, Texas

http://www.spacenews.com/article/financial-report/38336**spacex-buys-more-land-in-cameron-county**

Nov. 25, 2013 - SpaceX continues to solidify its presence in Cameron County. The recent purchase increased the site six-fold. Space Exploration Technologies Corp. increased its land holdings in the Boca Chica Beach area from 12 lots to 72 undeveloped lots. The purchase comes in advance of the Federal Aviation Administration's final environmental impact statement on the site, expected before the end of the year, and SpaceX's decision on the site.The combined area that SpaceX has bought now encompasses about 24 acres. SpaceX also has leased 56.5 acres from private property owners.

SpaceX proposes to construct facilities to support the orbital launch of the Falcon 9 and Falcon Heavy launch rockets that would carry commercial payloads, including satellites or experimental payloads. The rockets also could carry a capsule, such as the SpaceX Dragon. All launch trajectories would be to the east over the Gulf of Mexico.

As SpaceX' manifest grows, it needs to perform aerospace operations work, and operate an economically-viable site within tight schedules, expanding the commercial space launch industry by meeting its demand for launch site services. ##

Dream Chaser incurs minor damage in Crash Landing in California

http://spaceflightnow.com/news/n1310/26dreamchaser/#.Um497Ba0Lwx

http://beforeitsnews.com/space/2013/10/dream-chaser-crash-landing-called-a-non-flight-issue-2468406.html

October 26, 2013 A test article of the lifting body Dream Chaser spaceship built by Sierra Nevada Corp., one of several companies receiving NASA funding to develop a commercial space taxi, made a crash landing on a runway at California's Edwards Air Force Base on Saturday.

"The vehicle successfully released from its carrier aircraft, an Erickson Air-Crane helicopter, as planned at approximately 11:10 a.m. Pacific Standard Time. At the end of its first free flight, the Dream Chaser flipped over on the runway due to the mechanical failure on the craft's left main landing gear.

"Following release, the Dream Chaser spacecraft automated flight control system gently steered the vehicle to its intended glide slope" Sierra Nevada said in a statement. "The vehicle adhered to the design flight trajectory throughout the flight profile. Less than a minute later, Dream Chaser smoothly flared and touched down on Edwards Air Force Base's Runway 22L right on centerline."

"While there was an anomaly with the left landing gear deployment, the high-quality flight and telemetry data throughout all phases of the approach-and-landing test will allow SNC teams to continue to refine their spacecraft design," Quotes from 2nd Link above.

File photos: Dream Chaser in flight, and landing

Engineers blamed the mishap on a problem during deployment of the Dream Chaser's left landing gear, which is derived the main gear used by the U.S. Air Force's F-5E Tiger fighter jet.

The test flight over the Mojave Desert was conducted autonomously – without a pilot in the cockpit – after the Dream Chaser's release from a Sikorsky S-64 helicopter operated by Erickson Air Crane at 11:10 a.m. Pacific time (2:10 p.m. EDT; 1810 GMT), according to Sierra Nevada.

"Following release, the Dream Chaser spacecraft automated flight control system gently steered the vehicle to its intended glide slope," Sierra Nevada said in a statement. "The vehicle adhered to the design flight trajectory throughout the flight profile. Less than a minute later, Dream Chaser smoothly flared and touched down on Edwards Air Force Base's Runway 22L right on centerline."

Sierra Nevada officials has said each landing test would begin with a drop from 12,000 feet and last between 30 and 40 seconds as the Dream Chaser flies at an approximately 23-degree glide angle, ending with a flare maneuver about 300 feet above the desert and touchdown at a speed of more than 200 mph.

No personnel were injured in Saturday's flight, and officials are assessing damage to property. Air Force emergency personnel responded to the scene as a precaution, according to NASA.

The Space Act Agreement (between NASA and Sierra Nevada) describes the test this way: "A minimum of one and up to five additional Engineering Test Article free flight test(s) will be completed to characterize the aerodynamics and controllability of the Dream Chaser Orbital Vehicle outer mold line configuration during the subsonic approach and landing phase." ##

SPACE TOURISM

23 Astronaut Hopefuls win Axe Apollo's Free Trip to Space

http://www.space.com/23816-**axe-apollo-space-academy-astronaut-training**.html
http://www.space.com/23866-**axe-apollo-space-academy-spaceflight-winners**.html
http://www.space.com/19199-**axe-apollo-space-launch-contest**.html

December 8, 2013 - The AXE Apollo Space Academy competition will send 25 people into space on a suborbital space plane. A group of would-be astronauts, more than 100 participants from all over the world, headed down to Florida for the chance to win the opportunity of a lifetime: a free trip to the edge of space and back. They are headed for the AXE Apollo Space Academy at Kennedy Space Center in Florida.

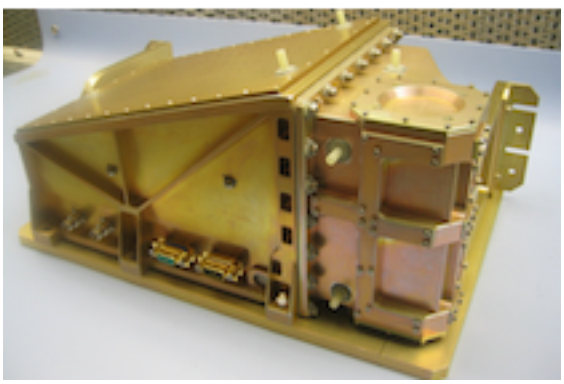
The 23 chosen winners will receive tickets to fly from Space Expedition Corporation aboard their XCOR Aerospace Lynx aircraft, a reusable shuttle that is expected to start flying customers to space in 2015, It costs $95,000 for a ticket on the Lynx spacecraft and more than 250 tickets have already been sold, according to XCOR officials. The 23 chosen will fly for free.

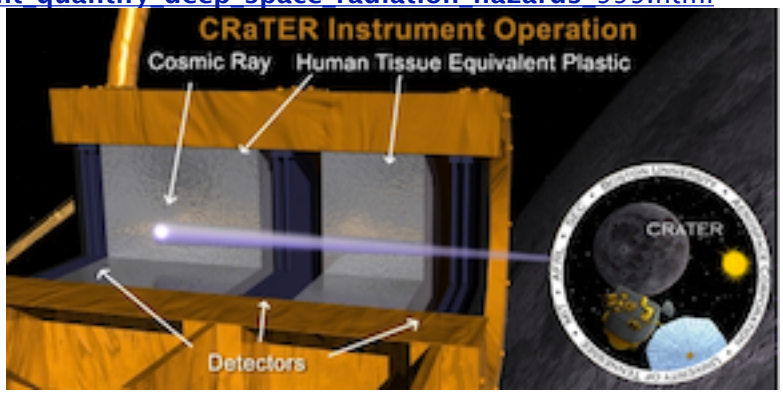
AXE is a men's personal care product company that has teamed up with Apollo 11 moonwalker Buzz Aldrin. The company kicked off its new AXE Apollo Space Academy, January 9 20123 as an online contest. The Lynx space plane will be operated by the tourism firm Space Expedition Curacao.

SPACE RADIATION PROBLEM

Scientists document and quantify deep-space radiation hazards: Data from Lunar Reconnaissance Obiter CRATER Radiation Detector

Nov 18, 3013 http://www.spacedaily.com/reports/
UNH_**scientists_document_quantify_deep_space_radiation_hazards**_999.html





Cosmic **Ra**y **T**elescope for the **E**ffects of **R**adiation (CRaTER) radiation detector aboard **LRO**

"The primary goal of CRaTER is to characterize the global lunar radiation environment and its biological impacts. This objective is critical if we are to "implement a sustained, safe, and affordable human and robotic program to search for evidence of life, understand the history of the solar system, and prepare for future human exploration", a vision established by the President's Space Exploration Policy Directive." - http://lunar.gsfc.nasa.gov/**crater**.html

Measurement Goals

- Measure and characterize that aspect of the deep space radiation environment, LET spectra of galactic & solar cosmic rays (particularly above 10 MeV), most critically important to the engineering & modeling communities to assure safe, long-term, human presence in space.
- Develop a novel instrument, steeped in flight heritage, that is simple, compact, and comparatively low-cost, but with a sufficiently large geometric factor needed to measure LET spectra and its time variation, globally, in the lunar orbit.
- Investigate the effects of shielding by measuring LET spectra behind different amounts and types of areal density, including tissue-equivalent plastic.
- Test models of radiation effects and shielding by verifying/validating model predictions of LET spectra with LRO measurements, using high-quality GCR and SEP spectra available contemporaneously on ongoing/planned NASA.

Space-based radiation as measured by a UNH-led detector aboard NASA's Lunar Reconnaissance Orbiter (LRO) provides critical information on the radiation hazards that will be faced by astronauts on extended missions to deep space such as those to Mars. The data quantifies measurements made since 2009 by the CRaTER radiation detector of the radiation hazards in near Earth 'geospace' out to Mars and other regions of the heliosphere. There are risks for both humans and satellites due to harmful radiation from galactic cosmic rays and solar energetic particles that can easily penetrate typical shielding and damage electronics. When this radiation impacts biological cells, it can cause an increased risk of cancer.

Previously, radiation measurements were derived using a material called "tissue-equivalent plastic"-a stand-in for human muscle capable of gauging radiation dosage and those hazards were not sufficiently well characterized to determine if long missions outside low-Earth orbit can be accomplished with acceptable risk.

CRaTER's seminal measurements now provide quantified, radiation hazard data from lunar orbit and can be used to calculate radiation dosage from deep space down to airline altitudes - crucial data in developing techniques for shielding against space-based radiation dosage. The results are the first Web-based tool for predicting and forecasting the radiation environment in near-Earth, lunar, and Martian space environments and a space radiation detector with unprecedented performance capabilities.

The near real-time prediction/forecasting tool "PREDICCS{ integrates for the first time numerical models of space radiation and a host of real-time measurements being made by satellites currently in space, providing updates of the radiation environment on an hourly basis and archiving the data weekly, monthly, and yearly to provides a clear picture of when a safe radiation dose limit is reached for skin or blood-forming organs, for example.

CRaTER lets us test the capability of PREDICCS to accurately describe the lunar radiation environment. The UNH detector DoSEN, short for Dose Spectra from Energetic Particles and Neutrons, measures and calculates the absorbed dose in matter and tissue resulting from the exposure to indirect and direct ionizing radiation, which can change cells at the atomic level and lead to irreparable damage.

DoSEN measures both the energy and the charge distribution of energetic particles that affect human and robotic health in a way not presently possible with current technology. Protons, heavy ions, and neutrons all contribute significantly to the radiation hazard.

On the Moon, there are additional hazards from neutrons that are created by high-energy radiation interacting in the lunar soil and radiating outward from the surface, caused by the partial reflection of galactic cosmic rays off the Moon's surface. This creates a surprising one-two punch of deadly radiation. On the plus side, it can also be used to peer below the lunar surface like a geological probe.

"Until now, people have not had the 'eyes' necessary to see this particular population of particles. With CRaTER, we just happen to have the right focus to make these discoveries." ##

Editor's Note: We need to know the dangers in detail so that we can figure out best how to protect ourselves from them. If it is "raining" out there, we have to know what kind of rain it is, how strong it is, and how it can be countered. We should not take these results as meaning that humans cannot pioneer the Moon, but rather as a helpful aid in helping us figure out what kind of "umbrellas"and "raincoats" our bodies need for sorties "outdoors" or "out-vac" on the Moon for what lengths of time and for what frequencies. ##

ORBITAL SPACE DEBRIS PROBLEM

How Can we Recycle "Used" Satellites?

http://www.spacemart.com/reports/**What_might_recyclable_satellites_look_like**_999.html

Nov 26, 2013 - No matter how painstakingly we choose the materials to build satellites, once a mission is over they are just so much junk. But what if one day they could be recycled in space for future missions - perhaps as construction material, fuel or even food?

As part of its "**Clean Space initiative**," ESA is looking for new ideas on materials that could be recycled or converted into different, useful resources for other processes. It is too late to do anything about the stuff that is already out there, but never to late to cease making the situation ever worse.

"A satellite payload typically costs its own weight in gold - and the further it travels out into the Solar System the more valuable it becomes. So recycling or converting space hardware for follow-on missions could bring significant added value."

Here on Earth, many industries are adopting the sustainable 'cradle to cradle' approach, where all the raw materials in a product can be later reused for another product, or consumed as food, with no waste residue and no loss in quality. The satellite industry would do well to follow suite.

Future planetary probes or satellites might become sources of fuel, water or other raw materials considered scarce for the exploration missions that come after them.

- Grinding down metal alloys into powder to serve as raw materials for manufacturing new hardware by 3D printing would be a prime example. Organic materials could be separated by heating for subsequent reuse of the resulting gases. Leftover solid rocket fuel might be broken down for reuse.
- Biodegradable materials could be harnessed as biological nutrients in a life-support system, such as ESA's Micro-Ecological Life Support System Alternative, MELiSSA, a long-term effort to create artificial closed-loop life support serving future manned missions, based on microbes and higher plants.

To enable such a widespread use of sustainable materials, future spacecraft might end up very different. ESA's new invitation for 'Sustainable Materials Concepts' is seeking companies to study various concepts of this approach, including considering the kinds of materials that could be reused as biological or technical nutrients - serving as resources for new other processes.

Questions to answer

- What sustainable materials might replace current space-grade materials such as titanium and aluminium alloys or carbon-fibre epoxy resins?
- How might the use of materials as biological or technical nutrients work in practice?
- What level of energy might be required for such conversion processes? Would 'slow manufacturing' following the example of nature be a way forward?

INTERNATIONAL SPACE STATION

Commercial Cargo Carrier "Cygnus" Unloaded by Station Crew

http://www.space.com/23160-**cygnus-spacecraft-unloaded-international-space-station**.html

About Cygnus: http://en.wikipedia.org/wiki/**Cygnus_(spacecraft)**

Cygnus Launch: October 10, 2013 Cargo delivered to ISS by Orbital Sciences' Cygnus spacecraft is now completely unloaded from the commercial resupply ship and aboard the station. Cygnus' hatch was opened on Sept 30 after its arrival.

The emptied spacecraft was then loaded with Space Station trash, and undocked from ISS on October 22, and burned up in the atmosphere on October 24, as planned.

Editor's comment:

In sharp contrast, Space-X Dragon Capsule safely landed back on Earth to be reused again.

One might rightly wonder why NASA would pay for a non-reusable craft - it does not make economical sense. Perhaps this indicates lack of US Congressional oversight on NASA planning.

But then, neither the European Space Agency's ATV cargo carriers nor Japan's HTVs are reusable. Imagine the cost of owning an automobile if each one had to be junked after its first use!

Is there any wonder that Space programs are so expensive!

We need to transition away from bureaucracy owned space stations to commercial ones! That will come as commercial companies find a way to make profits from competitive space activities. PK

China Unveils Space Station Research Plans

http://www.spacenews.com/article/civil-space/38131**china-unveils-space-station-research-plans**

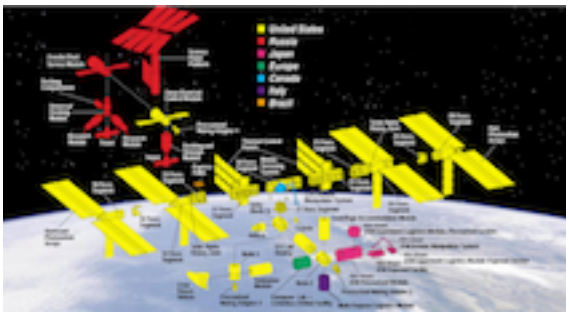
ORLANDO, Fla. — China National Space Agency (CNSA) intends to provide orbital laboratory space, experiment racks and facilities to scientists worldwide following the completion of the U.S.-led international space station program (currently set for 2020. (In all likelihood the International partners will give ISS another 8-year extension to 2028.)

Photos of Phase b Phase growth of China's Space Station.

"China Space Station (CSS) will operate in orbit from 2022 to 2032. This period will provide much more opportunities to scientists in China and all of the world after the International Space Station" (is deorbited), Gu Yidong, president of the China Society of Space Research, said at the American Society for Gravitational and Space Research conference in Orlando, Florida, US November 3-8.

Editor's comments: There is no indication that China will accept space station modules built by other potential partners, as has been the case with ISS from the outset. It would remain wholly Chinese owned and operated, and only token international contributions will be allowed. The difference is that the US Congress did not approve the space station project until it was reproposed by then President Clinton,as a joint US-Russian effort, open to other international partners.

See this illustration for contributions to ISS by United States, Russia, Japan, Europe, Canada, Italy, Brazil.

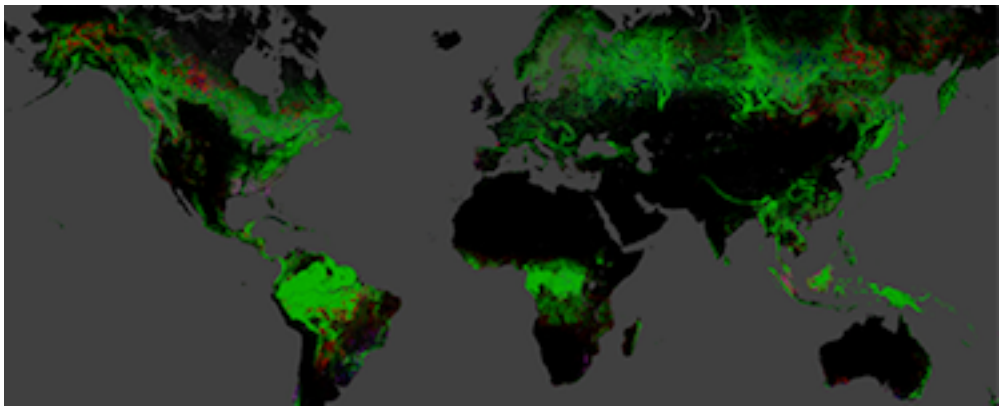


Full size image: http://www.labofcellgrowth.com/nasa%20online%20lessons/components_large.jpg

MISSION TO PLANET EARTH

Global Forest Change: gains and losses 2000-2010

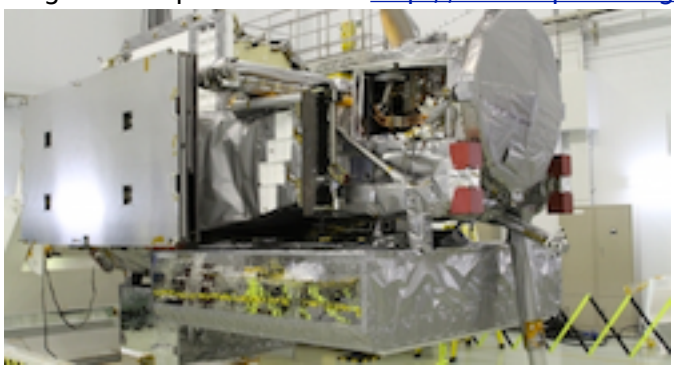
http://earthenginepartners.appspot.com/google.com/science-**2013-global-forest**



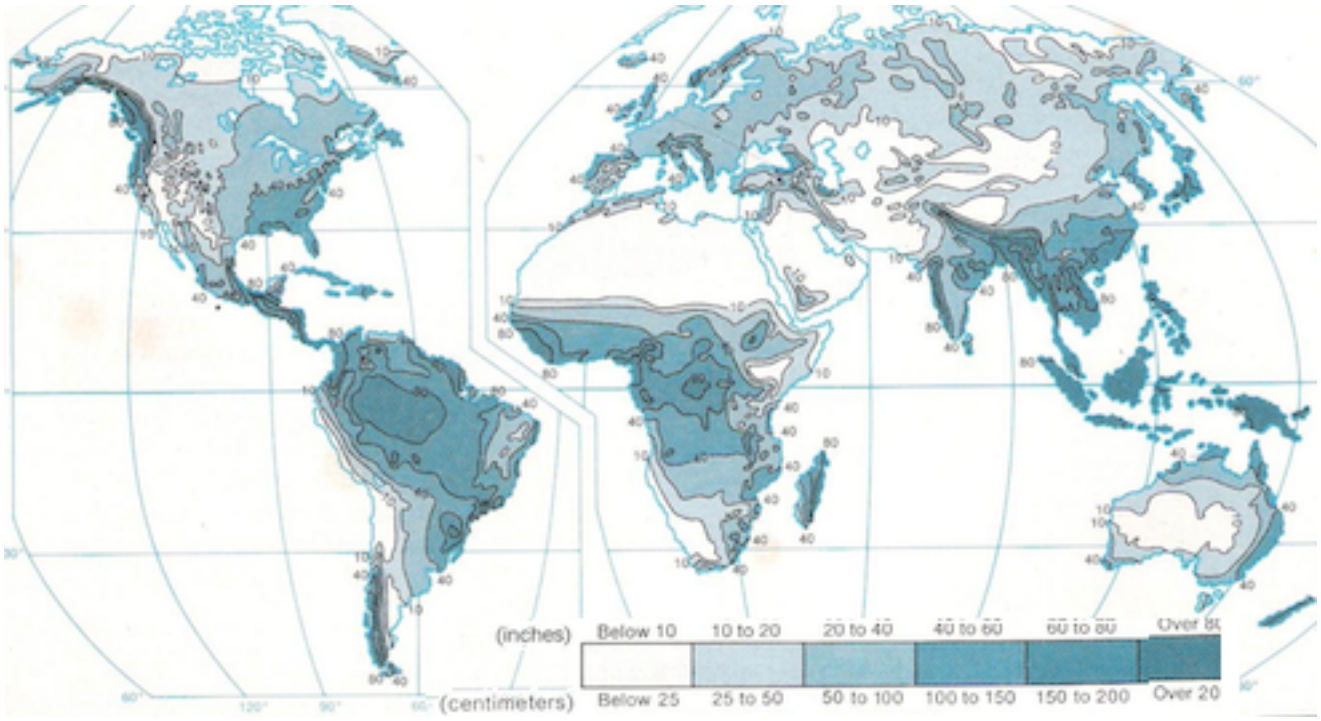
NASA and JAXA to Launch Global Precipitation Satellite February 28, 2014

http://www.spacedaily.com/reports/prnewswire-space-news.html

Dec. 26, 2013 -- **Environmental research** and **weather forecasting** are about to get a significant technology boost as NASA and JAXA prepare to launch a new satellite in February. A Japanese H-IIA rocket will launch the **Global Precipitation Measurement (GPM) Core Observatory satellite** from JAXA's Tanegashima Space Center. - http://en.wikipedia.org/wiki/**Tanegashima_Space_Center**



This satellite will provide advanced observations of rain and snowfall worldwide, several times a day to improve our understanding of the water and energy cycles that drive Earth's climate. Data provided by the observatory will help calibrate precipitation measurements made by an international network of partner satellites to quantify when, where, and how much it rains or snows around the world.



http://3.bp.blogspot.com/-3fizcZr7YLk/TioBwopqEsI/AAAAAAAAAI8/-QI6QOuJ9yM/s1600/Global+Precipitation.jpg

An accurate global picture of rain and snowfall is critical to understanding how weather and climate impact agriculture, fresh water availability. And it will help us respond to natural disasters.

With this addition, the GPM constellation will include the NASA-National Oceanic and Atmospheric Administration (NOAA) Suomi National Polar-orbiting Partnership mission, launched in 2012; the NASA-JAXA Tropical Rainfall Measuring Mission (TRMM), launched in 1997; and several other satellites managed by JAXA, NOAA, the US Dept. of Defense, the European Organisation for the Exploitation of Meteorological Satellites, the Centre National D'Etudies Spatiales of France and the Indian Space Research Organisation.

Data from the GPM mission will aid Earth science research and improve weather forecasting and response to weather disasters," said Shizuo Yamamoto, executive director of JAXA. "We would also like to aid other countries in the Asian region suffering from flood disasters by providing data for flood alert systems. JAXA's dual-frequency precipitation radar, will play a central role in the GPM mission.

Two innovative new instruments are the GPM Microwave Imager (Ball Aerospace & Technology Corp.which will observe rainfall and snowfall at 13 different frequencies, and the Dual-frequency Precipitation Radar, developed by JAXA to detect ice and light rain, as well as heavier rainfall.

http://www.jaxa.jp/projects/sat/gpm/index_e.html **http://www.nasa.gov/gpm** ##

EARTH FROM SPACE

http://astrobob.areavoices.com/2013/12/02/**new-view-of-u-s-at-night-could-someone-please-dim-the-lights/** (**VIDEO**)

Editor's comment:

Light Pollution can be so beautiful seen from Space, and the city lights at night will be an awesome sight for space tourists, be they on short suborbital hops, or actually, someday, orbiting Earth in space hotels. Indeed, they are already fascinating for those on nighttime flights over cloud-free areas.

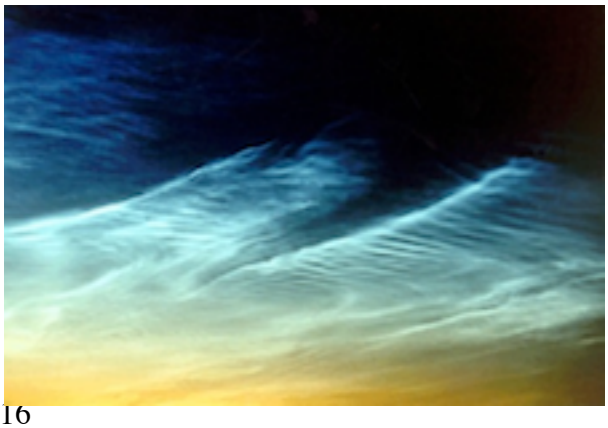
But it makes it difficult for us on the ground to see the Stars, and thus for young people to feel the lure of space and to put life on Earth in proper context.

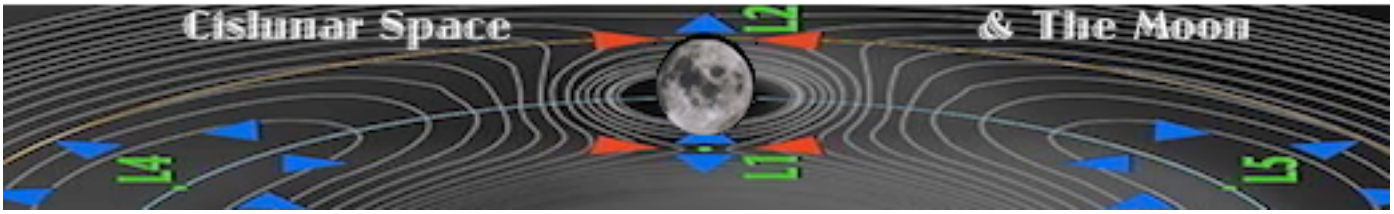
You may notice the difference between cities of the same size: some brilliant, with wasteful lighting, others less brilliant because they have chosen streetlights that light the street, but not the sky. Amateur astronomers have had some victories here.

We can have it both ways, efficient downward street lighting, and darker star-revealing skies. What is the situation in your community? TTSIQ

Noctilucent Clouds over Antarctica Video

www.space.com/24046-**electric-blue-clouds-glow-over-antarctica-video**.html





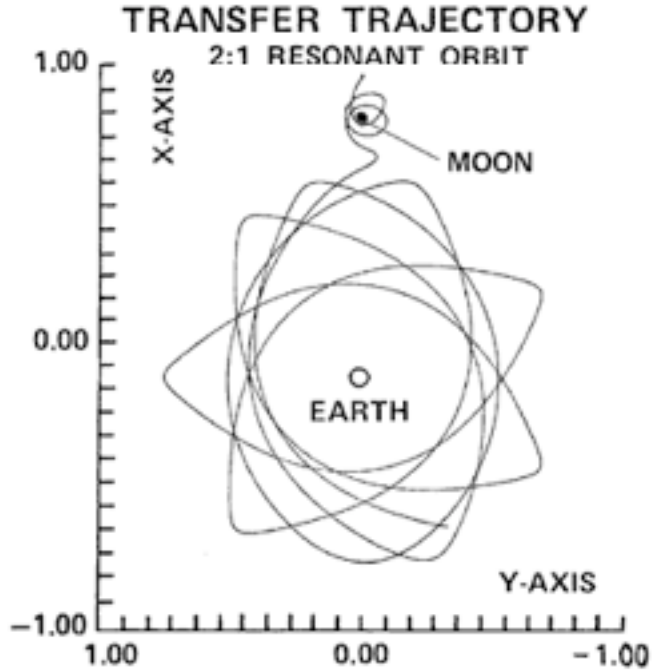
[The articles below have been summarized by the editor. For the full text, see the links cited.]

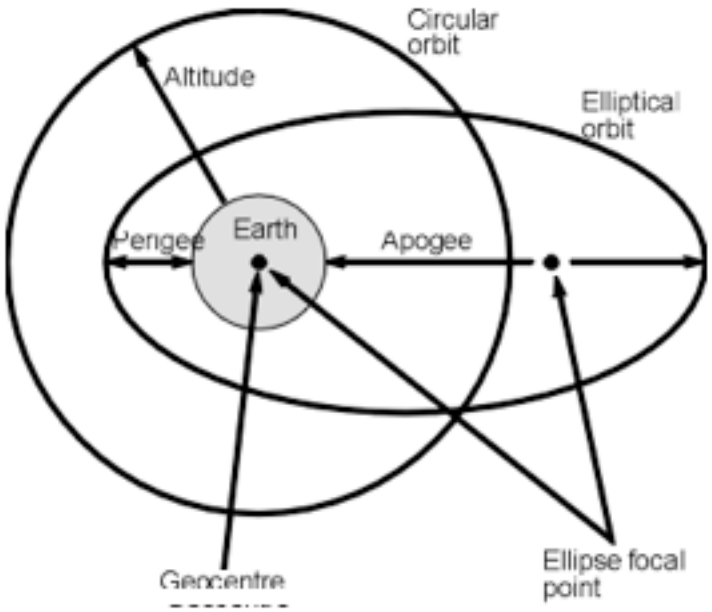
CISLUNAR SPACE

All about Cycling Orbits and how they Enhance Cislunar Infrastructure

In TTSIQ#5, pp. 81-3, we published an article by Al Anzaldua on this topic.

"**Integrating Cycling Orbits to Enhance Cislunar Infrastructure**"



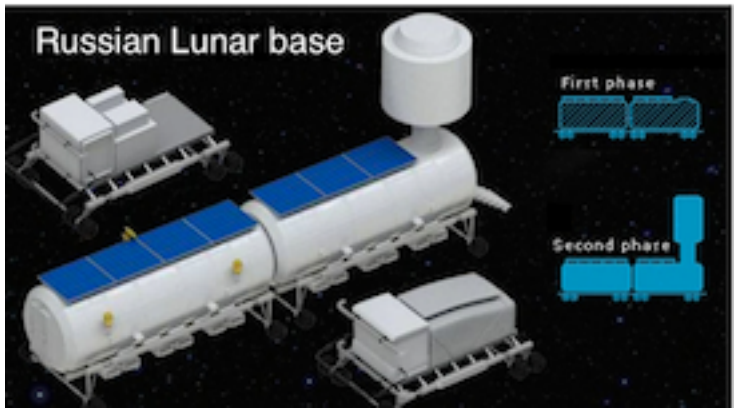


"One thing that is rarely mentioned about EML2 infrastructure, however, is that EML2 is also a perfect jumping off site to a perpetually cycling **E**arth-**M**oon 2:1 **R**esonant **O**rbit (cycling **EMRO**) and other cycling Highly Elliptical Orbits (HEOs), which would enhance any infrastructure architecture connected to it.

THE MOON

Russia could build a Manned Lunar Base

www.space-travel.com/reports/**Russia_could_build_manned_lunar_base**_999.html



October 8, 2013 - The Russian space agency Roscosmos has launched a feasibility study of a project to build a manned base on the Moon, Academician Lev Zelyony, director of the Russian Academy of Sciences'

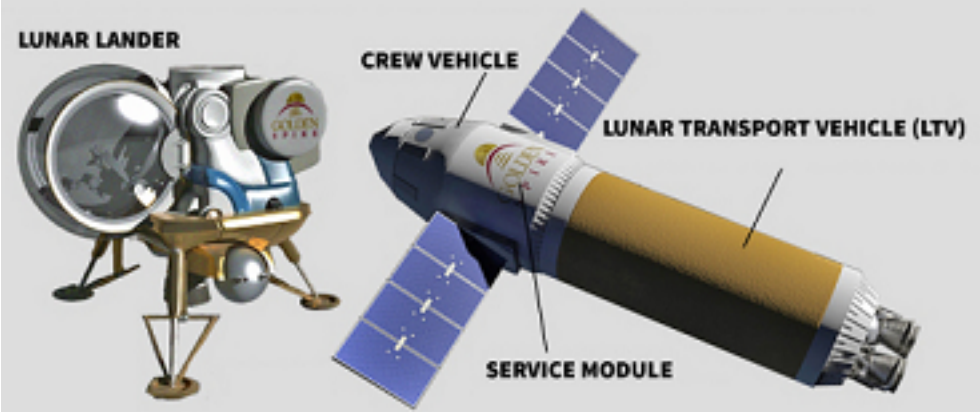
Space Research Institute, said "Our nearest task within the limits of the planning horizon is the construction of a piloted outpost on the Moon. A working group was recently set up to integrate proposals made by the leading space firms and institutes specializing in the exploration of the Moon.

A plan to build a spacecraft for a flight to the Moon, proposed by the space rocket corporation Energia, as well as projects proposed by the Lavochkin research and production association and the Space Research Institute, are being assessed.

"A spectrum of concrete tasks for crews to deal with on the Moon have been put forward. On the Moon, humans will have a difficult life. Long-duration missions are only possible in special shelters, most probably under the lunar surface. Space radiation is the main hurdle to long-duration missions to the Moon and Mars. ##

Reviews of Golden Spike's Commercial Plans to take Individuals to the Moon

http://www.thespacereview.com/article/2201/1



Turning science fiction to science fact: Golden Spike makes plans for human lunar missions - Jeff Foust

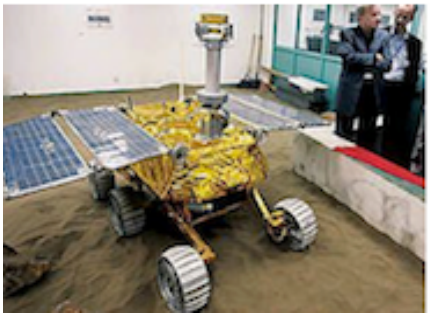
Back to the Moon, commercially – James Lovell (Apollo 13 captain)

For more on Golden Spike, read Larry J. Friesen's report in the Articles & Essays section below.

China's first Moon Rover: "Yutu" – now on the Moon

http://www.space-travel.com/reports/**China_unveils_its_first_and_unnamed_moon_rover**_999.html

http://www.spacedaily.com/reports/**Designer_moon_rover_uses_cutting_edge_technology**_999.html



Left: Yutu "Jade Rabbit" in the lab – **Center:** with human to scale – **Right:** rover picture taken by lander Sep 30, 2013 – Chinese scientists described the country's first Moon rover. will be a highly efficient and integrated robot, adaptable to harsh environments. China chose the name "Yutu" (Jade Rabbit) for its first Moon rover, after a worldwide online poll challenged people to come up with names.

The 140 kg (309 lb) rover will recognize obstacles on the Moon's surface, and plot a path of least resistance by a combination of onboard navigation systems and remote control from the command center. Its optical and microwave sensors will let it avoid rocks and craters and select the best route, use minimal fuel and make the smallest possible errors. It can "rest", automatically becoming dormant to recharge its batteries, and then return to work. It can endure a vacuum, intense radiation and extremes of temperature.

How & where Yutu was tested: www.space-travel.com/reports/**Chinas_most_moon_like_place**_999.html

The Chang'e-3 mission was launched December 1, the first Chinese spacecraft to soft-land on on another world. The rover has two (solar panel) wings for power, six wheels, and weighs 140 kg (309 lb).

When it arrived in lunar orbit, the intelligent rover choose the best landing site and gently touch down on the Moon's surface, using optical and microwave sensors to avoid large rocks and craters, and is capable of hovering to steer clear of obstacles. Once on the surface, it will select "the best route" to use minimal fuel. It will recognize surface obstacles and plot a path of least resistance by a combination of onboard navigation systems and remote control from the command center. The rover can rest, automatically becoming dormant state to recharge its batteries, and return to work after a while.

The rover is equipped with numerous detectors and information gathering systems such as a panoramic camera and radar measurement devices. The mission will last about three months. The data collected, 3D images, infrared spectrums and lunar soil analysis, will directly and accurately lead to greater understanding of the Moon. Yutu will have complete automatic navigation and operation. Not a simple copy of any previous US or Soviet/Russian rovers. It combines an integration of modern technologies of electronics, machinery, and thermal control.

Yutu will explore the lunar surface after departing the lander. The rover is equipped with a solar panel to power the vehicle during the lunar day on a three month mission. During this time, Yutu will explore a three square kilometer area, traveling **a maximum distance of 10 km from the landing point**.

Yutu will be capable of real time video transmission, while it will be able to to dig and perform simple analysis of soil samples. It carries **a radar unit on its belly that allows for the first direct measurement of the structure and depth of the lunar soil down to a depth of 30 meters (~100 ft)**. The unit will also investigate the lunar crust structure down to depth of several hundred meters. The rover also sports an alpha particle X-ray spectrometer and an infrared spectrometer.

The Lander

The main instrument on the lander itself is the **Lunar-based Ultraviolet Telescope.**

Links for Lunar-based Ultraviolet Telescope (**no images available as of 12/2/2012**)

http://adsabs.harvard.edu/abs/2011ScChG..54..558C

http://phys.scichina.com:8083/sciGe/fileup/PDF/11yg0558.pdf

Landing spot: Sinus Iridium, "Bay of Rainbows?

The destination is somewhere in Sinus Iridium, Bay of Rainbows, a northern lobe of Mare Imbrium. This location was picked based on mapping data returned by Chang'e .

China launched Chang'e-1 in 2007 and Chang'e-2 in 2010. The first probe collected a large body of data and a completed map of the Moon. The second mission greatly enhanced the resolution of the previous map and generated a high-definition image of Sinus Iridium, a plain of basaltic lava, considered by lunar observers to be one of the satellite's most beautiful features. ##

The Launch:

http://www.space.com/23790-**china-launches-moon-rover-mission**.html

December1, 2013 - The "Jade Rabbit" (Chinese "Yutu') got up and on its way, on schedule. Two weeks later the successful landing made this **the first lander on the Moon since the Soviet Luna 24** sample return mission landed in Mare Crisium August 18, 1976, **over 37 years ago** (crash landings not counting.) The last American craft to set down on the Moon was Apollo 17, a manned visit in 1972, 42 years ago.

ESA assists Chang'e-3 Moon Landing

http://www.space-travel.com/reports/**Helping_China_To_The_Moon**_999.html

Immediately after liftoff, ESA's station in Kourou, French Guiana, began receiving signals from the mission and uploaded commands on behalf of the Chinese control centre.

The tracking ran daily until the probe reached the Moon. During descent and after landing, ESA's deep-space stations pinpointed the craft's path and touchdown location. The effort was run from the Estrack Control Centre in ESA's European Space Operations Centre in Darmstadt, Germany.

[Editorial comment:]

The myopic "been there. done that" lack of support from the US (governed by politics, not reason) will at last be at an end. With a Russian and an Indian Moon landing planned, and with several Google Lunar X-Prize missions in the works, we can hope that this new beginning will endure. ##

Latest Post Landing reports: Yutu will survey the Moon's geological structure and surface substances and look for natural resources for three months, while the lander explores the landing site for one year.

Dec 20, 2013 - http://www.space-travel.com/reports/Most_**Change_3_science_tools_activated**_999.html

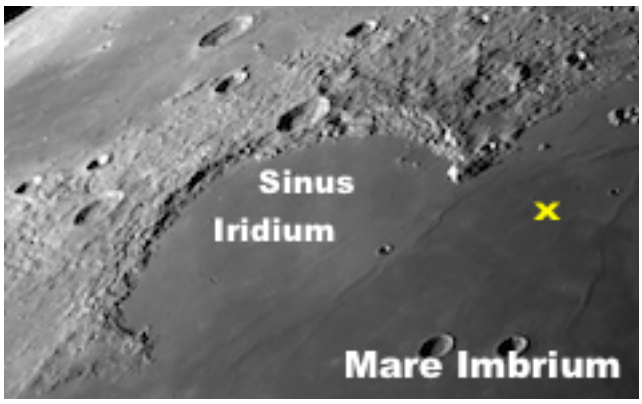
Dec 21, 2013 - http://www.spacedaily.com/reports/Chinas_**Yutu_naps_awakens_and_explores**_999.html

Dec 23, 2013 - http://www.spacedaily.com/reports/
Chinas_moon_rover_continues_lunar_survey_after_photographing_lander_999.html

DEC 26 - www.space-travel.com/reports/**Chinas_moon_rover_sleeps_through_lunar_night**_999.html

China's next step in 2017

http://www.space.com/24055-**china-moon-sample-return-mission**.html



Larger image of Sinus Iridium: http://bitacoradegalileo.files.wordpress.com/2010/02/**sinusiridum**2.jpg
http://en.wikipedia.org/wiki/Sinus_Iridum

The actual landing spot – **Yellow X** – is 44° 7′ 12″ N, 19° 30′ 36″ W – to the East of the goai
But it landed safely, intact, and ready to do science!

Two Apollo Astronauts Suggest US Cooperation With China's Moon Plans

http://nasawatch.com/archives/2013/11/american-moonwa.html

Astronauts **Buzz Aldrin of Apollo 11** and **Eugene Cernan of Apollo 17** tell Aerospace America that engineering details emerging from China's first robotic Moon lander suggest it is a formal precursor to a manned lunar module that would carrod Moon Mission

http://indiatoday.intoday.in/story/**after-mars-mission-india-plans-manned-lunar-mission**/1/333244.html

Dec 27, 2013 – (ISRO) The Indian Space Research Organisation and the Ministry of Defence (MoD) have signed a Memorandum of Understanding (MoU) for a manned Moon mission. The MoD has tasked the Indian Air Force (IAF) to identify the qualitative requirements for the crew. The Director General of Armed Forces Medical Services is to draw out the requirements.

The announcement did not include target dates for an Indian Manned Moon Mission.

Indians astronauts and astronauts of Indian extraction

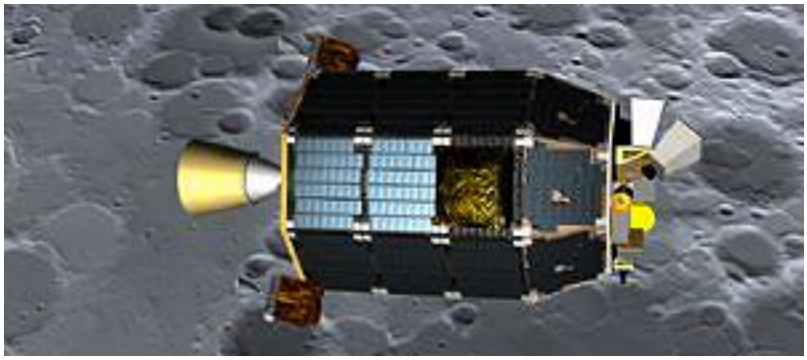
Former IAF officer Wing Commander **Rakesh Sharma**, from **Punjab**, the first Indian in space, flew aboard Soyuz T-11 in the Intercosmos program. http://en.wikipedia.org/wiki/**Rakesh_Sharma**.

Sunita Williiams (Sunita Lyn "Suni" Williams née Pandya (of **Gujarat** heritage) born September 19, 1965, is a former American astronaut and a United States Navy officer. She holds the records for longest single space flight by a woman (195 days), total spacewalks by a woman (seven), and most spacewalk time for a woman (50 hours, 40 minutes). Williams was assigned to the International Space Station as a member of Expedition 14 and Expedition 15. In 2012, she served as a flight engineer on Expedition 32 and then commander of the recent Expedition 33. ##

LADEE Settles Into Operational Lunar Orbit, Begins Collecting Data

www.space-travel.com/reports/NASA_**Spacecraft_Begins_Collecting_Lunar_Atmosphere_Data**_999.html

[See the report on new Laser Communications Technology tests performed between LADEE and Earth in the Cis-Lunar section above.]



Artist's concept of NASA's **L**unar **A**tmosphere and **D**ust **E**nvironment **E**xplorer (**LADEE**) spacecraft seen orbiting near the surface of the Moon.

On November 20, LADEE entered its planned orbit around the Moon's equator -- a unique position allowing it to make frequent passes from lunar day to lunar night, providing a full scope of the changes and processes occurring within the Moon's tenuous atmosphere as the terminator (the line between daylight and night) passes. LADEE now orbits the Moon about every two hours at an altitude of 12-60 km (8-37 mi) above the surface. For c. 100 days, it will gather detailed information about the structure and composition of the thin lunar atmosphere and determine whether dust is being lofted into the lunar sky.

What scientists learn from LADEE will help us understand similar phenomna on other airless bodies such as asteroids, Mercury, asteroids, and airless moons of other planets in our soalr system. We will be able to study the conditions in the atmosphere during lunar sunrise and sunset, where previous crewed and robotic missions detected a mysterious glow of rays and streamers reaching high into the lunar sky.

This won't be easy, as the lumpiness of the Moon's gravitational field, LADEE's orbit will require maintenance adjustments every three to five days, or only once every two weeks, depending on what we find. We need to keep LADEE's altitude within a safe range above the surface to get the best readings.

LADEE is the first spacecraft designed, developed, built, integrated and tested at NASA Ames. It also was the first launched beyond Earth orbit from NASA's Wallops Flight Facility on the Virginia coast. ##

LADEE ready to start Science Mission: December 5, 2013

http://www.space-travel.com/reports/**LADEE_Instruments_Healthy_and_Ready_for_Science**_999.html

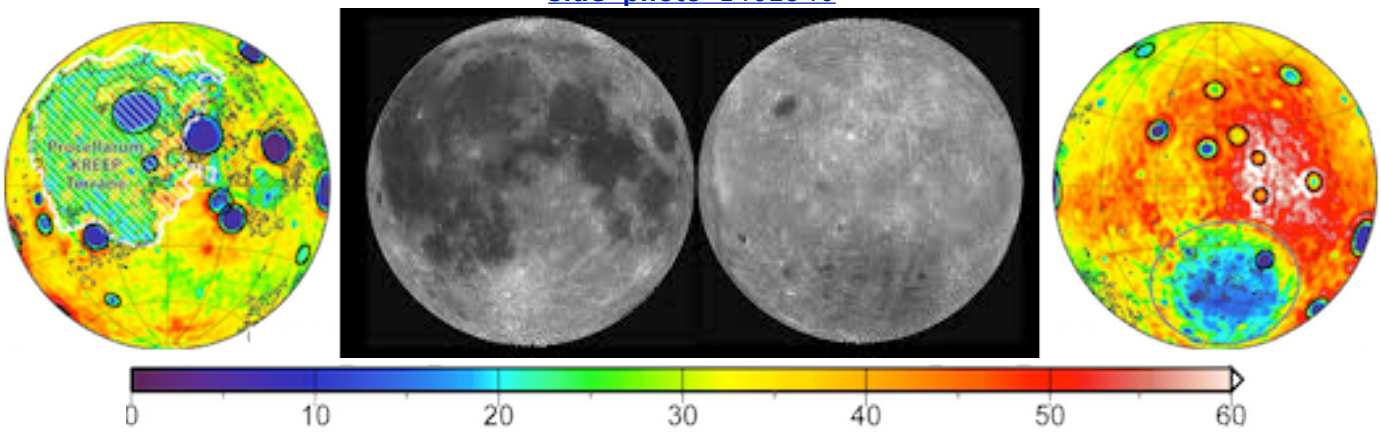
December 11 Mission Update:

http://www.nasa.gov/content/ames/**ladee-project-scientist-update-science-observations-begin**/#.UrTYQRa0Lww

GRAIL Moon mission yields clues to face of 'the man in the Moon'

www.space-travel.com/reports/**Moon_mission_yields_clues_to_face_of_man_in_the_moon**_999.html

http://www.ibtimes.com/**man-moon-explained-lunar-nasa-mission-more-large-impactors-near-side-photo**-1462940



(from lowest (blue) lest surface gravity to highest (red/white)

More Large 'Impactors' On Near Side

Nov 7, 2013 - Scientists using data from the twin lunar-orbiting **GRAIL** spacecraft are gaining new insight into how the face of the Moon received "its rugged good looks." The **G**ravity **R**ecovery and **I**nterior **L**aboratory mission has yielded clues to the asymmetric distribution of lunar impact basins.

"Since time immemorial, humanity has looked up and wondered what made the 'man in the Moon. We know the dark splotches are large, lava-filled, impact basins that were created by asteroid impacts about 4 billion years ago. GRAIL data indicate that both the near side and the far side of the Moon were bombarded by similarly large impactors, but they reacted to them much differently."

- Maria Zuber, GRAIL principal investigator from the MIT Massachusetts Institute of Technology.

The logical assumption had been that both hemispheres received the same number of impacts. But GRAIL revealed more large impact basins on the nearside than on the far side. However, we have known for a long time that temperatures of the near-side of the Moon were higher than those on the far side, due to an abundance of the heat-producing elements uranium and thorium; this would explain why more and more extensive volcanic eruptions occurred on the Moon's near-side hemisphere. The runny lava sheets cooled to a much darker shade of gray. Given that for some reason the Moon's nearside crust is considerably thinner than that on the farside, this makes sense.

Using a precision formation-flying technique, the twin GRAIL spacecraft mapped the Moon's gravity field. The new GRAIL data found more large impact basins on the near-side hemisphere of the moon than those on the far side, contrary to the long standing assumption.

"Impact simulations indicate that impacts into a hot, thin crust representative of the early Moon's near-side hemisphere would have produced basins with as much as twice the diameter as similar impacts into cooler crust, which is indicative of early conditions on the Moon's far-side."

The "Man in the Moon" -- a familiar illusion where a human face appears on the Moon's surface is believed to be caused by dark and lighter areas on the lunar surface are arranged. "The real coincidence is not that the "man in the Moon" faces Earth," instead, the real coincidence how the Moon slowed its spinning enough to give the apparent "face" a slight edge.

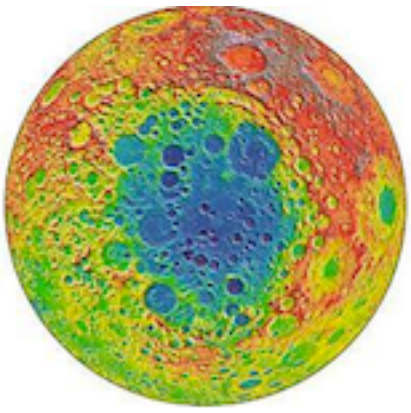
{Editor's theory: we now believe that the much thicker crust on the Moon's farside is the result of an collision of the early Moon with a second smaller moon ("Luna" and "Lunetta?") and this may have displaced the center of gravity some distance off center and that favored the slowing of the Moon's rotation down to its orbital period around the Earth, with the thicker crust at apogee (farthest from Earth.

See illustration below. [source: Taylor)

We would appreciate being corrected if this assumption is wrong. ##

South-Pole Aitken Basin could hold clues about Moon's Mantle

Dec. 13, 2013 - http://www.space-travel.com/reports/Ancient_crater_could_hold_clues_about_moons_mantle_999.html



Red areas on the topographic image indicate high elevations, and blue or purple areas indicate low elevation. The South Pole Aitken basin could hold clues about the composition of the Moon's mantle Credit: NASA/GSFC.

Researchers from Brown University and the University of Hawaii have found some mineralogical surprises in the Moon's largest impact crater. Data from the Moon Mineralogy Mapper aboard India's

Chandrayaan-1 lunar orbiter shows a diverse mineralogy in the subsurface of the giant South Pole Aitken basin. This could be reflective of mantle minerals dredged up at the time of the giant impact 4 billion years ago. If so, then the South Pole Aitken (SPA) basin could have clues to Moon's interior and the evolution of its crust and mantle.

At 2,500 km across, the SPA is the largest impact basin on the Moon and perhaps the largest in the solar system. Impacts of this size turnsolid rock into molten slush. It has been assumed generally that the melting process would obliterate any distinct signatures of pre-existing mineralogical diversity through extensive mixing, but this might not be the case. Impacts millions of years after that giant impact uncovered material from deep within the basin, offering important clues about what lies below.

Researchers looked at the central peaks of four craters within the basin. They form when material under the impact zone rebounds, forming an upraised rock formation in the middle of the crater. The tops of those peaks represent pristine mantle material from below the impact zone. (This has been known for some time.)

Using Moon Mineralogy Mapper data, the researchers looked at the light reflected from each of the four central peaks. The spectra of that light give clues about the makeup of the rocks, showing substantial differences in composition from peak to peak, some richer in magnesium than others. One crater toward the outer edge of the basin, contained several distinct mineral deposits within its own peak, possibly due to sampling a mixture of both upper and lower crust or mantle materials.

The kicker is that the varying mineralogy in these central peaks suggests that the SPA subsurface is much more diverse than previously thought, with significant compositional differences between these central peaks. The Moon Mineralogy Mapper has very high spatial and spectral resolution, showing details and differences not apparent before.

The distinct minerals formed as the molten rock from the SPA impact cooled. It's also possible that the mineral differences reflect differences in rock types that were there before the giant SPA impact.

A much larger survey of SPA craters is underway, in the hope of identifying the source of the diversity. If indeed the diversity reflects pre-existing material, the SPA could hold key clues about the composition of the Moon's lower crust and mantle.

"We think the upper mantle is rich in a mineral called olivine, but we don't see much olivine in the basin. That's one of the big mysteries about the South Pole Aitken basin. So one of the things we're trying to figure out is how deep did the impact really excavate. If it melted and excavated any material from the mantle, why aren't we seeing it?" If the impact did excavate mantle material, and it doesn't contain olivine, that would have major implications for models of how the Moon was formed. More research is needed. ##

Going Back to the Moon Could Settle Questions about Lunar Origin

http://www.space.com/23244-**moon-origin-sample-return-missions**.html

October 17, 2013 - LONDON — ON July 20, 1969, the world watched in awe and fascination as astronauts from Earth walked on the Moon during NASA's historic Apollo 11 lunar landing. Five more Apollo Moon Landings followed in the next three years, but the era of manned moon exploration ended more than 40 years ago. No human has walked on the Moon — or any other celestial body — since December. 14, 1972, when astronauts Eugene Cernan and Harrison Schmitt blasted off the lunar surface during Apollo 17, NASA's last manned moon flight.

“The End of the Beginning” - Harrison Schmitt walks back to the rover to return to the LEM for takeoff

To truly answer the unsolved mysteries of the Moon's origin, new missions to retrieve samples of the lunar surface and return them to Earth will be needed. A few kilos won’t do. While the Apollo samples

are invaluable, they represent only six locations, all on the nearside of the Moon, and close to the equator. These samples hardly exhaust our scientific curiosity, and do not represent many distinct areas of the Moon that we know to be of different composition. The Apollo collection isn't really representative of the whole Moon. In addition to NASA's Apollo missions, three Russian robotic probes also touched down on the moon's surface and brought rocks back. These were the Luna 16, 20 and 24 spacecraft.

But all of those early lunar missions, manned or unmanned, only returned rock samples found directly on the surface. The samples were collected from the dusty layer of pulverized lunar rock — the regolith, a product of meteoritic bombardment. Regolith consists of microscopic particles about 0.01 millimeters in size, making it a mixture of fine dust and rocky debris that resembles ready-mix dry mortar. It covers the moon's landscape to an average depth of several meters. We have no samples from below this surface dust blanket, and this is simply not sufficient to reveal the real composition of the Moon, and what that might tell us about how and of what the Moon was formed.

Some will argue that, considering that some of the surface debris must be splashout from the formation of craters by impactors that clearly penetrated the crust in many areas.

Are the Moon and Earth isotopic twins?

The prevailing theory is that the Moon formed some 4.5 billion years ago, when a mysterious planet-size body dubbed Theia slammed into the newly formed proto-Earth, blasting out material that ultimately coalesced into the Moon. But this idea has loopholes. Certainly, material from the alleged impactor, Theia, must have contributed to both our present Earth and the Moon.

One such loophole involves the isotopic similarities between the Earth and the Moon, which suggest that the Moon is more like a dwarf twin of Earth than a mix of our planet and a big impactor. It may be impossible to even properly compare the two bodies, considering the very limited lunar material we have to work with.

"In terms of trying to compare the bulk composition with the Earth, it's the mantle composition that really counts because the crust is just this thin layer on the top. And we don't have any samples of the Moon's mantle," said Ian Crawford, professor of planetary science and astrobiology at Birkbeck College, University of London.

Moon craters in the crosshairs

Nonetheless, the Apollo Moon landing missions did obtain samples of different lunar surface compositions, including rocks from both the highlands and from the low basaltic lave plains of the maria, so-called lunar seas formed by huge lava flows from deep below the surface.

Rocks from the Moon's crust, the highlands, are rich in aluminum, lighter in color and less dense than the basalts of the maria that cover 39% of the nearside, but much less of the farside — large smooth areas thought to be ancient, solidified molten lava flows, ultimately derived from the mantle.

We believe the Moon's maria basins formed during the final stages of a heavy meteoritic bombardment between 4.1 and 3.9 billion years ago, and were filled with lava sometime later, during volcanic eruptions, which filled these basins with lava and created the formations of the current lunar landscape.

The lunar regolith in the maria is fairly shallow, perhaps only several meters deep, while in the highlands the regolith can reach depths of about 100 meters (330 feet) but we have had no way to measure these depths during the Apollo missions.

Future Moonbase sites

Many impact basins on the Moon's farside, in particular the enormous South Pole-Aitken Basin, have apparently never been flooded with lava. And it is there, Crawford thinks, where we should send a future lunar mission aimed at examining a deep crater on the far side in hopes of collecting samples of the lunar mantle. "There may be mantle samples waiting to be found there, which could greatly help our Earth-moon comparisons," Crawford said. That basin is a deep impact crater that measures about 2,500 kilometers (1,600 miles) in diameter and is some 13 km (8.1 miles) deep.

In 1959, were got our first glimpse of the Moon's farside, from the Soviet Luna 3 probe. Nearly a decade humans got their first look at the permanently hidden side, when Apollo 8 orbited the Moon in 1968. But all lunar landings — manned and unmanned alike — have touched down on the near side.

Have some lunar meteorites that have landed on Earth come from the farside? It is impossible to pinpoint the exact origin of lunar meteorites. The point is that "new sample return missions from geologically diverse and previously unvisited areas of the Moon are required to develop a robust understanding not only of the origin of the Moon, but of other rocky planets in the solar system.

Russia and China aim to send robotic landers to the lunar surface in the next decade, but both aim for the near side. And there are still no firm plans to send astronauts back to the Moon anytime soon.

"There are specific scientific questions the Moon can tell us about," Crawford said. "But they require going and sampling at specific localities or deploying specific instruments. Maybe in a decade or two, we'll have such a mission. In the longer term, lunar exploration would really benefit from once again having people on its surface, perhaps operating out of a lunar similar to those in Antarctica," Crawford concludes.

Moon Gardens: NASA to sow 1st Seeds of future Habitat

http://rt.com/news/**nasa-grow-plants-moon**-420/

November 28, 1013 - NASA is entering new scientific territory with a plan to start growing plants on the Moon no later than 2015. The aim is to yield important knowledge about life's long-term chances in space – including for humansThe Lunar Plant Growth Habitat team – a small group of scientists, students, volunteers and contractors – plan to install specially-designed coffee-can sized containers in which plants will be encased, complete with sensors, cameras and other devices to relay information down to Earth.

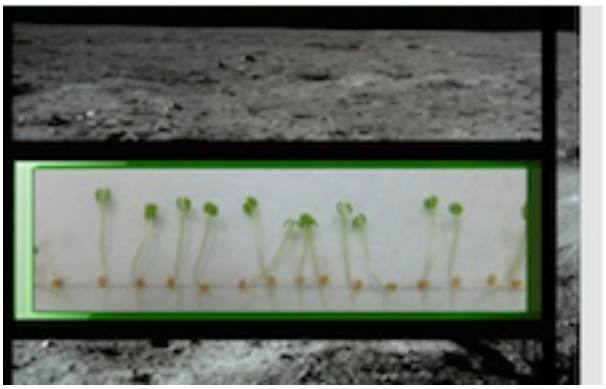
This would be the first life sciences project conducted on another world to explore opportunities for human life support, as well as to learn more about growing life in extreme temperatures.The goal is to enable people to live on the Moon for decades on end – instead of hours or a few days.

Follow-up experiments are already in the making. The idea is "to develop a simple sealed growth chamber that can support germination over a five-10 day period in a spacecraft on the Moon. Filter paper will be used to feed dissolved nutrients to the plant.

The plan is to start with basil, turnips and "Arabidopsis" described the 'lab rat' of plant biology. The small habitat containers must regulate their own water consumption, temperature and power supply. Upon landing on the Moon, a trigger would release a small reservoir of water wetting the filter paper and initiating germination of the seeds.

The air in the sealed container would be adequate for more than five days of growth. No additional air supply or air processing would be needed to determine the results. At intervals, the seedlings would be photographed with sufficient resolution to compare with growth in Earth control containers. Natural lunar sunlight will provide illumination for plant germination as a first ISRU (on site resource utilization) demonstration.

The experiment is quite inexpensive, in part due to technological advances, but also thanks to NASA's plan to crowdsourcie the initiative. The special kits and growth habitats will be distributed to schools, as well as to future scientists. NASA willcollect all the data from their experiments and compare it to the results on the Moon. This will also give students the opportunity to personally contribute to the study.This crowdsourcing initiative is already earning praise for its ingenuity.



Plant growth chambers and kits

Getting the test plants to the Moon

The plan is to send the plants on a commercial spacecraft. Google has launched a commercial space race, with its Lunar X-Prize 2015 involving many teams attempting to win prizes for being the first to safely land on the Moon, then travels 500 meters above, and transmits two 'mooncasts' back to Earth by the December 31, 2015 deadline. Bonus prizes are also be available. The beauty of the Google-prize approach is that NASA does not have to spend hundreds of millions of dollars or wait until the next space craft to land on the Moon.

Just 20 years ago, the project would have cost $300 million, while now, by piggybacking on a prize-competing amateur lander, it can be done at less than a hundredth the cost, a victory for both NASA and the private space industry. Even if NASA fails, a new door has been opened to undertaking incredibly ambitious projects at negligible costs.

Information about an ambitious Lunar Agriculture project launched in 1990 by two of TTSIQ's Editors:
http://www.moonsociety.org/chapters/milwaukee/**lunax**/index2.htm

Crowdfunded LunarSail Spacecraft Reaches Funding Milestone

http://www.space-travel.com/reports/
Crowdfunded_Lunar_Spacecraft_Reaches_Funding_Milestone_999.html
http://www.lunarsail.com/**crowdfunded-lunar-spacecraft-successfully-reaches-funding-milestone-work-begins-to-build-moon-orbiter/**

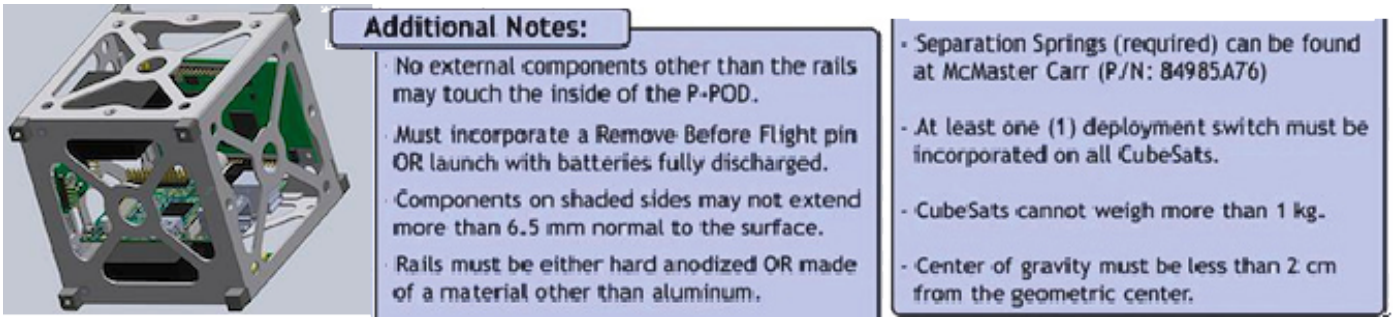
www.kickstarter.com/projects/aresinstituteinc/l**unarsail-the-worlds-first-crowdsourced-solar-sail**
[en.wikipedia.org/wiki/**Crowdfunding** "the collective effort of individuals who network and pool their money, usually via the Internet, to support efforts initiated by other people or organizations"]

Titusville FL (SPX) Oct 22, 2013 - The Aerospace Research and Engineering Systems Institute announces the successful completion of the first phase of crowdfunding and conceptual development of a unique spacecraft to explore the Moon with the public and classrooms across the country.

Based in Titusville, FL, **Ares Institute** (Ares is the Greek equivalent of the Roman god of war, Mars) is a 501 (c)(3) tax-exempt non-profit organization dedicated to promoting space exploration and STEM education through hands-on educational projects and public outreach.

Ares Institute created the LunarSail project to involve students and the public in the excitement of space exploration and promote STEM education by collaborating to design and build a small spacecraft and place it in orbit around the Moon.

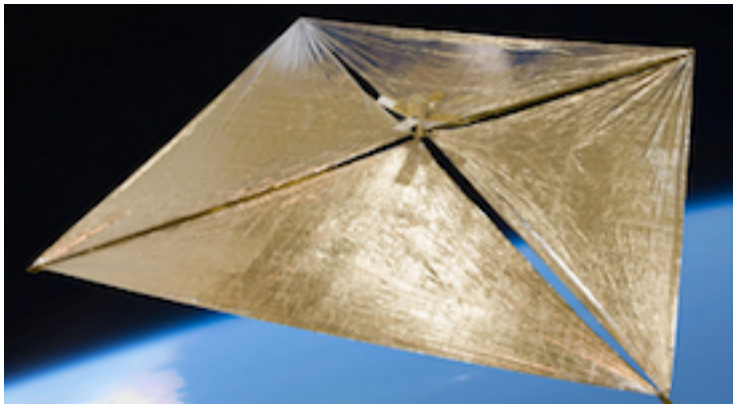
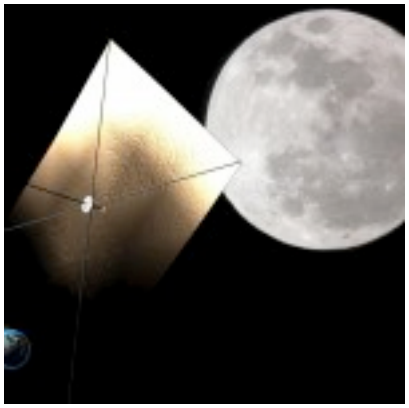
"We wanted to create something that would bring the excitement of space exploration to the public and advocate the importance of STEM education for our country's young students," says Matthew Travis, Executive Director of Ares Institute, Inc. Ares Institute believes that the most effective way to do this would with a real world project that engages students and permits them to contribute in a meaningful way to its success. Since promoting the benefits of space exploration to the public at large is part of its core mission, we are managing LunarSail as an open-source program and inviting the public to participate in the design process and mission-related activities after launch.



Crowdfunding allows anyone to donate directly to the spacecraft's construction and operation. In the first round of fundraising, Ares Institute raised almost 50% more than its original goal from public contributions in this way. Donors receive various rewards in return for their monetary contributions and support of the project, ranging from having their names and messages placed on the spacecraft and website to reserved, dedicated time on the spacecraft to conduct their own observations.

With the funding already raised, the team has begun to purchase spacecraft systems, computer hardware and software and outfitting laboratory working space.

LunarSail is an advanced technology development project **to demonstrate the ability of a spacecraft under solar sail propulsion to navigate itself into a lunar trajectory and then into Lunar orbit.** It's design is based on the CubeSat standard.

CubeSats are small, completely self-contained spacecraft assembled from individual units 10 cm on a side. Given their small size and relatively low cost, they have become a preferred satellite platforms for universities, private companies and even for NASA for scientific and engineering studies in space.

The purpose of the LunarSail project is to promote education in the science and math disciplines by enabling high-school and university students to participate in an exciting mission to explore the environment around the Moon. Ares Institute is seeking to partner with schools around the US to bring mission-related science activities to thousands of students, particularly those in minority and at-risk communities.

During the mission, students and teachers will be able to take advantage of related educational projects in the classroom, use of the spacecraft to conduct experiments and observations, educational apps and even games for mobile devices and real-time web-based activities.

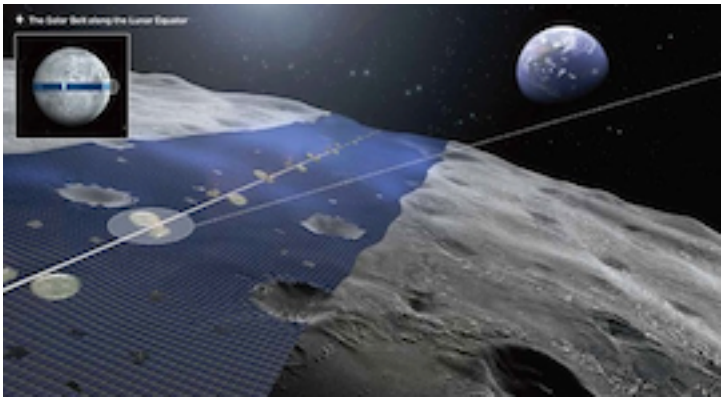
But LunarSail's main objective is to serve as a testbed for CubeSat operations beyond low Earth orbit in ways that require lunar or interplanetary trajectories, and that demonstrate practical application of solar sail technology for propulsion, trajectory/attitude control and rendezvous with a body in space. The craft's Science instruments will study the environment of the Earth-Moon system, conduct science observations, and take photos and video to be broadcast back to Earth for anyone to receive and use.

LunarSail is a grassroots project involving people within and outside of Ares Institute. While open to government-provided funding and assistance in finding a suitable launch opportunity, a substantial amount of Lunarsail's budget is being raised by crowdfunding and private donations. Ordinary individuals can donate money, labor, programming and ideas - making them proud co-owners of the mission and stakeholders in its success. Social media play a key role in publicizing this opportunity. The public is being invited to submit messages, artwork, music and short video clips that will be stored on the spacecraft.

After it enters lunar orbit, LunarSail will transmit the messages, graphics and video that have been stored on it back to Earth, for anyone and everyone to see and hear as long as they can pick up the signal from the spacecraft. All this will also be transmitted via social networks and displayed on the LunarSail website with attribution and captioning. For imagery and crowdfunding details visit the 3rd link above. ##

Japanese firm proposes 'Power Belt' for the Moon

Nov 29, 2013 - http://www.space-travel.com/reports/**Japanese_firm_describes_proposed_power_belt_for_the_moon**_999.html
http://www.space.com/23810-**moon-luna-belt-solar-power-idea**.html



A Japanese company has unveiled its concept of a lunar solar power generation installation that could send 13,000 continuous terawatts of power back to Earth.

Shimizu Corporation's "Lunar Ring" concept is a robot-built array of solar cells in a 1.6 km (1 mi) wide belt along the entire 10.918 km (6,784 mi) lunar equator - an alternative to a Solar Power Satellite ring in Geosynchronous Earth Orbit.

Machines and equipment from the Earth would be assembled in space and then installed on the lunar. Power cables would transfer electricity from the lunar solar cells to transmission facilities, where high-energy-density lasers would beam it to offshore receiving facilities on Earth.

"A shift from economical use of limited resources to the unlimited use of clean energy is the ultimate dream of mankind.The luna ring ... translates this dream into reality through ingenious ideas coupled with advanced space technologies," said the Shimizu press release..

No cost estimate is available. Construction could begin in 20 years. Legal issues concerning the needed involved lunar rights of way would have to be addressed.

Previously, David Criswell had proposed a pair of solar panel arrays, one on both limb of the Moon, to generate power to be beamed to Earth. The problem with this idea is that the side of the Moon that faces Earth "librates" a total of 15° on a monthly schedule, so that the power transmitters would have to be about 8° this side of the nominal 90° E and 90° W positions. http://en.wikipedia.org/wiki/David_Criswell

Which system would be least expensive and easier to construct? To be determined. ##

Misplaced Lunar Orbiter Imagery Found After 46 Years

http://spaceref.com/moon/misplaced-lunar-orbiter-imagery-found-after-46-years.html#more

High resolution imagery from the Lunar Orbiter program, forgotten for nearly 50 years, has been retrieved from original data tapes.The five Lunar Orbiter missions, flown between 1966 and 1967, were rather heavily documented.

This extensive documentation has helped the Lunar Orbiter Image Recovery Project (LOIRP) to locate images on the original analog data tapes and retrieve them at a resolution that was impossible in the 1960s. While the Lunar Orbiter program was methodical in documenting everything, every now and then imagery slipped through the crack. Often times the misplaced images are unremarkable and incomplete. However, in this case, we have found complete high resolution imagery of a location close to the Apollo 15 landing site at Hadley Rille. The imagery uncovered is number 5105 taken by Lunar Orbiter V in 1967. ##

GOOGLE LUNAR X-PRIZE NEWS

Recognizing Giant Leaps: Google Lunar XPRIZE Establishes Milestone Prizes

Nov 7, 2013 - http://www.space.com/23503-**google-lunar-xprize-milestone-prizes.**html

Back in 2007, building upon the successes of the Ansari XPRIZE for suborbital spaceflight and the Northrop Grumman Lunar Lander Challenge, XPRIZE and Google launched the $30 million Google Lunar XPRIZE, the largest incentivized competition to date. The concept was easy to explain: land on the Moon, move 500 meters and send back video, images and data. The prize requirements were conceived to demonstrate the minimum useful capability a spacecraft would need for future uses in space exploration and scientific research. Thirty teams signed up for this audacious challenge by the close of registration in 2010.

Six years later, not much progress

Given the large investment needed to send a robot to the Moon, two elements of the Google Lunar XPRIZE ecosystem are critical:

1. Potential customers for the technology developed by teams, and
2. Investors to help create the businesses to leverage those markets.

Since the Google Lunar XPRIZE was launched, there has been a global economic downturn

- Reducing an already small pool of investors willing to take risks on pioneering new markets.
- Stagnated or reduced the budgets that governments are willing to spend on space exploration
- NASA has changed its focus from going back to the Moon to exploring asteroids.

The Milestone Prizes

Two years ago, XPRIZE began a dialogue with teams to better understand the challenges that they were facing and to determine what steps it might take to better nurture and support this prize system. A way to recognize and support the teams that were making substantial technical progress toward the requirements of the competition was needed.

Within the next year, there are certain developmental milestones for flight-ready hardware that teams must pass to meet the mission requirements and be ready to launch by the end of 2015. Recognizing and rewarding these milestones will not only help the competing teams by allowing them to access financing at a critical point in their mission timeline, but it will also raise public excitement and support for the teams.

The Milestone Prizes are for **demonstrating** by actual testing and analysis) **robust hardware and software** in the areas of **imaging**, **mobility** and **lander systems** — all necessary to achieve a successful Google Lunar XPRIZE mission.

Teams will submit their proposals to our judging panel, which will select up to four proposals to monitor in each of the imaging and mobility subsystems, and three proposals for the lander system, for a total of 11 proposals. A team may have proposals selected in more than one area.

Provided the team successfully accomplishes the tasks described in their selected proposal in the timeframe agreed, they will win a Milestone Prize. The amounts are US $250,000 for the Imaging Subsystem Milestone Prize (for up to 4 teams), US $500,000 for the Mobility Subsystem Milestone Prize (for up to 4 teams), and $1 million for the Lander System Milestone Prize (for up to 3 teams), for a total purse of $6 million. The Milestone Prizes can be won through the end of September 2014.

Penn State's Google Lunar XPRIZE Team Lunar Lion Sets Launch

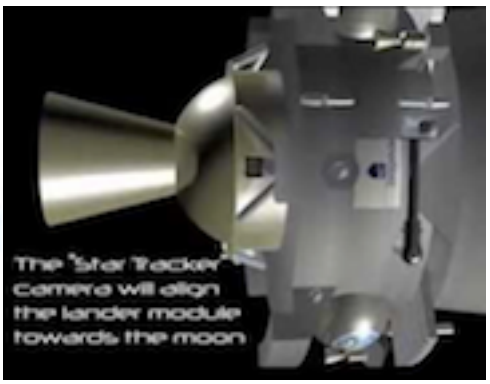
http://moonandback.com/2013/11/25/**penn-states-google-lunar-xprize-team-lunar-lion-sets-launch**/

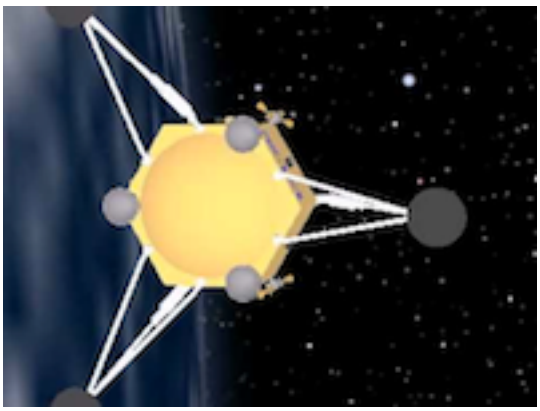
VIDEO – http://moonandback.com/2013/11/25/lunar-lion-to-the-moon/

Contracts with Industry Newcomer Phoenicia for Space on Rocket

UNIVERSITY PARK, Pa. — The **Lunar Lion**, a moon lander designed and built by the Penn State Lunar Lion team, **the only university-led team** in the Google Lunar XPRIZE competition, will be sent into space as part of a multiple spacecraft effort coordinated by Team Phoenicia LLC, of Menlo Park, Calif. The fully refundable launch reservation fee has been paid to Phoenicia, a significant milestone for the project.

"Phoenicia has brought together a complementary set of payloads, filling a need in the industry. This gives us the advantage of clear program planning and clear fundraising goals. It also means that the clock is ticking toward those goals," says Michael Paul, director of space systems initiatives at Penn State's Applied Research Lab.





Funding for the Lunar Lion mission, 90% of which must be derived from private sources according to competition rules, is coming through a mix of individual gifts and corporate support while leveraging existing assets at Penn State.

Under terms of an agreement between the parties, Phoenicia will contract with a launch vehicle provider and provide systems integration services for a launch to be shared by several spacecraft, the largest of which being the Lunar Lion.

Phoenicia is using a SHERPA, built by Spaceflight Inc., to accommodate additional secondary payloads to maximize the launch vehicle's full capacity. SHERPA, developed by Spaceflight's sister company, Andrews Space, accommodates payloads up to 660 pounds on each of five available ports, includes a propulsion system and links other subsystems to operate as both a hosted payload platform and an in-space maneuvering stage. Spaceflight will immediately make available ports on SHERPA to bring additional spacecraft to low earth orbit and a trans-lunar injection orbit.

Penn State is taking advantage of this unique opportunity to achieve a lunar trajectory without having to bear the full cost of the launch vehicle. "While the Lunar Lion is the largest spacecraft on this launch, it will be accompanied by several mid-sized Earth satellites that will be placed in low Earth orbit," said Baird. "Once those customers' spacecraft have been released, the Lunar Lion will be pushed on to its lunar-intercept trajectory, accompanied by other payloads, including several CubeSats."

The Google Lunar XPRIZE will be awarded to the first privately funded team to land a spacecraft on the Moon, move it 500 meters, and send back video, images and data before the end of 2015.]The winner of the Google Lunar XPRIZE will be the first privately funded spacecraft to land on the Moon.

Moon Express Software Flies NASA "Mighty Eagle" Robotic Lunar Lander

http://www.prnewswire.com/news-releases/**moon-express-software-successfully-flies-nasa-mighty-eagle-robotic-lunar-lander**-233502831.html

HUNTSVILLE, Al, Nov. 26, 2013 /PRNewswire/ - **Moon Express**, a commercial lunar enterprise, announces a successful free flight test of its **lunar lander software** on NASA's "Mighty Eagle" prototype robotic lander. The "closed loop" free flight test conducted yesterday was the latest in a series of progressive tests of the company's flight software conducted at the NASA Marshall Space Flight Center (MSFC) in Huntsville, Alabama. The collaboration is helping Moon Express develop its commercial lunar landers for low-cost robotic missions to the Moon beginning in 2015, in an effort to win a Google Lunar -Prize

Under the terms of a Reimbursable Space Act Agreement signed with Moon Express, NASA Marshall is providing its "Mighty Eagle" lander test vehicle and engineering team in support of a series of test flights to help validate Moon Express's Guidance, Navigation and Control (GNC) flight software. Guidance algorithms developed by Moon Express were integrated into the existing Guidance, Navigation and Control Software on-board the Mighty Eagle used to perform a flight test series. In return, Moon Express reimbursed Marshall Space Flight Center for the cost of providing the test vehicle and technical support.

Moon Express is a leading contender in the $30M Google Lunar XPRIZE and is headquartered at the NASA Ames Research Park in Silicon Valley with a Propulsion Development Facility in Huntsville, Alabama. For more information about Moon Express, Inc., visit: http://www.moonexpress.com (Video included)

The First Telescopes on the Moon

Moon Express Enables Private Scientific Collaboration on China Moon Mission

http://www.digitaljournal.com/pr/1616073 - http://inagist.com/all/407267179076145152/

Dec. 2. 2013. **Moon Express**, a US commercial lunar enterprise and **Google Lunar X-Prize** contestant, is enabling scientific collaboration between the International Lunar Observatory Association (ILOA) and

China's **Chang'e-3 Moon mission** successfully launched today from the Xichang Satellite Launch Center in Sichuan province, southwest China.

The U.S. private sector collaboration on Chang'e-3 is made possible through a Memorandum of Understanding (MOU) signed between ILOA and the National Astronomical Observatories, Chinese Academy of Sciences (NAOC) on September 4, 2012 in Hawaii, and a MOU signed between ILOA and the China National Space Administration (CNSA) on August 13, 2013, in Beijing.

ILOA Telescope

The first such private U.S.A. / China collaboration, the parties have agreed to an exchange in kind in which ILOA participates in observing and receives Galaxy, astronomical images from Chang's-3's Ultra-violet telescope and NAOC receives observing time on ILOA telescopes traveling to the Moon aboard Moon Express landers in 2015 and 2017.

The collaboration is scientific and educational in nature, and will establish a cooperative program to conduct Galaxy, Astronomical Imaging for Global 21st Century Education from the lunar surface.

"As ILOA prepares for Galaxy 21st Century Education collaboration with the Chang'e-3 UV telescope, I hope today's successful launch of China's Chang'e-3 probe to the Moon will have a great impact on US space policy in a positive and constructive way to insure the U.S.A. has robotic Moon operations leading to permanent human presence," said ILOA Founding Director, Steve Durst.

Moon Express has designed and built the International Lunar Observatory precursor (ILO-X) under contract to the ILOA and will deliver it to the lunar surface aboard Moon Express' inaugural mission in 2015. ILO-X is the world's first private lunar telescope and will be accessible over the internet, pioneering a new era of global space research and citizen science with space observation and communication technology on the Moon. The ILO-X is a precursor to the larger, permanent lunar observatory "ILO-1" – a multifunctional 2-meter dish scheduled to be delivered by Moon Express to the Moon's South Pole in 2017 to conduct Galaxy observation and commercial communications activities.

"We are beginning a new era of commercial lunar exploration," said Bob Richards, Moon Express Co-founder & CEO and ILOA founding board member. "Moon Express is proud to be working with ILOA on a historic private sector science collaboration with China on the Chang'e-3 mission that, if successful, will be the first such American scientific activity on the lunar surface in over forty years."

ABOUT MOON EXPRESS

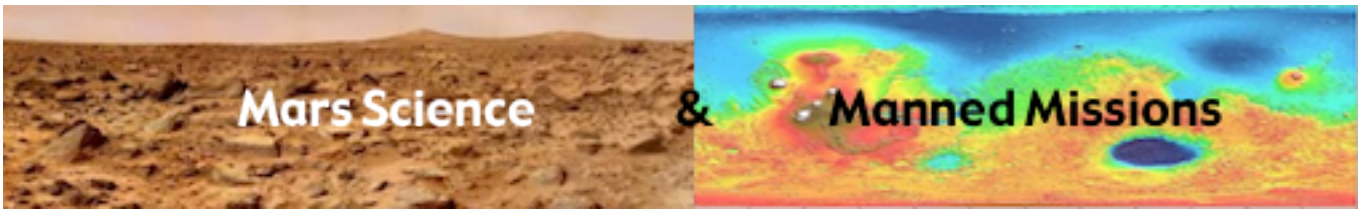
Moon Express (MoonEx) a privately funded lunar resource company created to establish new avenues for commercial space activities beyond Earth orbit. The company is partnered with NASA for lunar lander development and is engineering a series of low-cost robotic missions to the Moon for commercial and government customers, with a long term goal of locating and developing lunar resources for use in space and on Earth. Moon Express won a $10M commercial lunar contract from NASA in 2010 and is a leading contender in the $30M Google Lunar XPRIZE competition for the first private team to land a robot on the Moon. Moon Express is headquarted in Silicon Valley at the NASA Ames Research Park and has a Propulsion Development Facility in Huntsville, Alabama.

The Moon Express founders, Dr. Robert (Bob) Richards, Naveen Jain, and Dr. Barney Pell, believe in the long term economic potential of the Moon to produce resources essential to humanity's future on Earth and in space. For more information, visit: www.moonexpress.com

ABOUT THE ILOA - http://www.iloa.org - http://www.iloa.org/4MissionUpdate0713.html

The International Lunar Observatory Association (ILOA) is an interglobal enterprise incorporated in Hawaii as a 501(c)(3) non-profit to help realize the multifunctional ILO – to advance human knowledge of the Galaxy and Cosmos through observation from our Moon, and to participate in lunar base build out.

The ILOA also co-sponsors with Space Age Publishing Company affiliate an international series of Galaxy Forums to educate and inspire people about Galaxy 21st Century Education and the wonders of the Cosmos. The ILOA is supported by a number of space luminaries world-wide including Director Emeritus John Young, commander of the Apollo 16 mission to the Moon. ##



[The articles below have been summarized by the editor. For the full text, see the links cited.]

MARS ANALOG EXERCISES

Mars Society Plans 365 day long Analog Exercise on Devon Island

Call for Volunteers: Mars Arctic 365 Mission (MA365) – Full text below

http://www.marssociety.org/home/press/announcements/**ma365-call-for-volunteers**

One-Year Mars Mission Simulation at the Flashline Mars Arctic Research Station (FMARS):

Note that the deadline for submission will have passed by publication time of this issue.

We include the crew requirements listed below for information purposes only.

"The Mars Society is seeking six volunteers for the crew at FMARS during an extended full year 365 day simulation of human Mars exploration operations on Devon Island in northern Canada (August 2014 through July 2015).

"Expertise is sought in geology, geochemistry, microbiology, biochemistry, and paleontology. Two additional crew members will be chosen primarily for their skills in engineering areas. The ability of crew members to support both roles is considered a strong plus. For 12 months, this crew will conduct a sustained program of field exploration on Devon Island, 1450 km (900 mi) south of the North Pole, operating under many of the same constraints that will be faced by explorers on an actual human Mars mission.

The crew is responsible for all of its own field work, lab work, reportage, repair of equipment, and chores of daily life. They will work in online collaboration with a Remote Science Team, a Mission Support Group, and an Engineering Support Team located in the United States.

"In addition to the six person crew, one field support person will also participate in the expedition in and out of simulation role. This person should have excellent field mechanical and wilderness skills.

"Both volunteer investigators who bring with them a proposed program of research of their own compatible with the objectives of this mission, and those simply wishing to participate as members of the crew supporting the investigations of others, will be considered.

"Volunteers may submit applications as individuals, couples or both. Applications will be considered from anyone in good physical condition between 22 and 60 years of age without regard to

race, creed, color, gender, or nationality. Scientific, engineering, practical mechanical, arctic, wilderness, first aid, medical, and literary skills are all considered a plus. Applicants should have either a four-year college degree or equivalent experience."

"Applicants must pass a physical exam and be cleared by their personal physician to participate. They must be non-smokers and should state what, if any, food allergies and/or dietary restrictions they may have. Dedication to the cause of human Mars exploration is an absolute must, as conditions are likely to be very difficult and the job will be very trying.

Those selected will be required to act under crew discipline and strict mission protocols during the Arctic simulation. Prior to the mission, the selected crew members will take part in a two-week training mission at the Mars Desert Research Station outside Hanksville in southern Utah, and will also participate in other evaluation, training and preparatory sessions.

"Applicants should state whether or not they require salary. Applications including resume, character references, proposed research program (if any) and a brief letter explaining why you wish to participate should be sent to: ma365@marssociety.org. Total length of application should not exceed four pages, and the deadline for submitting applications is November 30, 2013.

Mission Science Agenda:

"The overall purpose of Mars Society simulations is to investigate field techniques that would be relevant to the scientific exploration of Mars. The approach of our investigations is to have real science goals in Mars analog environments and to conduct field work under simulated Mars mission constraints. Relevant field activities include geological surveys, search for evidence of past life, search for extant life, and environmental and meteorological observations. In addition investigating the role and optimal combination of human exploration, telepresence, robotic exploration and the use of remote sensing tools are all part of these simulations."

"By virtue of its one full Earth year duration, the MA365 mission simulation opens up additional focused science. The focus of MA365 will include coupled physical and biological studies of the Arctic active layer over the transition from hard winter freeze to summer thaw, other natural science areas of interest, as well as extended crew psychological, food science, engineering and human factors research.

Examples of science activities include (but are not limited to):

1. Temperature and flow relations in the active layer of the permafrost across -20 to 0C and applications to models of fluvial feature formation over permafrost on Earth and Mars.
2. Experiments with manipulation of the snow cover thickness and monitoring of the effect on the thaw of the underlying ground.
3. Measurement of melt generation in snowpacks and application to models for the melting of dusty snowpacks on Mars as the mechanism for creating gully features
4. Measurement of in situ biological activity and changes in diversity and abundance as temperatures increase from -20 to 0C
5. Measurement of the release of CH4 - an important greenhouse gas - from permafrost and possible applications to the source of CH4 on Mars.
6. Carbon release studies of permafrost as temperature changes with global warming.
7. Deployment of interactive sensor networks to achieve science goals and human factors studies of the human-sensor network interface.
8. Isolation and confinement of this expedition enables research on human performance under extreme conditions analogous to space mission conditions.
9. Deployment & utilization of remote instruments, incl. telescopes during the long Arctic winter night.
10. Climatological studies.
11. Geologic studies.
12. Studies of human exploration field operations.
13. Tests of prototype Mars exploration equipment.

Science team members selected for this expedition are expected to have a track record in a science area listed above or a related activity. They are also expected to supervise a field research project leading to peer-reviewed publication working in collaboration with the Science Advisory Group and the Remote Science Team for the expedition.

"Equipment to conduct field exploration will be provided, but team members may also propose to bring field equipment and instruments as part of their activities." **TMS**

Europe's Mars Rover Prototype Takes Big Test Drive in Chile Desert

October 24, 2013 - http://www.space.com/23316-**europe-mars-rover-test-drive-exomars**.html
http://www.space.com/23228-**europe-mars-rover-test-drive-photos**.html

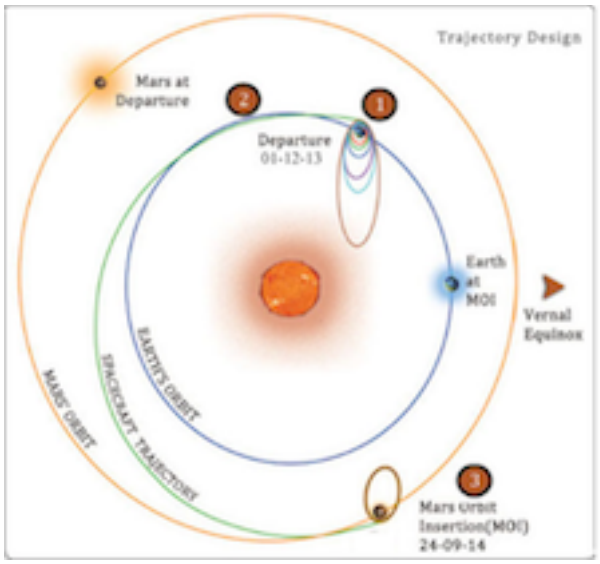
The prototype, "Bridget," spent several days working in Chile's far northern Atacama Desert as part of the Sample Field Acquisition Experiment with a Rover (SAFER) trial between October 7 and 13.

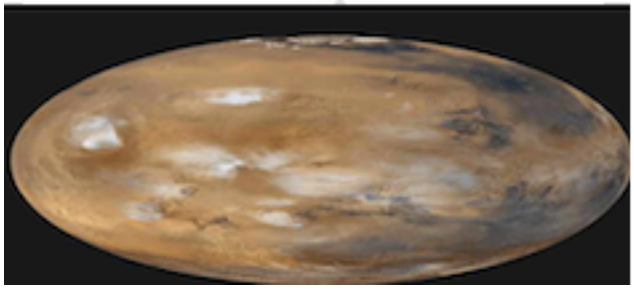
For ESA, the field trial represented a vital opportunity to test Mars roving in the field. While NASA is used to steering Red Planet rovers — the agency has piloted four on Mars, with the 1-ton Curiosity rover being the most recent — ExoMars will be the first European one. It is expected to launch in 2018. ##

MARS MISSIONS

India's Mangalyaan Mars Orbiter is on its way to Mars

www.forbes.com/sites/saritharai/2013/11/07/**how-indias-isro-launched-its-mars-mission-at-cut-rate-costs**/
http://i.space.com/images/i/000/033/540/i02/**india-mars-probe-mangalyaan**-131014b-02.jpg?1381791969
(Explanatory Poster)





November 7, 2013 ISRO (Indian Space Research Organisation) spent a mere $75 million to launch a small spacecraft to Mars, a 225 million km (140 million mi] journey. Mangalyaan, "Mars craft" in Hindi, is India's first interplanetary mission. It should arrive September 2014 in ten months. If the mission succeeds, India will be the first Asian country, and the fourth in the world, to do so.

In the past 50 plus years, India has spent a relatively small amount of money on space programs and yet achieved remarkable results. The $75 million spent on Malayalaan is a remarkably little compared to the billions of dollars spent by the United States, Russia, Europe, and Japan. India is establishing a reputation for low-cost innovation in othr fields as well. The secret seems to be an ingenuity that commands respect.

Kopillil Radhakrishnan, chairman of ISRO, explained how the agency made Mangalyaan the world's least-expensive Mars endeavour. Excerpts:

1. "I don't like the phrase 'frugal engineering'. ISRO's general philosophy is cost effectiveness. The Russians look for robustness and the Americans go after optimization. Our aim at ISRO was how do we get to Mars on a budget."
2. "We adopted a modular approach. Take the launch vehicle, for instance. We acquired the technology for the Vikas engine in the 1970s by working with the French. There was no money transaction. We have since produced 120 such engines with Indian materials and fully fabricated here. For every successive launch, we have taken the base of our previous, proven launch technology, modified and built on it. Here, we had to add the cryo to the previous module as we needed higher engine power. We used the same modular tactic with our payload as well. The modular approach gave us cost and schedule advantages."
3. "When we conducted ground tests – which are time consuming and expensive – we kept the number of tests small but wrung out the best out of each. This is our way, historically."
4. "For transferring Mangalyaan from Earth orbit to Mars' orbit, we used a couple of strategies to bring down fuel consumption drastically."
5. "We are schedule-driven to the extreme. This prevents cost overruns. The mission has taken 15 months from the time our Prime minister announced it in August last year to the liftoff. In parts of Europe, even space scientists have a 35-hour workweek. For us here, 18-hour days are common. During the launch period, many of our scientists were working 20 hour-days. Being time effective makes us cost effective." The Mars craft will take nearly a month to build up the velocity to break free from Earth's orbit and finally begin its long journey to Mars. (see the diagram above.)

http://www.marsdaily.com/reports/
Frugal_Mars_mission_launchpad_for_India_in_global_space_market_999.html

Nov 10, 2013- India has set a new benchmark for frugal interplanetary travel and that puts it in a position to earn a larger share of the $300-billion global space market. Indian science author Pallava Bagla cautions others not to underestimate Mangalayan because it is a low-cost mission." NASA's Maven Mars mission, set for a November 18 launch, will have cost 10 times as much. India's successful $89 million lunar orbiter mission in 2008 -- Chandrayaan-1 -- showed how to explore space on a minimal budget. and the Mars mission enhances this low-cost reputation. ISRO has an annual budget of $1.1 billion, one-17th of NASA's. Ingenuity is key. Lacking a rocket large enough to fire the probe directly out of Earth's atmosphere, ISRO displayed the famed Indian skill of "jugaad" -- cheap alternative solutions.

A slingshot to Mars

The 350-tonne launch vehicle will orbit Earth for nearly a month, building up the speed to "slingshot" its way out of the earth's gravitational pull to embark on its 400 million km (260-million-mile) path. If successful, this feat will earn respect Indian technology, whether the science part of the mission is successful or not. ISRO's growing list of low budget successful missions commands respect and may well bring more space launch business to India from other nations.

Additional Reports

- http://economictimes.indiatimes.com/news/politics-and-nation/**prudent-mars-mission-launchpad-for-india-in-global-space-market**/articleshow/25549675.cms
- http://articles.timesofindia.indiatimes.com/2013-11-05/india/43693030_1_**orbiter-mission-mars**-orbiter-mission-director-p-kunhikrishnan

November 7 - Indian Scientists start raising Mangalyaan's orbit

http://articles.timesofindia.indiatimes.com/2013-11-07/india/43773125_1_spacecraft-orbit-istrac

CHENNAI: Soon after its launch on Tuesday, the spacecraft, now in an elliptical Earth orbit with a perigee (closest point to earth) of 250km and an apogee (farthest point of the orbit) of 23,500km, deployed all the three sections of solar panels, as also the antenna.

In the next ten days, A 150 scientist team at the ISRO Telemetry, Tracking and Command Network (Istrac) in Bangalore, working nights, will carry out four more such orbit-raising manoeuvres. "All the corrections will be done in the wee hours, because that's the time when we have the best visibility of the spacecraft." These exercises involve remotely firing the engine of the spacecraft when it is at its perigee, so that the thrust sends it farther than the earlier apogee.

The next crucial event will be at 12.42 am India time on December 1, when scientists at Istrac will fire the spacecraft engine for a "trans-martian injection" out of Earth orbit. Being on time for each manouvre is vital. Any delay would bring down the life of the orbiter, since a lot of fuel would then have to be spent to catch up with the desired path to Mars,

On **September 24, 2014**, the spacecraft is to enter orbit around Mars through a reverse process of orbit-raising, when scientists reduce the velocity of the spacecraft to get it hooked to an elliptical Mars orbit of 365km (perigee) – 80,000 km (apogee), from where it will carry out scientific observations of the red planet.

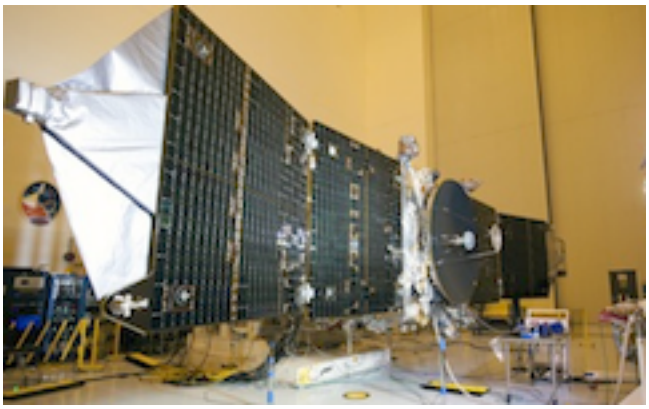
Update and additional information:

Nov. 30th – successful burn to put it on a course from Earth Orbit to Mars
http://www.space.com/23802-**india-mars-probe-red-planet-journey**.html

Mangalyaan related videos:

http://www.youtube.com/watch?v=UDWyRhQzlEc
http://www.youtube.com/watch?v=0-Ygp4ZzjYA
http://www.youtube.com/watch?v=whjipGPAHIE
http://www.youtube.com/watch?v=4HfP7z4CUic – recommended

NASA Mars mission (MAVEN) is on its way to Mars



MAVEN = **M**ars **A**tmosphere and **V**olatile **E**volutio**N**

November 18, 2013– MAVEN launched on time, Next Stop Mars Orbit September 2014

Reports: http://lasp.colorado.edu/**home/maven/**
http://www.space.com/23633-**nasa-mars-spacecraft-launches-maven-mission**.html
http://www.mnn.com/earth-matters/space/stories/**mission-to-mars-5-things-to-know-about-nasas-maven-probe**

Videos:

www.nasa.gov/press/2013/november/**levar-burton-shares-maven-s-story-in-a-new-nasa-psa/**
www.space.com/23525-**why-is-mars-a-desert-wasteland-nasa-maven-mission-will-investigate-video**.html

MAVEN is big: The solar-powered MAVEN spacecraft is pretty hefty. While the probe's body is a cube measuring 2.4 m (8 ft) on a side, MAVEN spans a total of 11.4 m (37.5 feet) with its solar panels deployed, making the craft as long as a school bus. **MAVEN weighs 2,454 kg (5,410 lb)**

Elliptical orbit

When MAVEN gets to Mars, it will go into an elliptical orbit bringing it as close as 150 km (93 mi) and reaches as far away as 6,000 km (3,728 mi). MAVEN will make a handful of "deep dips" during the course of its mission, coming within 124 km (77 mi) of the Martian surface on five occasions, which will enable it to sample the Mars' upper atmosphere directly and get a wider view of the planet from afar.

Solving a Martian mystery

Scientists believe thatMars was a potentially habitable planet billions of years ago, with a thick atmosphere and large amounts of liquid water fon its surface. But apparently, something happened, and Mars slowly became the cold and dry world we see today, its atmosphere just 1 percent as Earth's.

The hope is that MAVEN will help us understand this dramatic shift, how it happened, and how long it took. The question MAVEB is designed to answer is why so much of Mars' atmosphere was lost to space, and what role this loss played in Mars climate change over the last four billion years.

MAVEN will use **eight different science instruments** (http://lasp.colorado.edu/home/maven/science/instrument-package/) to study Mars' upper atmosphere and the solar wind, the stream of charged particles flowing from the Sun that is thought to have stripped away much of the water and other volatile compounds in the Martian atmosphere. The instruments are grouped in three suites:

The Particles and Fields Package

- Solar Wind Electron Analyzer (SWEA)
- Solar Wind Ion Analyzer (SWIA)
- Suprathermal and Thermal Ion Composition (STATIC)
- Solar Energetic Particle (SEP)
- Langmuir Probe and Waves (LPW)
- Magnetometer (MAG)

The Remote Sensing Package, will determine global characteristics of the upper atmosphere and ionosphere via remote sensing.

- Imaging Ultraviolet Spectrograph (IUVS)

The Neutral Gas and Ion Mass Spectrometer (NGIMS)

MAVEN will not look for signs of life

While MAVEN's observations should help researchers better understand Mars' past and present habitability, the probe will not directly search for signs of life. In fact, MAVEN is not equipped to sniff for methane, a gas that could be an indicator of extant life. (About 90 percent of Earth's methane is produced by living organisms.) The reason it is not so equipped, however, is budgetary (ED: for shame!)

Communications link

MAVENl also serve the space agency in another way — as a communications relay between 2 rovers on Mars (Opportunity and Curiosity) and their controllers on Earth.

Daily Updates: http://www.nasa.gov/mission_pages/maven/main/index.html#.Uotj4GR3748

NASA's Curiosity Rover Confirms Mars Origin of Some Meteorites

http://www.jpl.nasa.gov/news/news.php?release=2013-298&cid=release_2013-298

October 17, 2013 - Examination of the Martian atmosphere by the Curiosity rover confirms that some meteorites that have dropped to Earth really are from Mars. A high-precision count of two forms of argon -- argon-36 and argon-38 -- in Mars' atmosphere by Curiosity's Sample Analysis at Mars (SAM) instrument provides the most definitive evidence yet of the origin of Mars meteorites while at the same time providing a way to rule out Martian origin of other meteorites.

These lighter and heavier isotopes of argon exist naturally throughout the solar system. On Mars the ratio of light to heavy argon is skewed because much of that planet's original atmosphere was lost to space. The lighter form of argon was taken away more readily because it rises to the top of the atmosphere more easily and requires less energy to escape. That left the Martian atmosphere relatively enriched in the heavier isotope, argon-38.

Past analyses of gas bubbles trapped inside Martian meteorites had already narrowed the Martian argon ratio to between 3.6 and 4.5 atoms of argon-36 to every one of argon-38. Measurements by the Viking landers in the 1970s put the ratio in the range of four to seven. The new SAM direct measurement on Mars now pins down the correct argon ratio at 4.2. Figuring out the planet's atmospheric loss enables us to better understand how Mars transformed from a once water-rich planet, like our own, into the drier, colder and less-hospitable Mars we see today.

Argon makes up only a tiny fraction of the gas lost to space from Mars, But it is special because it's a noble gas, inert, not reacting with other elements or compounds, and therefore a more straightforward tracer of the history of the Martian atmosphere. While Curiosity is not designed to trace Argon, he Mars Atmosphere and Volatile Evolution Mission (MAVEN), enroute to Mars, is designed to do so. ##

Gale Crater Mudstone: Geochemically Benign Potentially Habitable Environment

http://www.marsdaily.com/reports/**New_Views_of_Mars_from_Sediment_Mineralogy**_999.html

Dec 17, 2013 - The first detailed examination of clay minerals in their original setting on Mars gives new insights on Mars past habitability. The sedimentary rock samples tested were collected by the Mars Science Laboratory rover Curiosity at Yellowknife Bay in Gale Crater The Chemistry and Mineralogy X-Ray Diffraction and Fluorescence (CheMin XRD/XRF) instrument analyzed the samples.

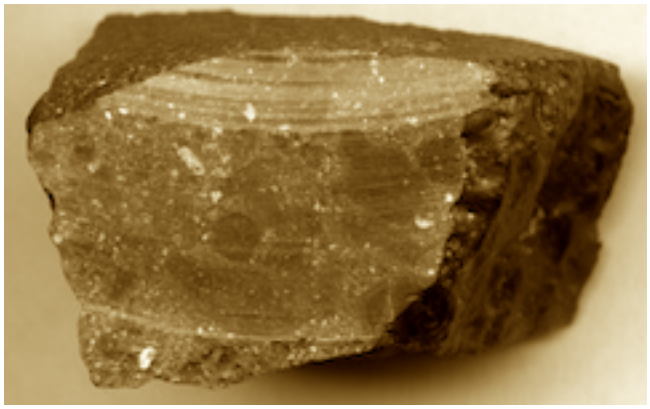
The X-ray diffraction results reveal the presence of smectite, a type of clay mineral typical of soils and sediments that have not been deeply buried, heated, or otherwise altered. The diffraction data are also significant for what they do not detect - clay minerals such as chlorite or illite that form in strongly alkaline or hydrothermal waters.

These findings are laid out in the paper "Mineralogy of a Mudstone at Yellowknife Bay, Gale Crater, Mars" by Planetary Science Institute Senior Scientist David T. Vaniman. This is the first analysis of a complete mineral assemblage in a Martian sediment, "accounting for all of the associated debris that settled into a lake as well as minerals formed in the lake and after it dried out."

This mineral analysis is important not only for what is seen but also for what is not present. Unlike the sediments that the Rover Opportunity has found at Meridiani Planum; the Gale Crater mudstone lacks iron sulfates that indicate an acidic environment. "The only sulfates found in the mudstone are calcium sulfates, associated with veins that formed after the lake was gone and not indicative of an acidic system. The mudstone mineralogy is consistent with a geochemically benign and potentially habitable environment." ##

Mars Meteorite Reveals 1st Look at Ancient Martian Crust

http://www.space.com/23670-**mars-meteorite-ancient-martian-crust.html**



(Sepia coloration added by editor to B/W photo)

November 20, 2013 - A meteorite, NWA 7533, found last year in the Sahara Desert is likely the first recognized piece of ancient Martian crust.It is 4.4 billion years old and appears to have come from Mars' ancient and cratered southern highlands, "that portion of Mars that holds all the secrets to Mars' birth and early development," according to lead author Munir Humayun of Florida State University.

"It's the part of Mars' history where the oceans and atmosphere developed, and where life would have developed if it ever did on Mars," Humayun added. "I will liken this to opening a treasure chest — it may take a while before we find the best treasures, but treasures aplenty lurk in this meteorite."

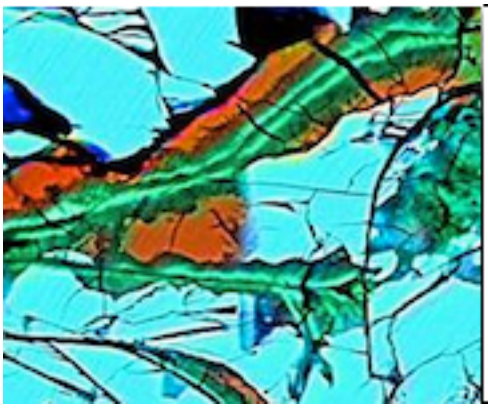
NWA is short for northwest Africa, where the rock was found. That crystals within it called zircons formed about 4.4 billion years ago sets the meteorites age, about 100 million years after the first dust condensed in the solar system. "We now know that Mars had a crust within the first 100 million years of the start of planet-building, formed concurrently with the oldest crusts on Earth and the Moon.

After measuring the abundances of certain elements within the meteorite, the team was able to calculate a thickness for the Red Planet's crust. "The amount of melting on Mars was low, sufficient to accumulate a 50-kilometer-thickness [31 miles] crust, but Mars evidently escaped the giant impact-style melting that affected the Earth and moon. This is the first reliable geochemical estimate of the thickness of Mars' crust, and it agrees with geophysical estimates from gravity and topography." ##

Scientists Discover how the Atmosphere of Mars turned to Stone

http://www.marsdaily.com/reports/
Scientists_discover_how_the_atmosphere_of_Mars_turned_to_stone_999.html

Glasgow, UK (SPX) Oct 24, 2013 - Scientists at the Scottish Universities Environmental Research Centre, the University of Glasgow and the Natural History Museum in London may have discovered how Mars lost its early carbon dioxide-rich atmosphere to become the cold and arid planet we know today. This is the first direct evidence from Mars of a process, called "carbonation" which currently removes carbon dioxide from our own atmosphere, potentially combating climate change on Earth.



This image is a false colour image of the Lafayette meteorite (sample code USNM 1505-5) from a scanning electron microscope showing evidence of carbonation, with siderite (orange) replacing olivine (blue)

It is becoming widely accepted that accumulation of carbon dioxide in the Earth's atmosphere is contributing to global warming. The loss of carbon dioxide from the atmosphere of Mars, however, around 4000 million years ago is likely to have caused the planet to cool. Understanding how carbon dioxide was removed from the Martian atmosphere could suggest new ways of reducing the accumulation of greenhouse gases in our own atmosphere.

"In a paper published in the journal Nature Communications, the research team describe analyses of a Martian meteorite known as Lafayette, sourced from the research collections of the Natural History Museum in London and the Smithsonian Institution in Washington. It formed from molten rock around 1300 million years ago, and was blasted from the surface of Mars by a massive impact 11 million years ago. Since its discovery in Indiana, USA, in 1931, Lafayette has been studied by scientists around the world."

Carbon Dioxide "Sequestration"

The scientists focused on a carbon-rich mineral, **siderite** that appears to have been formed by the process of "carbonation", in which water and carbon dioxide from Mars' atmosphere reacted with rocks containing the mineral **olivine**. These reactions then formed **siderite crystals, replacing the olivine**, and in so doing captured the atmospheric carbon dioxide and permanently stored it within the rock.

Lafayette provides direct evidence for storage of carbon dioxide in the fairly recent history of Mars, some time after 1300 million years. As all of the ingredients for carbonation were present on early Mars, in the form of olivine, water and carbon dioxide, this reaction "**may explain how carbon dioxide was removed from the planet's atmosphere changing its climate from warm, wet and hospitable to life, to cold, dry and hostile.**"

This process also occurs naturally on Earth, and is the focus of research examining methods of permanently locking up carbon dioxide from power stations. But the magnitude of the effect on early Mars indicates that it has the potential to be effective on a planetary scale.

Dr Tim Tomkinson of the Scottish Universities Environmental Research Centre, Research Associate at the University of Glasgow and lead author of the paper, said "Mars once had a thick atmosphere that was rich in water and carbon dioxide, and so this process of carbonation may help answer the mystery of why the Martian climate deteriorated around 4000 million years ago."

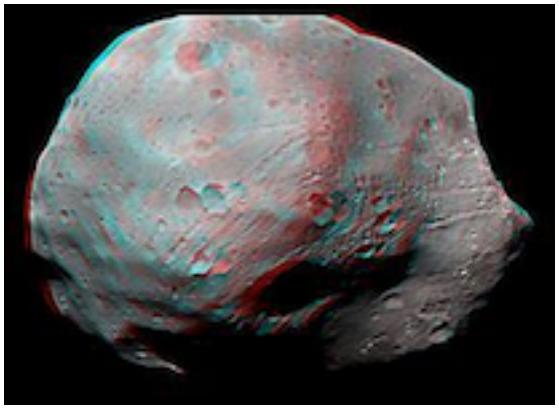
"This discovery is both significant in terms of the way in which scientists will study Mars in the future but also to providing us with vital clues to how we can limit the accumulation of carbon dioxide in the Earth's atmosphere and so reduce climate change."

Dr Caroline Smith, Curator of Meteorites at London's Natural History Museum, and co-author of the paper said, "Our findings show just how valuable meteorites from Museum collections like those we have here at the Natural History Museum really are. There is so much important and useful scientific information locked away in these rare rocks. Our study shows that as we learn more about our planetary next door neighbour, we are seeing more and more similarities with geological processes on Earth." ##

Russia to make 2nd attempt to reach Mars' moon Phobos – in 2020-22

http://www.marsdaily.com/reports/**Russia_to_Make_Second_Attempt_at_Mars_Moon**_Mission_999.html

www.marsdaily.com/reports/**Phobos_Grunt_2_Russia_to_probe_Martian_moon_by_2022**_999.html



Oct 17, 2013 – Russia will take a second crack at bringing back dust samples from Phobos, the larger of the two moons of Mars, after an attempt in 2011 ended in the spacecraft crashing back to Earth, when the second stage failed to ignite.

Russia's next bid to recover material from Phobos won't take place until the 2020 or 2022 launch window. Launch windows open every 25 and a half months, a bit over two years apart. Lev Zelyony, the director of the Space Research Institute at the Russian Academy of Sciences, said the project, nicknamed "Boomerang," is "still important," and claimed the Phobos samples could lead to new discoveries about the birth of the solar system. The mission is codenamed "Boomerang" ["бумеранг."]

Phobos, whose name is Greek for "fear" (hence "phobia") is thought by some to be a captured asteroid and may contain material from the early period of the solar system's creation.

{**Editor:** some think that Phobos and Deimos both were formed by debris cast into orbit round Mars after a major collision between Mars and another proto-planet, in which case Phobos would offer nothing special, mineral wise, nothing that is that does not exist in similar proportions in Mars crust.]

Russia has had a string of four Mars mission failures: Phobos-1 and Phobos-2 (1988), Mars-96 (1996) and Phobos-Grunt (2011). However, the technologies developed for these missions have nce sibeen used in both Russian and international Martian projects.]

Zelyony also discussed a number of Russia's other upcoming space projects at the conference, including two unmanned Moon landings in 2015 and 2018, plans for a probe to Jupiter's largest moon Ganymede starting in 2014, and a mission to recover soil samples from Mars after 2024. ##

Incredible Technology: How to Mine Water on Mars

Dec 23, 2013 – http://www.space.com/24052-**incredible-tech-mining-mars-water.**html

Mars is wetter than it looks

Present day Mars appears to be"bone-dry" but we are learning that Mars has quite a bit of water both locked up in the soil and in dust covered glaciers at both poles and elsewhere. That Mars once supported liquid water has been becoming ever more clear, and exploratory missions have found that water ice still exists on the planet's poles and just beneath its dusty surface. Apparently, that relatively thin soil layer is an environment sufficiently protected from evaporation and/or sublimation.

Accessing that water is the big challenge:

No mission has attempted to extract water on Mars or anywhere beyond Earth in quantity.

Put up or shut up!

Boldly proposing to begin settlement of Mars within a decade or so, the Netherlands-based organization **Mars One** plans to send an unmanned lander to Mars in 2018 that would carry an experiment to demonstrate that water extraction is possible. Mined water could be used for drinking, growing plants or creating fuel.

"Here on Earth, we've experimented with different technologies to extract moisture out of the atmosphere or soil," said Ed Sedivy, civil space chief engineer at the security and aerospace company Lockheed Martin and program manager for NASA's Phoenix lander flight system." But the question is, at the concentration of water and the temperatures on Mars we will face, how do we test to find which technologies are likely to work?

H2O on the Red Planet

Today, Mars is too frigid, and its atmospheric pressure is too low, to support liquid surface water — except for very short spans of time at low altitudes — even though frozen water in the ice caps and beneath the soil surface has been verified. But in 2008, NASA's Phoenix lander detected water ice vapor at its landing site by digging up chunks of soil, heating them above freezing, and analysing them with its mass spectrometer.

Curiosity's amazing find

Since then, Curiosity's SAM Instrument (Sample Analysis at Mars) has found that "Martian soil contains about two pints of water per cubic foot of soil." That is surprisingly "wet.'

Do we microwave the soil, or .....?

There's another method that could be more efficient, produce water in quantity, not traces, which would require less digging. Edwin Ethridge, a senior ISRU (In-Situ Resource Utilization) scientist and retired NASA consultant, and his colleagues have studied using microwave beam to extract water n simulated lunar and Martian environments. A conventional kitchen microwave oven "cooks" some simulated lunar regolith, the layer of loose soil and rocks found on the Moon's surface. The heat vaporized the frozen water, which was then collected and condensed on a chilled plate.

Water absorbs microwaves (short electromagnetic waves) very well, but ice does not, so the microwave beams actually heat up the rock, which heats the ice upon contact. This technique should work much the same way on Mars. The main advantage over excavating is that it requires less digging — but we might need to drill holes down and beam microwaves through them.

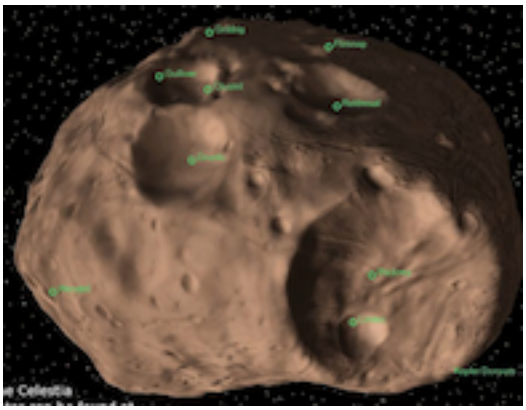
Drilling for water on the Moon

Of course, the Moon and asteroids are also places where local water supplies would make an enormous difference. NASA's Lunar Reconnaissance Orbiter (LRO) sensed water on the Moon remotely, and the Lunar Crater Observation and Sensing Satellite (LCROSS) that impacted the moon in 2009 found direct evidence of water ice and vapor in a perpetually shadowed lunar polar crater. Lunar Prospector, a decade earlier, had detected water ice in craters 15° or more away from the poles that were only partially permanently shaded. ###

Dust Samples from Phobos will also contain Dust from Mars

http://www.marsdaily.com/reports/**Martian_moon_samples_will_have_bits_of_Mars**_999.html

Nov 13, 2013 - A planned Russian mission to return dust samples from Mars' moon Phobos could kill two birds with one stone, according to a study by Brown University geologists, in Providence, Rhode Island, US.



Phobos: 360° Video: http://spaceinvideos.esa.int/Videos/2013/12/**Phobos_360**

The surface of Phobos contains tons of dust, soil, and rock blown off the Martian surface by large projectile impacts. Phobos' orbital path plows through occasional plumes of Martian debris, so that Phobos has been gathering Martian dust debris for millions of years. Thus a sample-return mission planned by the Russian space agency could sample both Mars and Phobos at the same time.

www.celestiamotherlode.net/catalog/images/screenshots/various/marsmoons_Phobos_Poly_1__.jpg

http://en.wikipedia.org/wiki/Phobos_(moon) With an irregular shape, Phobos is only 26.8 × 22.4 × 18.4 km in size (16.65 x 13.9 x 11.4 miles) in dimensions, and 7 times more massive than Deimos.

The mission is not scheduled to be flown until 2020 or shortly thereafter. It will be Roscosmos' second attempt. The first try, launched in 2011, experienced an engine failure while still in Earth orbit.

Researchers in Brown's planetary geosciences group, started with a model based on our own Moon to estimate how much of Phobos' regolith (loose rock and dust on the surface) would come from projectiles. They then used gravitational and orbital data to determine what proportion of that projectile material came from Mars.

"When an impactor hits Mars, only a certain of proportion of ejecta will have enough velocity to reach the altitude of Phobos, whose orbital path intersects only a certain portion of that, So we can crunch those numbers and find out what proportion of material on the surface of Phobos comes from Mars."

Thus regolith on Phobos should contain Martian material at a ratio of 250 parts per million (1 part in 4,000). The Mars bits should be distributed fairly evenly across the surface, mostly in the upper layers.

Phobos is a mysterious little moon in its own right. We are still not sure where Phobos came from. Is it a chunk of Mars that was knocked off by an impact early in Martian history, or is it a captured asteroid? If it is a carbonaceous chondrite asteroid, Phobos could become a major source of fuels such as liquid methane and ammonia. Its interior "might" hold significant amounts of water.

Recent Phobos Flybys

ESA's Mars Express flew by Phobos twice and that allowed scientists to get a better grasp on Phobos mass. The results show that the moon has a curiously low density. "Is that low density due to ice in its interior or is it due to Phobos being completely fragmented, like a loose "rubble pile: with a lot of voids? (We expect that a lot of asteroids are in fact such rubble piles, the result of very slow velocity impacts.(We don't know." The upcoming Russian mission could help solve some of those mysteries about Phobos, and by inference, about smaller Deimos (1/7th the Mass of Phobos).

And we might learn a good deal about Mars in the process. ##

http://en.wikipedia.org/wiki/Phobos_(moon) - http://en.wikipedia.org/wiki/Deimos_(moon)

Trivia: In Edgar Rice Burroughs "John Carter on Mars" Novels, written before the discovery of Phobos, "Barsoom" (Mars) had two small moons named **Thuria** (Phobos) and **Cluros (**Deimos)

ESA's Mars Express to Fly Within 'Touching Distance' of Phobos

http://www.space.com/24072-**mars-express-phobos-moon-flyby-video**.html

On December 29th, Mars Express will pass its closest yet to Phobos. In previous passes, the small object's gravity pull on Mars Express helped narrow down our estimates of Phobos' mass, indicating that Phobos' interior must have between a quarter and a third empty space, indicating that it was a dust-covered "rubble pile." This pass will bring the probe to within 45 km (28 mi) of the object's surface. Phobos itself has a very irregular shape, 27 by 22 by 18 km (16 by 14 by 11 mi). A 68 kg person (150-lb) person standing on its surface would weigh just 56 g (2 oz.)

[Editor: a near surface void could provide an ideal, fully shielded, manned base from which to teleoperate rovers and construction equipment on Mars' surface in preparation for the arrival of personnel.]

http://www.space.com/10733-**mars-moon-phobos-photos**.html

http://www.space.com/24064-**mars-moon-phobos-fly-around-created-from-spacecraft-photos-video**.html

zen water, but we may need to rethink that." "finger-like features typically less than 5 m (16 ft) wide that appear and extend down steep, rocky slopes during spring through summer, then fade in winter and return the next spring. Recently observed slopes stretch as long as 1,200 m (4,000 ft)."

The Overprotection of Mars? Does "Planetary Protection" go too far?

http://www.marsdaily.com/reports/**The_Overprotection_of_Mars**_999.html

Nov 19, 2013 - A recent commentary paper published in the journal Nature Geoscience argues that planetary protection policies and practices designed to guard solar system bodies from biological contamination from spacecraft need to be re-evaluated because they are "unnecessarily inhibiting" a more ambitious agenda to search for life on Mars.

In "The Overprotection of Mars", the authors argue that, from an astrobiological perspective, the most interesting missions to "Special Regions" - where, in theory, Mars life could exist or Earth life could survive - are rendered "unviable" as a result of onerous Committee on Space Research (COSPAR) planetary protection protocols and the need to comply with "detailed and expensive sterilization requirements."

"If Earth life cannot thrive on Mars, we don't need any special cleaning protocol for our spacecraft; and if Earth life actually can survive on Mars, it most likely already does, after four billion years of meteoritic transport and four decades of spacecraft investigations not always following sterilization procedures. Planetary protection policies are at least partly responsible for the lack of life-hunting Mars

missions since Viking, as they impose very stringent requirements for sterilization of the spacecrafts which, in my opinion, are not necessary.".
[There follows a strong rebuttal by those in favor of keeping the present policy and procedures.]
[**Editor:** if the present policy is strictly maintained, we can forget about humans ever setting foot on Mars. We offer **a counter-philosophy**; **If** a planet within human reach cannot give birth to a "climax biosphere, one capable of evolving sentient life, then it is humanity's **duty** to introduce Earth life forms that can support human colonization, and thus bring that planet into a spreading intelligent metabiosphere.

Intelligent life is the **climax of evolution**, and spreading it as far as we can is a duty. **It is why we are here.** And it is the vocation of other intelligent species as well, wherever and whenever they arise.]

Mars Reconnaissance Orbiter Reveals a More Dynamic (& "Wet") Red Planet

www.nasa.gov/press/2013/december/**nasa-mars-spacecraft-reveals-a-more-dynamic-red-planet/#**
Dec. 10, 2013 - NASA's Mars Reconnaissance Orbiter (MRO) has revealed to slender dark markings -- possibly due to salty water – that advance seasonally down slopes close to the Martian equator.

Up until now, the equatorial regions of Mars has been regarded as dry, free of liquid or frozen water, but that may be incorrect. MRO's High Resolution Imaging Science Experiment (HiRISE) camera. That we can track how these features recur each year shows how important it is to send long-lived orbiters and probes to Mars.

The seasonally changing finger-like surface flows were first reported two years ago on mid-latitude southern slopes. These features are typically less than 5 m (16 ft) wide that appear and extend down steep, rocky slopes during spring through summer, then fade in winter to return again the next spring. These slopes stretch as long as 1,200 m (4,000 ft.)

Five sites with these markings are in Valles Marineris, the largest canyon system in the solar system. At each site, the features appear on both north- and south-facing walls. On the north-facing slopes, they are active when those slopes get the most sunshine. The counterparts on south-facing slopes start flowing seasonally when more sunshine hits their side. We have no direct evidence of water, as yet. Dissolved salts can keep water melted at temperatures when purer water freezes, and they can slow the evaporation rate so brine can flow farther.

Impacts of small asteroids or bits of comets dig many fresh craters on Mars every year. Twenty fresh craters have exposed bright ice previously hidden beneath the surface. Five were reported in 2009. The 15 newly reported ones are distributed over a wider area in all directions.

"The more we find, the more we can fill in a global map of where ice is buried," said Colin Dundas of the U.S. Geological Survey in Flagstaff, Ariz. "We've now seen icy craters down to 39 degrees north, more than halfway from the pole to the equator. They tell us that either the average climate over several thousand years is wetter than present or that water vapor in the current atmosphere is concentrated near the surface. Ice could have formed under wetter conditions, with remnants from that time persisting today, but slowly disappearing."

The growing set of data from a series of orbiters studying Mars continually since 1997 covers nearly nine Martian years (each almost two year, 687 Earth days long.

The dust cycle is a main driver of the climate system, so that a key question is why dust storms encircle Mars in some years and not in others. "These storms affect annual patterns of water vapor and carbon dioxide in the atmosphere, freezing into polar ice caps in winter and replenishing the atmosphere in spring. Identifying significant variations in annual patterns requires many Martian years of observations.

Data from long-term studies will help future human explorersknow where to find resources such as water, how to prepare for hazards such as dust storms, and where to be extra careful about contamination with Earth microbes. ##

HUMANS TO MARS

Details of 1st Private Manned Mars "Flyby" Mission Unveiled

Nov. 20, 2013 - http://www.space.com/23671-**inspiration-mars-manned-flyby-mission-details**.html
http://www.space.com/19990-**mars-and-back-in-501-days-video-animation**.html
The **Inspiration Mars Project** is revealing exactly how it plans to launch two married astronauts on an ambitious manned flyby mission to the Red Planet by early 2018, a scenario that would involve NASA and federal funding plus very hardy pioneering spirit. Led by multimillionaire Dennis Tito, the world's first space tourist — hopes to use NASA equipment and expertise as well as government funding ("perhaps several hundred million dollars") to set off for Mars in early January 2018.

In the proposal, begin human exploration of the solar system and affirm America's leadership throughout the world." A married couple (with no dependents, should they not return) would set off for Mars in the Dec. 25, 2017 – Jan. 5, 2018 "drop dead" launch window. The mission could not be flown at any other time as the mission architecture takes advantage of a rare favorable alignment of Mars and Earth which would not recur for some time.

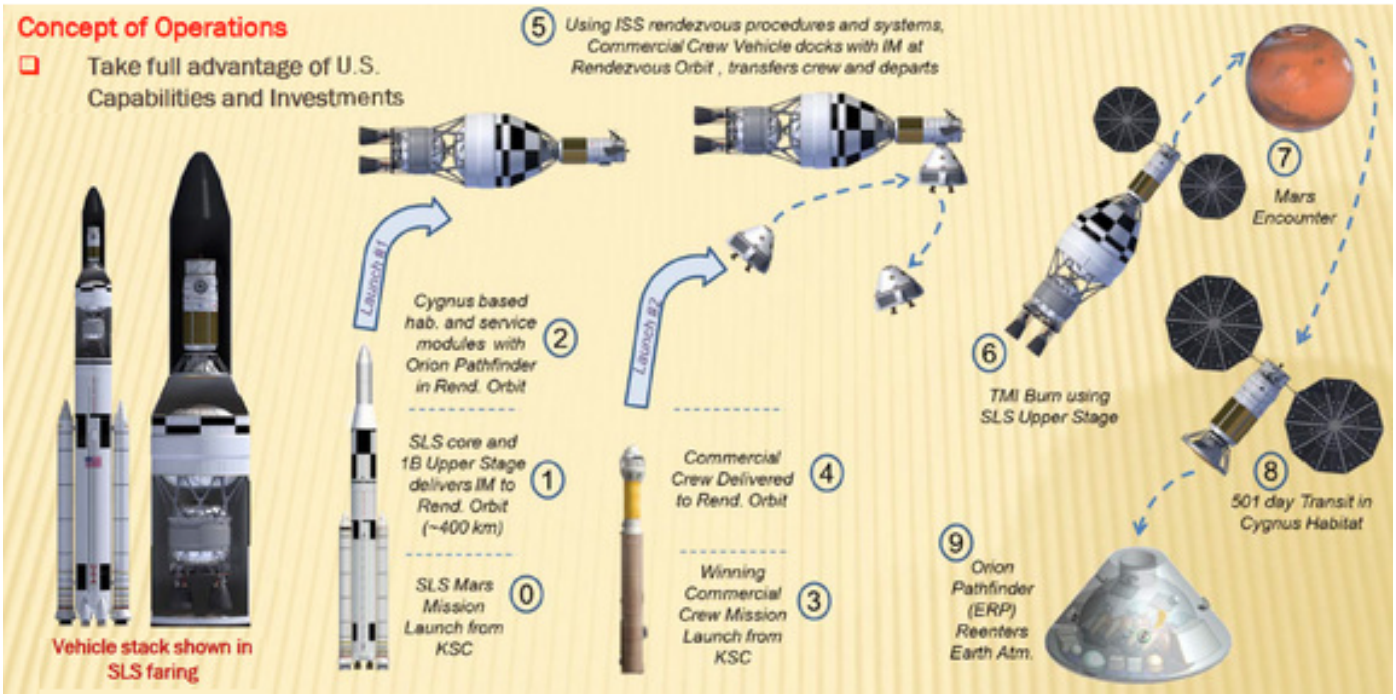
The couple would not land on the Red Planet but would cruise within 150 km (100 mi) of its surface (which would be turned away from the Sun, plunged in darkness, then head back home, landing back on Earth in May 2019 after spending 501 days in space. The rationale is that this flyby mission would help inspire the next generation of researchers and engineers, and preserve the country's competitive edge in science and technology, as well as lay the foundation for even more ambitious manned missions.

The current mission plan calls for using NASA's not yet ready "Space Launch System" now in development with a first flight slated for late 2017. That date could easily slip and dependence on a rocket now on the drawing boards is the weakest part of the plan.

The mission would require two launches in quick succession. In the first liftoff, an SLS would loft four payloads to Earth orbit: an SLS upper-stage rocket; a 600-cubic-foot habitat module derived from Orbital Sciences' Cygnus cargo vessel; a service module that would support the habitat module with power, propulsion and communications systems; and an Earth re-entry pod, which would be based on NASA's (Boeing's) Orion capsule, yet to be flown. No alternative to SLS is mentioned in the article.

In the original rollout, a Bigelow 330 inflatable module was envisioned as crew quarters. This idea has apparently been dropped, a sign that the 330 may not be ready by the drop dead deadline. The 330 would have provided superior radiation shielding to the Cygnus craft that replaces it. This is not a good sign.

The second launch — using a commercial rocket — would deliver the two astronauts to orbit aboard a yet-to-be-selected private spaceship. The couple would then transfer to the habitat module, and the SLS upper stage would propel them on toward Mars. They would transfer to a reentry pod hours before an ocean landing. The re-entry pod will have to protect the astronauts from the blazing heat generated when it slams into Earth's atmosphere at about 51,500 km/h (32,000 mph) – a higher velocity than in any Apollo mission. The current plan emphasizes the use of technology already proven or in development whenever possible.



Who will go? Willing couples without dependents (should the couple not return safely) are already applying, one of whom the editor has had the privilege of knowing for over 15 years, Dennis and Claudia Chamberland of the **Atlantica Expeditions** project to pioneer a permanent habitat on the ocean floor.

http://UnderseaColony.com

Ongoing Coverage TTSIQ #3, April 2012, reported on the Inspiration Mars Project when it was first announced, Dave Dunlop and Peter Kokh taking pessimistic, and positive positions respectively in the articles section. **http://www.nss.org/tothestars/ToTheStars_003_2013apr.pdf**

News Report on the project – pages 15-16; Editorial comments – pages 33-39 ##

Mars One Project Unveils Details of 1st Private Robotic Mission

December 10, 2014 - http://www.space.com/23899-**private-mars-colony-robotic-mission-2018**.html

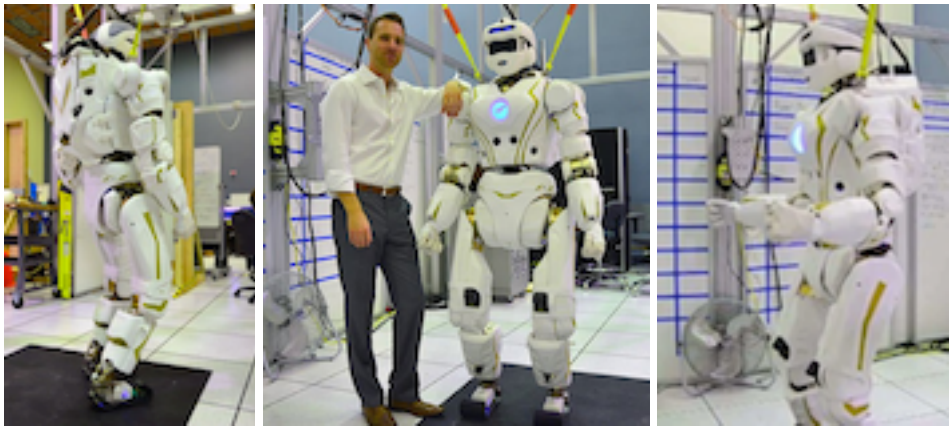
The non-profit Mars One foundation has inked deals with Lockheed Martin Space Systems and Surrey Satellite Technology Ltd. (SSTL) Under the plan, **Lockheed Martin will build the Mars One lander**, , and **SSTL will build a communications satellite**, both **planned to launch in 2018** — two years later than initially planned. The first four volunteers, committing to remain on Mars permantly will arrive a few years later according to current plans.

http://www.space.com/23894-**mars-one-lander-spacecraft-explained-infographic**.html

http://www.space.com/20764-**how-to-die-on-mars-the-mars-one-project-explained-video**.html

Robots will arrive on Mars first to Prepare a Site for Humans
Meet NASA's 1st Walking Robot

Dec. 11, 2013 - http://www.space.com/23929-**nasa-valkyrie-humanoid-robot**.html



> Mars related Videos <

Mars Underground:

http://www.space.com/23525-**why-is-mars-a-desert-wasteland-nasa-maven-mission-will-investigate-video.**html

http://www.youtube.com/watch?v=WGgW45PgTuI

http://www.space.com/23885-**curiosity-mars-radiation-not-too-high-for-humans-but-video.**

http://www.space.com/20250-**curiosity-finds-ancient-mars-habitable-opportunity-not-so-much-video**.html

India's Mangalyaan mission to Mars - http://www.youtube.com/watch?v=whjipGPAHIE

http://www.space.com/23424-**amazing-3d-mars-video**.html

http://www.space.com/23373-**huge-martian-landforms-detail-revealed-by-european-probe-video.**html

http://www.space.com/23445-**mars-missions-superfast-propulsion-incredible-technology**.html

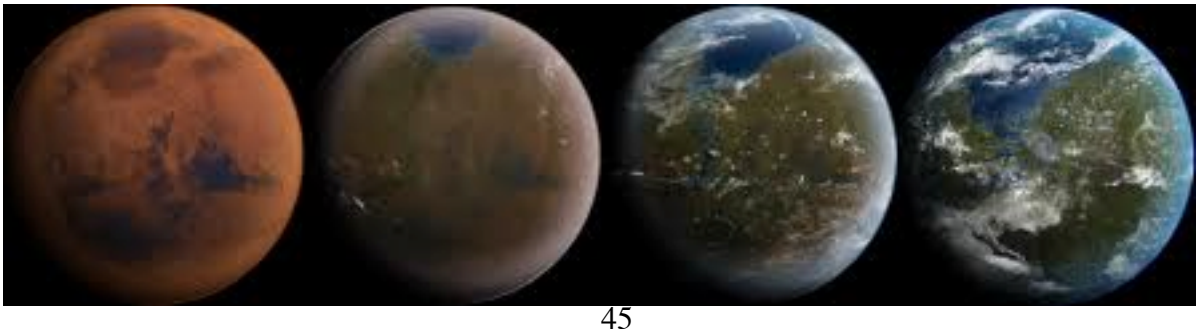
www.**youtube**.com/watch?v=XOPUdZtnt24 Oct 28, 2013 - Uploaded by European Space Agency, ESA

"From the highest volcano to the deepest canyon, from impact craters to ancient river beds and lava flows"

http://spaceinvideos.esa.int/Videos/2013/12/**Mars_360_the_north_pole**

Artist visions of Mars in the process of "terraforming"

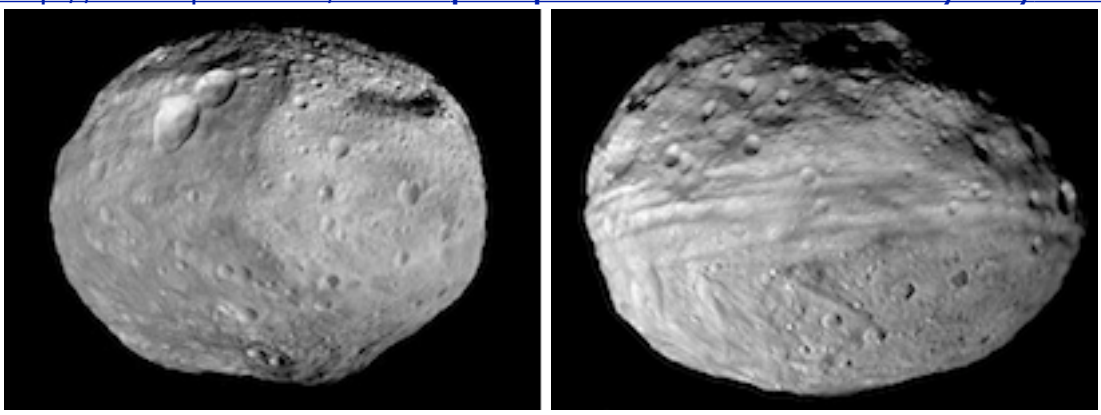
http://www.youtube.com/watch?v=sKPrwY0Ycno Mars billions of years ago, and today



[The articles below have been summarized by the editor. For the full text, see the links cited.]

Mystery of Vesta's Origin Deepens

http://www.space.com/23488-**protoplanet-vesta-formation-mystery**.html



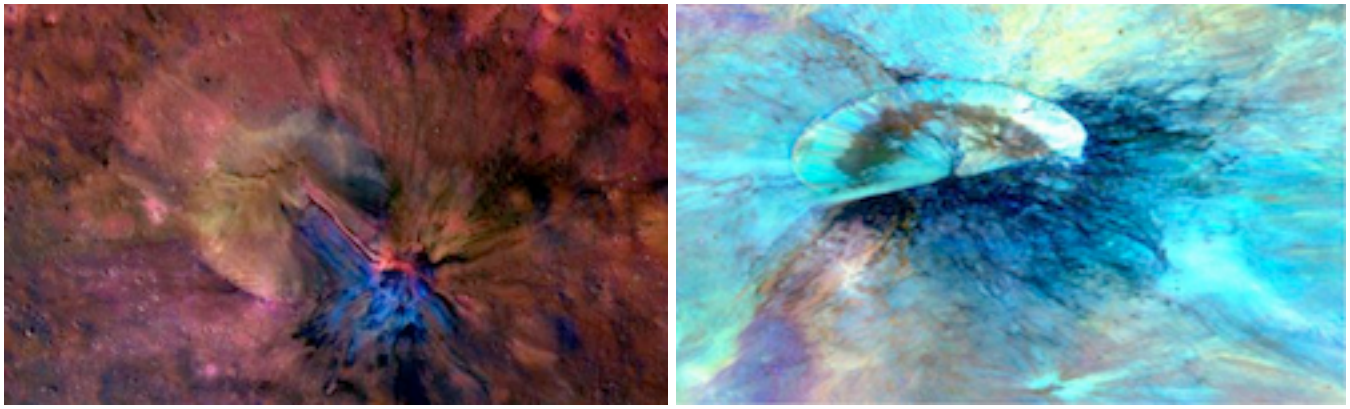
November 8, 2013 - The discovery of mysterious rocks on Vesta, deepens the mystery of its origins. Vesta is the second-largest asteroid in the solar system. The 530-km (330-mi) wide "protoplanet is also the brightest large asteroid, with a surface about three times more luminous than the Moon.

Vesta's large size and mass helped it retain the heat of formation, so that lighter molten rock floated outward while denser rock sank inward. The result is an an onion-like structure like Earth's, differentiated into an outer crust, a central core and a mantle layer in between. Impacts by smaller astro chunks regularly blast rocks off Vesta.

Meteorites known as diogenites are thought to come from Vesta's mantle or lower crust, and sometimes possess substantial amounts of the green mineral olivine, a major ingredient of Earth's upper mantle. So scientists examining data from the Dawn probe expected to find olivine in places on Vesta where large impacts unearthed deeply buried rocks. We have indeed spotted olivine on Vesta, but not where we expected, in Vesta's deep southern craters, but surprisingly near shallower northern craters, mixed with the most common type of rock found on Vesta's surface. This suggests olivine might exist within Vesta's crust instead of deeper within its mantle. The mystery deepens. ##

Color-Keying Gray Images of Vesta Reveal Unnoticed Geological Structures

Dec 20, 2013 - http://www.space.com/24036-**asteroid-vesta-images-dawn-spacecraft**.html



Left: This composite image of the **crater Aelia**, reveals the flow material on the inside and outside
Right: Crater Antonia 17 km (11mi) wide in the enormous southern hemisphere Rheasilvia basin

By matching the camera's seven color filters to various wavelengths, scientists have revealed geologic structures invisible to the naked eye while also creating images of Vesta that seem more like works of art. In effect, this method "overhauls" the views of Vesta that have become familiar.

Because minerals affect wavelengths of light differently, the filters revealed differences in the composition of the asteroid that might otherwise have gone unseen. The new images reveal geologic structures such as buried craters, impact melts, and material carried in by falling space rocks.

Vesta and Dawn are ancient objects that have undergone very different evolutionary paths. Mission scientists hope that Dawn's observations of both bodies will give us insights to the early days of the solar system. The Dawn mission visited Vesta from July 2011 to September 2012 and will arrive at Ceres around the end of March 2015, the first probe to two solar-system bodies beyond Earth. ##

Dwarf Planet Ceres - 'A Game Changer in the Solar System'

http://www.spacedaily.com/reports/
Dwarf_Planet_Ceres_A_Game_Changer_in_the_Solar_System_999.html

[Abridged Article by Nola Taylor Redd for Astrobiology Magazine]Dec 26, 2013

In March of 2015, NASA's Dawn probe will arrive at the dwarf planet Ceres, the first of the smaller class of planets to be discovered and the closest to Earth. Ceres orbits the Sun in the asteroid belt between Mars and Jupiter, but is not a typical asteroid but a unique body with many similarities to Jupiter's moon Europa and Saturn's moon Enceladus, both potential abodes for life.

On August 15, Britney Schmidt, science team liaison for the Dawn Mission, and Julie Castillo-Rogez, planetary scientist from JPL, spoke in an Google Plus Hangout titled 'Ceres: Icy World Revealed?"

Ceres is a game changer in the Solar System, perhaps unique. When discovered in 1801, it was universally considered to be a planet. It orbited between Mars and Jupiter, right in a glaring gap where scientists had mathematically predicted a planet should lie.

[See "**Bode's Law**" - http://en.wikipedia.org/wiki/Titius-Bode_law]

But inconveniently, more small bodies were found to be orbiting the sun in this "gap." They were ultimately classified as "asteroids" or "minor planets" with Ceres being but the largest. In 2006, Ceres, by far the largest and most massive "asteroid" and the only truly spherical one, was upgraded to the new classification of "dwarf planet." The fact that Ceres is so round tells us that it almost certainly had to form in the early solar system, a later formation would have created a less rounded shape. Ceres also has a very low density, in comparison to rocky asteroids from the size of Vesta on down. That is a clue.

"Underneath this dusty, dirty, clay-type surface, we think that Ceres might be icy," Schmidt said. "It could potentially have had an ocean at one point in its history." Yet, among icy bodies, Ceres stands out as the closest to the Sun, close enough to feel the warmth of the star, allowing ice to melt and reform.

The Dawn probe's investigation of Ceres interior could provide insight into the early solar system, especially locations where water and other volatiles might have existed.

"**Studying the surface**

Ceres' distance has made it a challenge to study from afar. Hubble Space Telescope images have provided some insight to its surface, but have resolved features no larger than 25 km (in diameter. Several round circular spots mar the terrain, features which Schmidt said could be any one of a number of geologic terrains, including potentially impact basins or chaos terrains similar to those found on Europa. The largest of these, named Piazzi in honor of the dwarf planet's discoverer, has a diameter of about 250 km. If Piazzi is an impact basin, it would have been formed by an object about 25 km (15 mi) wide.

But there is another possible indication about the dwarf planet's surface. "It doesn't mean that Ceres hasn't been hit by something bigger than 25 kilometers."t just means that whatever is going on on Ceres has totally erased" any evidence of that. During periods of heavy bombardment early in the Solar System's history, Ceres must have ta ken some bigger hits too, but an icy surface might relax and erase the scaring evidence. Telescopes on Earth have sudied the light reflecting from Ceres and read its spectra. "The spectrum tells us that water has been involved in the creation of clay-like materials on the surface."

Astronomers have found evidence of carbonates, minerals that form in a process involving water and heat. Carbonates are often produced by living processes. The original material formed with Ceres has mixed with impacting material over the last 4.5 billion years, creating "this mixture of water-rich materials that we find on habitable planets like the Earth and potentially habitable planets like Mars."

A prime site for life?

Water is a necessary ingredient for the evolution of "life as we know it." Planets that may have once contained water, such as Mars, as well as moons that could contain it today, like Enceladus and Europa, are all thought to be ideal for hosting or having once hosted life. But, in comparison to the icy moons of Jupiter and Saturn, Ceres' closeness gives it special interest. Both Earth and Ceres use the Sun as a key

heat source, while Europa takes its heat from its tidal interaction with Jupiter. In addition, Ceres/ surface temperature averages 130 to 200 °Kelvin, compared to Earth's 300 K, while Europa is a frosty 50 to 110 K.

"At least at the equator where the surface is warmer, Ceres could have preserved a liquid of sorts, The chemistry, thermal activity, the heat source, and the prospect for convection within the ice shell are the key ones that make us think that Ceres could have been habitable at least at some point in its history.

The future of Ceres

As we learn more about Europa and Enceladus, the desire to investigate further grows stronger. But Ceres could also be a great boon for astrobiology and space exploration. It would be considerably easier and less expensive to probe Ceres' interior than those of Europa and Enceladus, although drilling through Ceres' clay crust might be more difficult than drilling through ice crusts.

Ceres could make a great launching point for missions to the outer solar system. Its smaller mass would make it easier to land on-and leave-than Mars, which could make it a good site for manned missions. But developing the needed infrastructure on Ceres to support such missions would be a challenge. The authors warn, "We have such a big planet bias, we have such a bias for things that look exactly like us," Schmidt said. In this kind of special place in the Solar System, we have a very unique object that might be telling us a lot about what we don't know about building a habitable planet."

"Ceres .. [is] .. just going to be an absolute game changer, a new window into the Solar System that we wouldn't have without going there," Schmidt said.

Shape of Huge Asteroid with 2 Moons Revealed By SETI, Amateur Astronomers

October 07, 2013 - http://www.space.com/23103-**triple-asteroid-shape-amateur-astronomers**.html

Artist's concept of the large 270 km (168 mo) wide asteroid **Sylvia** surrounded by its two satellites, **Romulus** and **Remus**. The primary asteroid of the system may have a dense, regularly-shaped core, surrounded by fluffy material. Both moons are very elongated and composed of two lobes.

October 7, 2013 - Professional astronomers have learned some key characteristics of this giant asteroid and its two moons, with help from sharp-eyed amateur astronomers, whose observations helped determine that asteroid 87 Sylvia has an irregular shape and a dense, spherical core surrounded by a layer of relatively fluffy material. The asteroid's larger moon, **Romulus**, is about 24 km (15 mi) wide.

"Combined observations from small and large telescopes provide a unique opportunity to understand the nature of this complex and enigmatic triple asteroid system," according to lead author Franck Marchis, of the SETI (Search for Extraterrestrial Intelligence) Institute in Mountain View, California.

The presence of these moons allows us to constrain the density and interior of an asteroid, without the need for a visit. "Knowledge of the internal structure of asteroids is key to understanding how the planets of our solar system formed." 87 Sylvia lies in the main asteroid belt between Mars and Jupiter.

These observations help scientists devise accurate models of the triple-asteroid system, and to predict the position of the two moons around the big "primary" asteroid at any time. These models were put to the test on January 6, 2013, when 87 Sylvia passed in front of a distant bright star, an "occultation."

Chelyabinsk Fallout: Asteroid Numbers Raise Impact Threat Stakes

http://www.space.com/23501-**russian-meteor-explosion-asteroid-threat**.html
http://www.space.com/23112-**russian-meteor-explosion-meteorites-cosmic-crashes**.html
http://world.time.com/2013/10/16/**meteorite-pulled-from-russian-lake-one-of-worlds-biggest**/

November 07, 2013 - The number of asteroids zooming close to Earth is far greater than previously believed, highlighting the need to ramp up efforts to find and track these potentially dangerous space rocks, experts say. A new analysis of the Russian meteor explosion that injured more than 1,000 people in

the city of Chelyabinsk this past February estimates that similar impacts occur about seven times more often than previously thought.

That means there could be more than 20 million near-Earth asteroids roughly 19 m (62 ft) wide — the size of the Chelyabinsk object — rather than three or four million, adding to the Russian meteor explosion's importance as a teachable moment.

Left: Impact site of the main mass of the Chelyabinsk meteorite in the ice of **Lake Chebarkul**.
Full image: http://i.space.com/images/i/000/034/179/original/impact-site-main-mass-chelyabinsk-meteorite.jpg?1383760362

Right: largest remnant of the impactor retrieved from the lake Full image: http://i.space.com/images/i/000/034/171/i02/**main-mass-chelyabinsk-meteorite**.jpg?1383759530

Out of the blue The Russian meteor caught scientists and citizens by surprise, exploding without warning on Feb. 15. The shock wave created by the blast was equivalent to about 500 kilotons of TNT and shattered windows throughout the area. More than 1,200 people to the hospital. (There were no fatalities.)

It's not surprising that there was no warning. We have discovered just 10,000 or so near-Earth objects to date, and for each of these there may be hundreds more as yet undetected. That they are so small but yet pack so much kinetic energy, is the problem.

Researchers at the University of Western Ontario in London, Ontario, Canada, "performed a global survey of recent airbursts packing at least 1 kiloton of energy. They concluded that the number of Chelyabinsk-like events — and, by extension, Chelyabinsk-meteor-size asteroids — appears to be about seven times greater than previously estimated." ##

Reconstructing the "Pre-History" of the Astrochunk that grazed Chelyabinsk

December 10, 2013 - http://www.space.com/23915-**russian-meteor-asteroid-history**.html

Scientists have pieced together the epic history of the space rock that slammed into the atmosphere over Chelyabinsk, Russia on February 15, creating a shock wave that injured 1,200 people.

The tale begins just after the solar system began shaping up 4.56 billion years ago.

Molten droplets formed within the first four million years and over the next 10 million years, these tiny pieces, along a lot of dust, coalesced into an asteroid on the order of 100 km (60 mi) wide. Textures spotted within pieces of the Chelyabinsk asteroid recovered here on Earth reveal that the rock was likely once buried several kilometers beneath the surface of this larger object, the "LL chondrite parent body".

Analysis of "shock veins" within the recovered remnant indicate that the parent body suffered a major impact about 125 million years after the solar system started forming. This "parent body" absorbed

strike after strike between 4.3 billion and 3.8 billion years ago, during the time that Earth and other planets in the inner solar system were also pummeled, a period known as the "late heavy bombardment.")

After this period, the LL chondrite parent body apparently was left alone for a few billion years. But meteorite fragments record evidence of two more large impacts in the last 500 million years, with one of them coming between 30 million and 25 million years ago.

Then something happened with consequences for people on Earth as well. "The meteoroid then experienced a gravitational resonance in the asteroid belt that altered its orbit, so at that point, it moved from being a main-belt asteroid to being a near-Earth asteroid."

Work published a few months ago indicates that the Chelyabinsk asteroid remnant was exposed to space just 1.2 million years ago, suggesting another impact around that time. This collision perhaps finalized the size of the space rock, which is thought to have measured about 20 m (65 ft) wide when it entered Earth's atmosphere. And finally, one more collisional event, over Chelyabinsk on Feb. 15, 2013

Other fragments of that parent LL chondrite still exist out in the depths of space, such as 640 m (1,770 ft) long asteroid Itokawa - http://en.wikipedia.org/wiki/25143_Itokawa - visited by Japan's Hayabusa spacecraft visited in 2005, gathering samples that were returned to Earth five years later. ##

http://www.space.com/19959-**russian-meteor-explosion-all-you-need-about-chelyabinsk-s-surprise-space-rock-video**.html

http://www.space.com/19965-**russian-meteor-fragments-found-origin-calculated-video**.html

http://www.livescience.com/15445-**fallen-stars-gallery-famous-meteorites**.html

http://en.wikipedia.org/wiki/**Chelyabinsk** - pop 1,150,000 -1500 km (940 mi) ESE of Moscow

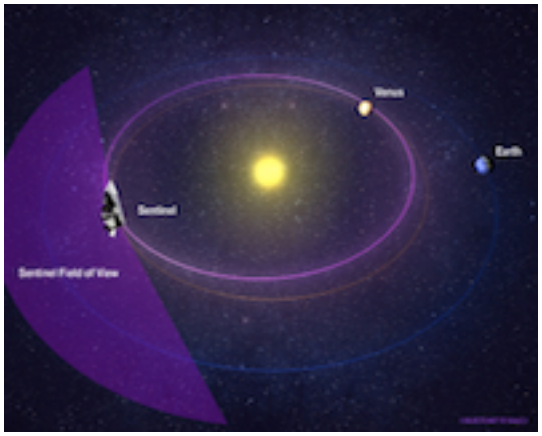
Asteroid Threat: Cutting Through Red Tape To Save The World + VIDEO
The "Sentinel" Mission

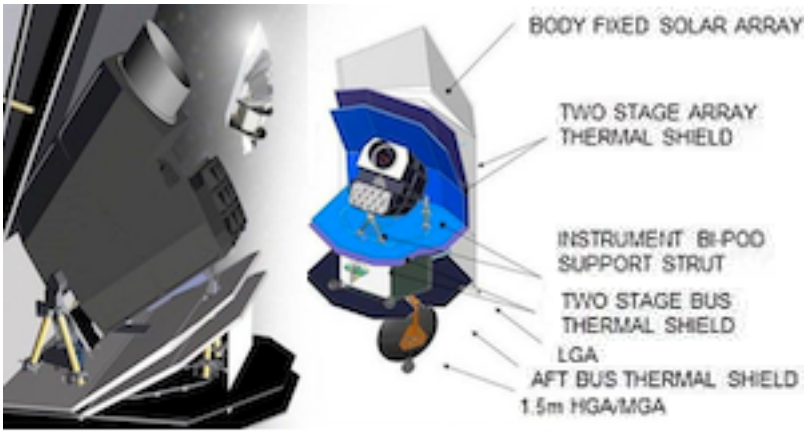
www.space.com/23346-**asteroid-threat-cutting-through-red-tape-to-save-the-world-video**.html

http://b612foundation.org/**sentinel-mission**/

http://www.space.com/23344-**asteroid-threat-earth-united-nations-response**.html

www.nbcnews.com/science/**asteroid-activists-launch-fund-raising-campaign-space-telescope**-850974





Left: Sentinel's orbit around the Sun Right: Sentinel Infrared Telescope

Oct 25, 2013 - **The B12 foundation wants to put an infrared telescope** (only way to spot most of the potential doomsday impactors) **into orbit around the Sun**, raising funds privately and publicly to do this.

Japan Test-Fires 'Space Cannon' to Shoot Asteroid

October 24, 2013 http://www.space.com/23320-**japan-test-fires-space-cannon-hayabusa2**.html

Credit: JAXA/Akihiro Ikeshita

A "space cannon" scheduled to fire a metal bullet at an asteroid in 2018 that is the target of Japan's Hayabusa 2 mission has been successfully tested. The mission is planned for a 2014 launch and the purpose of the cannon is to create a cloud of samples that the probe can collect and return them to Earth. The original Hayabusa mission collected dust from an asteroid, returning to Earth in 2010, but now JAXA scientists are hoping to use the space cannon to get a better look at the interior of a space rock.

Earth's Water Likely Came from Very Early Asteroid Strikes

http://www.space.com/23336-**earth-water-origin-asteroid-impacts**.html

October 25, 2013 - Earth got most of its water from asteroid impacts nearly 4.6 billion years ago, shortly after the solar system first took shape. A new study of a meteorite that fell to Earth in 2000 found evidence that the water in its parent asteroid had disappeared soon after the rock had formed, when it was still warm inside. In contrast, asteroids that bombarded Earth and the Moon and other inner system rocky planets several hundred million years after the solar system's birth during the period of late heavy bombardment from 4.1 billion years to 3.8 billion years ago were thus probably relatively dry. The conclusion is that Earth's water was supplied by "still wet" asteroids 400-600 million years earlier, shortly after (relatively speaking) Earth was formed.

Comets Encke & Ison fly by Mercury, studied by Messenger Mercury Orbiter

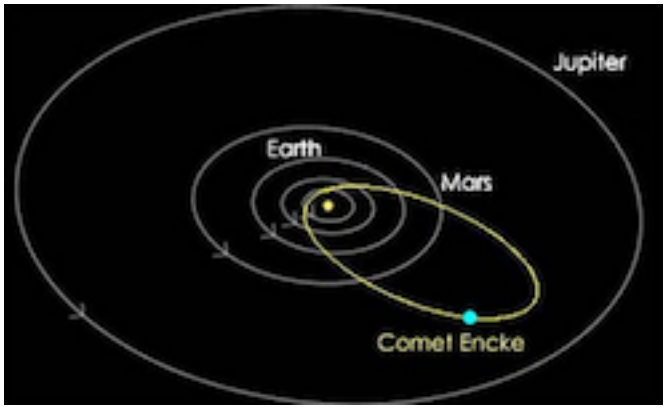
"A Unique Coincidence" - NASA

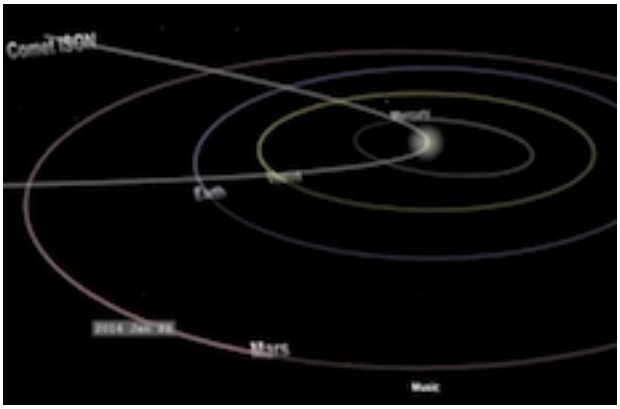
http://www.spacedaily.com/reports/

MESSENGER_Detects_Comets_ISON_and_Encke_Prepares_For_Closer_Encounters_999.html

http://science.nasa.gov/science-news/science-at-nasa/2013/15nov_**twocomets**/

http://earthsky.org/space/**video-two-comets-fly-by-mercury-november-18-and-19**





On November 18, 2013, **Comet Encke** passed within 0.025 AU of Mercury, followed a day later by **Comet Ison** at 0.24 AU (1 AU is the distance between the Sun and Earth, 150 million km, 93 million mi).

NASA's MESSENGER spacecraft, orbiting Mercury, turned away from the planet, and toward the passing comets. "a unique coincidence and a golden opportunity to study two comets passing close to the Sun."

Why ~~is~~ (was) Comet ISON Green?

http://phys.org/news/2013-10-**comet-ison-green**.html

[http://www.wnd.com/files/2013/10/comet-ison-tucson-20131007-600.jpg]

October 25, 2013 - Some readers may have recent images of Comet ISON as it approached its close encounter with the Sun on November 28.. But you might wonder why many images show the comet with a greenish "teal" or blue-green color.

The green color is actually a good omen, and lots of comets display this color. It is a sign the comet is getting more active as gets closer to the Sun – meaning it is now putting on a good show for astronomers, and if it can continue to hold itself together, it might become one of the brightest comets in the past several years.

"ISON's green color comes from the gases surrounding its icy nucleus," says SpaceWeather.com's Tony Phillips. "Jets spewing from the comet's core probably contain cyanogen (CN: a poisonous gas found in many comets) and diatomic carbon (C2). Both substances glow green when illuminated by sunlight in the near-vacuum of space." Both are normally colorless gases that fluoresce a green color when excited by energetic ultraviolet light in sunlight. Not to worry! Those poisonous gasses are spread out in space much too thinly to touch us here on Earth. ##

Comet Ison Seemed to have Vaporized in Close Pass around the Sun. But Ison's "Ghost" seen by two spacecraft

November 29, 2013 - http://www.stuff.co.nz/science/9457374/ISON-**Comet-vaporised-by-sun**
December 2, 2013 - http://www.space.com/23795-**comet-ison-s-ghost-seen-by-two-spacecraft-videomet_ison_ghost**_stereo_soho.html

At first, it seemed that comet's 5.5-million-year journey to the inner solar system ended during a suicidal trip around the Sun, leaving no trace of its once-bright tail or even remnants of rock and dust, scientists said. The comet, known as ISON, was discovered last year when it was still far beyond Jupiter, raising the prospect of a spectacular naked-eye object by the time it graced Earth's skies in December. Comet ISON passed just 1.2 million km (700,000 mi) from the surface of the Sun.

Astronomers used a fleet of solar telescopes to look for the comet after its slingshot around the sun, but

At closest approach, the comet was moving faster than 350 km/s (217 m/s) through the sun's atmosphere. At that distance, it reached temperatures of 2,760 °C (5,000 °F) - hot enough to vaporise not just ices in the comet's body, but dust and rock as well.

If the comet or any large fragments survived the close encounter with the sun, they might be visible to the naked eye in Earth's skies in a week or two.

Comets are believed to be frozen remains left over from the formation of the solar system some 4.5 billion years ago. Ison was discovered last year by two amateur astronomers using Russia's International Scientific Optical Network, or ISON. Computer models show ISON was a first-time visitor.
http://www.theglobeandmail.com/news/world/**comet-ison-pulls-a-disappearing-act-after-close-approach-to-the-sun**/article15654037/

Excitement began building on Thursday morning, Thanksgiving Day, November 28th, as the comet pulled into view of the Solar and Heliospheric Observatory (SOHO), a joint U.S.-European satellite that has previously spotted many "sun-grazing" comets. Other comets with similar orbits have become truly spectacular for skywatchers on Earth, in particular the Great Comet of 1680, which was one of the brightest of all time. That now seems unlikely to happen with ISON.

A breakup, if captured by NASA's cameras, could reveal important scientific information about the comet's structure. Any debris from the comet would be subjected to temperatures of about 2,700 degrees Celsius (5,000 °F). Any light or emission detected would provide details about the comet's elemental composition. Although ISON is not the only comet to have been lost through solar immolation, it remains one of the most interesting and best observed among sun grazers.

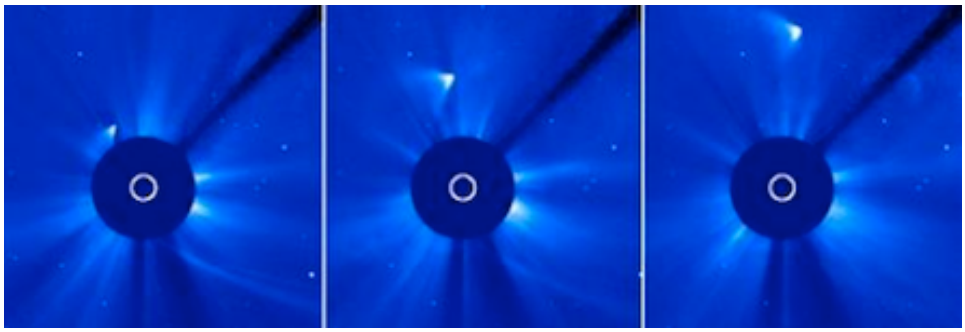
Millions of people watched on the Internet as the comet disappeared on schedule but then failed to reappear. It was quite a disappointment, as Ison would have been easier to see from the Northern Hemisphere after passing behind the Sun than before, as it approached the Sun from well below the ecliptic – the plane in which the planets orbit around the Sun.

Editor's comment: The common belief by astronomers that comets visiting the inner solar system were displaced from the Oort cloud by a passing star has always seemed to me to make no sense. If a passing star disturbed one comet, it should have disturbed many, and over a long period as stars pass one another very very very very slowly over many thousands of years. It seems just as likely or unlikely that the Sun is passing the fringe of an Oort cloud around another star. Which stat passes which is totally relative..

Comets in the Oort cloud have a very high angular momentum. For every comet that loses almost all of that momentum in order to head straight for the sun, there must be millions or billions more disturbed into orbits that do not bring further in than the Kuiper belt. A little bit of math should show that the traditional theory holds no snow. ##

Video (set to funeral parlor music):
http://www.space.com/23777-**rip-comet-ison-icy-visitor-missing-after-sun-flyby-video.html**

Does Ison remnant live?: http://phys.org/news/2013-11-**comet-ison-survive**-scientists-tiny.html
http://www.space.com/23780-comet-ison-survival-sun-roasting.html#
http://www.space.com/23782-**comet-ison-is-alive-survives-sun-swing-video.html**
http://www.space.com/23795-**comet-ison-s-ghost-seen-by-two-spacecraft-videomet_ison_ghost_stereo_soho**.html



In this combination of three images provided by NASA, comet ISON appears as a white smear heading up and away from the Sun on Thursday and Friday, Nov. 28-29, 2013. ISON was not visible during its closest approach to the sun, so many scientists thought it had disintegrated, but images like this one from the ESA/NASA Solar and Heliospheric Observatory suggest that a small nucleus may still be intact. (AP/NASA)

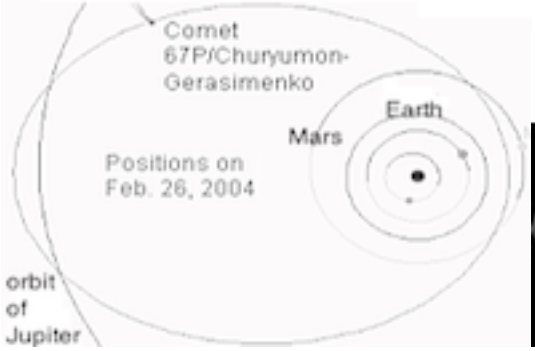
Latest assessment: Dec 10 2013 - http://www.space.com/23916-**comet-ison-dead**-sun-flyby.html

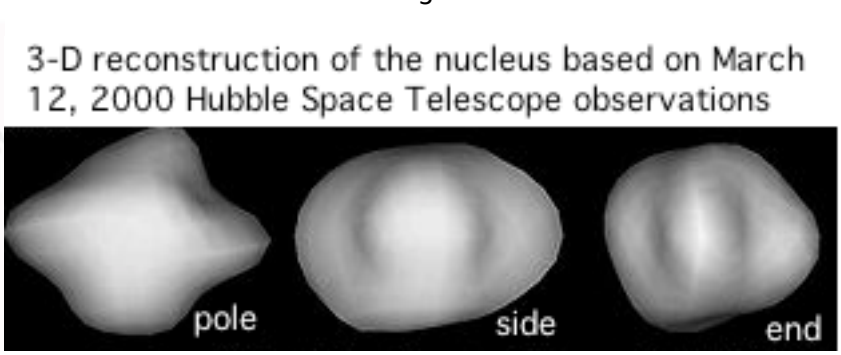
Rosetta to visit Comet 67P/Churyumov-Gerasimenko Nov 2014

http://www.esa.int/Our_Activities/Space_Science/**Rosetta**/**Comet_67P_Churyumov-Gerasimenko**
http://www.bbc.co.uk/news/science-environment-24134698

Mission Video: www.esa.int/Our_Activities/Space_Science/Rosetta/**Rosetta_100_days_to_wake-up**

11 October 2013 - ESA's comet-chasing mission Rosetta will wake up in 100 days' time (Jan 20, 2014) from deep-space hibernation to reach the destination it has been cruising towards for a decade.



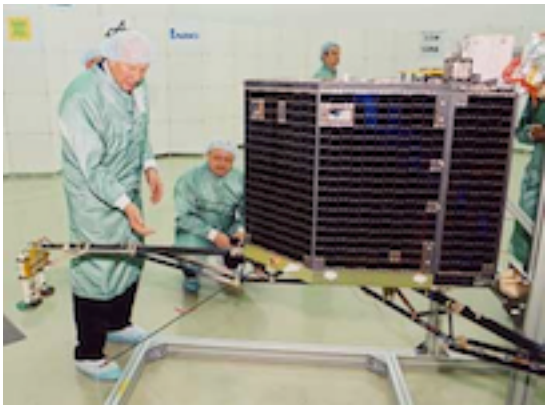


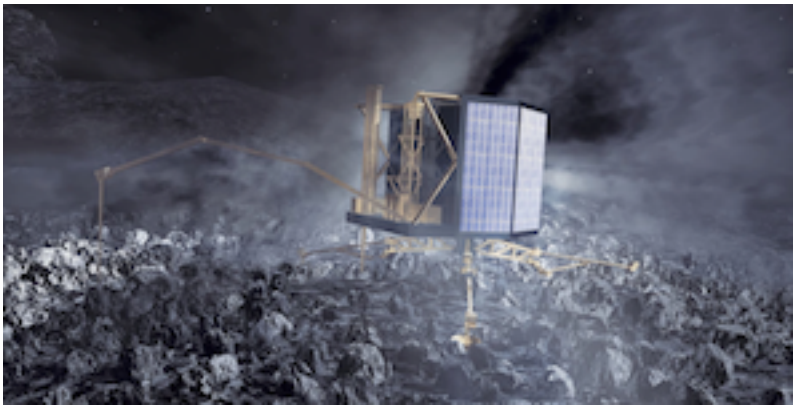
Diameter of nucleus	4 km (2.5 mi)
Orbital period	6.6 years
Minimum distance from Sun	186 million km (115 million mi)
Maximum distance from Sun	857 million km (532 million mi)
Orbital eccentricity	0.6
Orbital inclination	7.1°
Year of discovery	1969
Discoverers	K. Churyumov, University of Kiev, Ukraine
	S. Gerasimenko, Inst Astrophysics, Dushanbe, Tajikistan
Wakeup	January 20, 2014 10:00 UTC
Arrival & Start of global mapping	August 2014
Lander probe deployed	November 2014 -- Mission end December 2015

The Mission: This European Space Agency probe was launched way back in 2004 and has spent the past nine years working its way out to the orbit of Jupiter, to chase down Comet 67P/Churyumov-Gerasimenko.

The plan is for Rosetta to circle and track this comet as it sweeps in towards the Sun. The exciting part, however, will be the deployment of the probe's **Philae lander** which will attempt to lock down on 4km-wide 67P and ride it (Philae has screws and harpoons to hold it down.)

How long Philae will be able to withstand any outgassing as the ices heat up on approach to the Sun is anyone's guess. Will 67P be a "bucking bronco?" Named after its 1969 discoverers Klim Churyumov and Svetlana Gerasimenko, it is a "Jupiter class" comet taking 6.45 years to orbit the Sun: see table above for orbit information.





L: Assembled Lander **R:** Artist view of probe on surface of comet

Its icy core is about 4 km across and rotates every 12 hours and its shape is reasonably well known (3 views above). There are three key active regions. ##

ESA Launches Wake-Up Call Contest for Comet-bound Spacecraft

Dec 11, 2013 - http://www.space.com/23933-**rosetta-comet-spacecraft-wake-up-call**.html

Contest closes January 20, 2014

In August 2014, the ESA's **Rosetta** Spacecraft [Left, above] will rendezvous with **Comet 67P/ Churyumov-Gerasimenko** and deploy its **Philae lander** [Right, above].

The European Space Agency is **asking comet fans around the world to create a special video message to rouse the Rosetta spacecraft under the new 'Wake Up Rosetta' campaign.**

The project invites everyone to create and share **a video clip of themselves, alone or in a group, shouting "Wake Up, Rosetta!"** The top 10 selections will receive prizes, including **having their message transmitted to Rosetta as it closes in on its target.** Contestants can post their videos to the ESA's Facebook page, where other users can vote.

https://www.facebook.com/EuropeanSpaceAgency

http://www.esa.int/Our_Activities/Space_Science/**Rosetta/Comet_67P_Churyumov-Gerasimenko**

http://en.wikipedia.org/wiki/67P/**Churyumov%E2%80%93Gerasimenko**

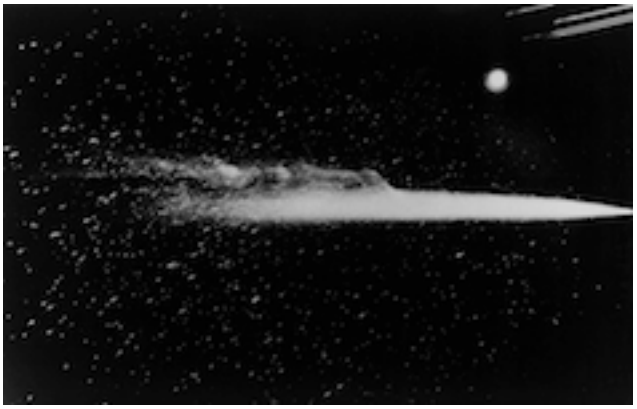
'Comets of the Centuries': 500 Years of the Greatest Comets Ever Seen

http://www.space.com/24069-**greatest-comets-of-past-centuries**.html

The greatest comets of the 16th, 17th, 18th, 19th, and 20th Centuries
[The Greatest Comet of the 21st Century? To be determined!!]

Photos of Halley's Comet Through History

http://www.space.com/11552-**photos-halleys-comet-images-astronomy**.html

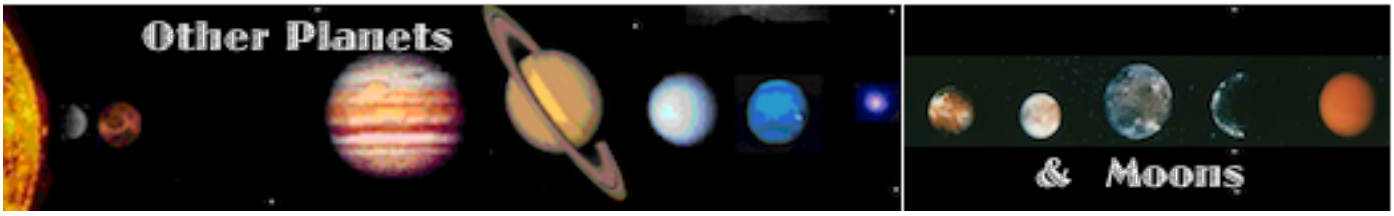


May 13, 1910

1986

January 13,1986

March 13, 1986



[The articles below have been summarized by the editor. For the full text, see the links cited.]

CUBESATS TO THE MOON, MARS ... ANYWHERE IN THE SOLAR SYSTEM?

Bottle Rockets: Water Could Propel Future Tiny Satellites into Deep Space

What this article is NOT about

http://exploration.grc.nasa.gov/education/rocket/**BottleRocket**/about.htm
http://www.**bottlerockets**music.com

What this article IS about

http://www.tasnimnews.com/English/Home/Single/210226
http://www.satnews.com/story.php?number=249803502

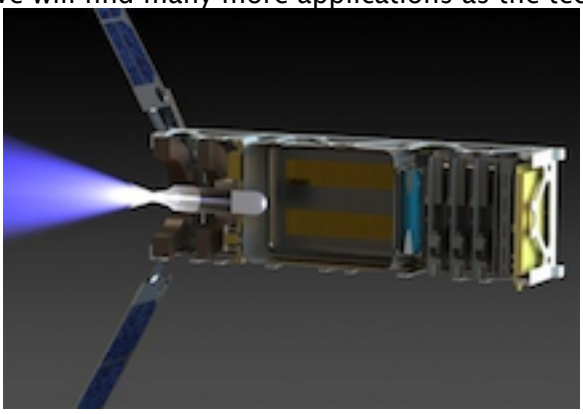
This story comes out of Tehran (Tasnim), but is about technology being developed in the US December 03, 2013 - Since the CubeSat specification was developed in 1999 by Stanford and California Polytechnic, low-cost satellites have become a reality for academic institutions and companies around the world. Their standardized dimensions and off-the-shelf components make for simpler design and production.But there's a problem: these 10-cm cubes have been limited by Earth's orbit.

Now, a team of researchers wants to make interplanetary exploration more affordable by crowdfunding the development of a novel thruster that uses water as its propellant. Their **CubeSat Ambipolar Thruster**, or **CAT**, works in a similar way to existing rocket thrusters — by heating up a propellant and expelling it through a nozzle. The CAT will heat its propellant "to millions of degrees instead of thousands of degrees," says project leader Ben Longmier from the University of Michigan. This extremely high temperature turns it into plasma, which is guided through a magnetic nozzle. This extremely high temperature translates to high efficiency of the engine, which, combined with its small size and simple components, also makes it very cheap.

Going beyond Earth Orbit has up till now, been an expensive task. Longmier's team is seeking just $50,000 US to develop their thruster, which can then be attached to a regular CubeSat to send it far beyond Earth's orbit, opening new horizons and destinations for small satellites and probes.

Potential uses for the technology

- Observe the atmospheres of other planets
- Gather far more data on solar flares, making space weather more predictable
- Identify and tag objects in the asteroid belt for mining or exploration
- Search for life on the watery moons of Saturn and Jupiter
- Create an interplanetary internet.
- We will find many more applications as the technology matures



The risky side

In the lab, things break and arc and melt. It's easy to fix and you're off running again. In space, if it breaks it's likely dead."This won't as much of a problem with the CAT thruster as with a billion-dollar craft, as another model can be launched at low cost. But running out of funding before the engine becomes operational is a real risk. That's why the team has taken to Kickstarter to raise funds for its endeavor.

Funding Goals: From basic to more ambitious

A first attempt at raising $200,000 for the project failed this past August, managing to gather just $68,000 before the deadline. Now, the team has launched a second crowdfunding drive with a lower target of $50,000 that'll allow — with the help of some private investors — for the creation of a minimum viable thruster. The idea is to get the project moving, and then worry about the rest of the funding later.

With more money, this preliminary thruster can become more advanced. Raising $80,000 means increased efficiency of the nozzle, while $500,000 would allow the team to increase the throttle range. And if funding reaches $1,750,000, topping the funding gathered for the Arkyd Space Telescope, then the team will send CAT into deep space, allowing backers to vote on its destination.

Says Sara Seager, a professor of Planetary Science and Physics at MIT "By giving interplanetary capability to small satellites, they'll open up interplanetary space to a wide variety of people [including] traditionally non-space-faring nations." For more, read the unabridged article, linked above. ##

MERCURY

Messenger probe searches for moons of Mercury, as yet undiscovered

July 22, 2013 - http://www.spacedaily.com/reports/MESSENGER_to_Capture_Images_of_Earth_and_Moon_During_**Search_for_Satellites_of_Mercury_999.html**

Excerpts from the article linked above

[snip] "We don't know why Mercury does not have a moon," said William Merline, of the Southwest Research Institute (SwRI) in Boulder, Colorado, who, along with SwRI's Clark Chapman, leads MESSENGER's investigation of small bodies orbiting Mercury and in the inner solar system.

"It may have been just unfortunate in not having the right history, in terms of collisions," Merline continued. "Or it may at one time have had a moon in an orbital trajectory that was disrupted by the strong gravitational pull of the Sun, in combination with Mercury's highly eccentric (oblong) orbit around the Sun.

"Such an orbit makes the effect of the Sun's gravity highly variable with time, and may degrade the conditions for stability of a moon's orbit. But these possibilities are only speculations, based on theoretical ideas. To complete the picture, we must search for the existence of satellites to validate any of these suggestions."

[snip] "In February, 2013, MESSENGER, which began orbiting Mercury in March 2011, conducted its first search for satellites, and those data are still being studied. This search takes place during Mercury's aphelion, the planet's farthest point from the Sun, a location that has the advantage that the camera will be as cold as it ever gets.

"Since we are looking for very faint objects, having a warm camera introduces thermal noise. The downside of being farther from the Sun is that any satellites will be dimmer at this time, as the Sun is their light source. So it was a tradeoff between brighter targets or a quieter detector, and we opted to go for a time when the detector would be quieter."

The team has also optimized the search pattern, taking many images at varying time intervals to spot faster-moving objects, according to Chapman. "The camera can potentially see objects as small as 100 meters, or 328 feet, in size, about the length of an American football field."

If there are any moonlets to be found, they must be quite small to have escaped detection to date.

Venus, Earth's "evil twin" also has no known satellites. As Mercury and Venus are the closest planets to the Sun, that may well have a lot to do with them orbiting solo. ##

Did Volcano on Mercury Erupt for a Billion Years?

December 6, 2013 - http://www.space.com/23868-**billion-year-erupting-mercury-volcano**.html

So close to the Sun, Mercury is subject to constant, very high solar radiation with no atmosphere of consequence to soften the ongoing blast. The planet's thick coat of meteor carved craters also shows signs of damage from within - atypically smooth plains — much like the Moon's maria — suggesting that in some places, the impact cratered crust had once been resurfaced by giant lava flows.

MESSENGER's first flyby in early 2008 captured a hazy image of a feature in the Northern hemisphere, showing a "kidney-shaped depression," clearly very different from the uniform impact cratered terrain elsewhere. This depression was surrounded by an unusually bright, reflective material, later identified as pyroclastic debris; the scientists were looking at an alien volcano.

It soon became apparent that the "crater" in the flyby image was actually several — a collection of distinct, individual depressions, rather than the single summit vent typically associated with a volcano.

But strikingly similar to a type of volcano found on Earth, a "compound volcano," caused when the location of volcanic activity "migrates" over time. But the flyby images were too coarse to allow a more detailed interpretation.

When MESSENGER returned in 2011, the kidney was back in its sights. Now in full orbit, the stabilizing influence of Mercury's gravity allowed the satellite to map the planet in great detail, Now this enigmatic volcano took on new dimensions. Several new craters, invisible during the flyby, emerged on the sharpened images — the volcano grew by 30 percent - it was more extensive than first thought.

More subtle features were revealed. The floors of the volcanic depressions were less smooth, and contained tiny impact craters. This find gave geologists the chance to do something incredible.

Contrast with Earth: Most of Earth's ancient scars have been erased by erosion or subduction of the planet's crust. But with no plate tectonics to recycle Mercury's crust, and no wind to reshape its surface, the countless meteors which have etched themselves into the planet's landscape over time provide a record useful for scientists. The density of impact craters in a given area can be used to estimate its age; roughly speaking, the more meteors which have hit, the older it is.

This 'crater-age' can also help reconstruct ancient volcanic activity. The density of impact craters within a volcanic crater is a clue to the time of its last "resurfacing" eruption. That allows us to estimate how long ago or how recently Mercury's various craters were active.

Despite being so close together, the clustered craters of the volcano had very different histories. The largest depression, in the far West of the formation, was peppered with meteor scars, suggesting that activity there had dwindled a relatively long time ago. The Easternmost craters, however, were almost pristine; it seemed that here, activity had persisted until much more recently. All this added up to an astonishing conclusion: According to the researchers, **the impact pattern suggested that activity in the volcanic complex could have lasted for billions of years.**

For contrast, a terrestrial volcano that endures a million years is considered ancient. Here on Mercury, we see a single volcanic structure that apparently had remained active for as long as there has been multicellular life on Earth. This incredible view of Mercury has raises an enticing question: Have scientists just found the longest-lived volcano our solar system?

Volcanic area  on Mercury

Full size: http://i.space.com/images/i/000/008/413/original/4-mercury-volcanoes.jpg?1299043752

VENUS

Sounding Rocket to Peek at Venus Atmosphere to see if planet was ever wet

http://www.spacedaily.com/reports/**Sounding_Rocket_to_Peek_at_Atmosphere_of_Venus**_999.html

November 27, 2013 - NASA is sending a sounding rocket to probe the atmosphere of Venus. The Venus Spectral Rocket, **VeSpR** for short lifted off from White Sands, N.M., on Nov. 25.

VeSpR is a two-stage system, combining a Terrier missile - originally built as a surface-to-air missile and later repurposed to support science missions - and a Black Brant model Mk1 sounding rocket with a telescope inside. Integration took place at NASA's Wallops Flight Facility in Virginia.

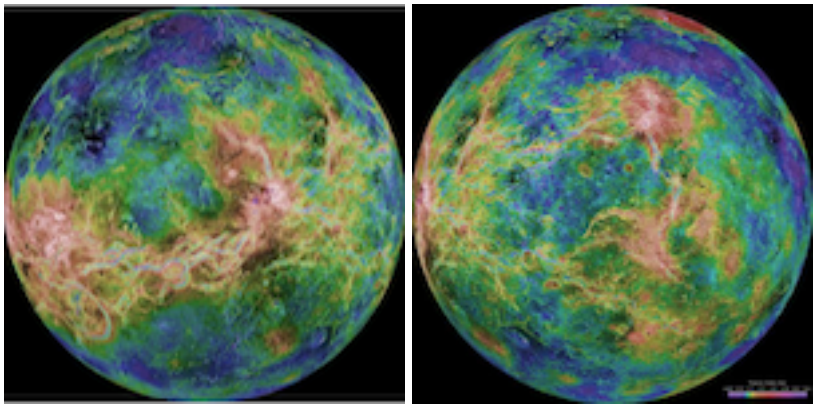
The experiments will look at ultraviolet (UV) light that is being emitted from Venus' atmosphere, which can provide information about the history of the planet's water. Measurements like these cannot be done using Earth-based telescopes because our atmosphere absorbs most UV light before it reaches the ground.

But neither do w have to send a probe to Venus to make these measurements. And that means that we don't have to wait months for a probe to reach Venus. The sounding rocket will carry the telescope

more than 110 km (65 mi) above the Earth's surface; at that altitude, our atmosphere thins out enough to permit UV readings.

Venus today has a thick atmosphere that contains very little water, but it might once have had an ocean. Scientists are still trying to determine whether water existed on the surface of Venus or only high up the atmosphere, where temperatures were cooler. If the surface temperature stayed below the boiling point of water long enough, rivers might have once flowed on the planet. Venus may have even had ice.

The key to figuring out how much hydrogen and deuterium, a heavier version of hydrogen, remain in the atmosphere. Both can combine with oxygen to make water, either in the familiar H2O form or the rarer hydrogen, deuterium and oxygen form, called HDO. (Very small amounts of D2O also form.) Intense UV light from the sun has broken apart nearly all of the water molecules in Venus' atmosphere.



False colors indicate height aboveor below the mean. If Venus ever had an ocean, it would have covered the **blue** and maybe also the **green** colored areas. The bright **tan** indicates high plateaus or mountains. Because regular hydrogen atoms in the water are lighter, they escape into space more quickly than do the heavier deuterium ones.

By comparing the amount of deuterium now in the atmosphere to the amount of hydrogen, researchers can estimate how much water disappeared from Venus and how quickly it happened. Earlier estimates, made from data collected by NASA's 1978 Pioneer Venus spacecraft and other observations, indicated Venus could have had enough ancient water to cover the whole globe with 7 m (23 feet. Not much by Earth's standards. But it turns out that the amounts of hydrogen and deuterium can vary at different heights in Venus' atmosphere, which could change the calculations. To help resolve the uncertainty, VeSpR will make measurements specifically in the upper atmosphere.

The **VeSpR** instrument will observe Venus for just 8 minutes (observing only one hemisphere) with data being transmitted in real time, before the payload returns on a parachute safely to Earth. Later, the payload will be retrieved so that the instrument can be used for future experiments. If the abundance of deuterium indicates Venus once had seas, perhaps even an ocean, that would be quite a finding. ##

NB. Venus' high/low areas do seem to suggest some water-lubricated plate tectonics in the past. PK

JUPITER

JUPITER'S MOONS

Russia "May" Land Probe on Jupiter's Moon Ganymede with Europe's Help

http://www.space.com/21622-**russia-europe-jupiter-probes**.html

Video: http://www.space.com/9933-**touring-jupiter-big-moons-io-ganymede-europa-callisto**.html

June 19, 2013 (We missed reporting on this in the July Issue.) PARIS — A Russian probe being designed to land on Ganymede, Jupiter's largest moon, "could" launch toward the gas giant with a European spacecraft being developed to explore Jupiter's icy ocean-covered satellites.

The benefits of such a joint launch arrangement, including sharing reconnaissance and mapping from **JU**piter **IC**y moons **E**xplorer (JUICE), are clear. But Earthly concerns, such as government finances and the realities of technical developments, could thwart the proposal. It all depends on if the Russians are ready to fly at the same time as the Europeans.

A 19 year wait! - a generation from now

JUICE won't **launch until 2022** and not enter orbit around Jupiter until 2030, making repeated flybys of three of its largest moons — Ganymede, Callisto and Europa (Io is not mentioned.)

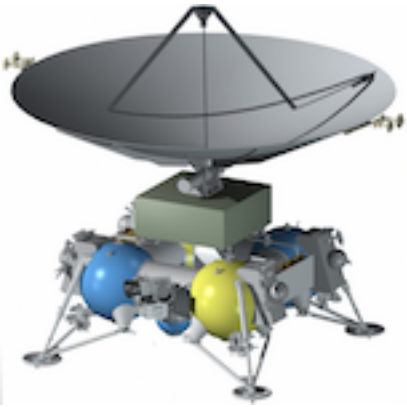
Not until September 2032, will JUICE arrive at Ganymede, the first probe to enter orbit around a moon of another planet. Equipped with radar, a mapping camera and other instruments, JUICE will

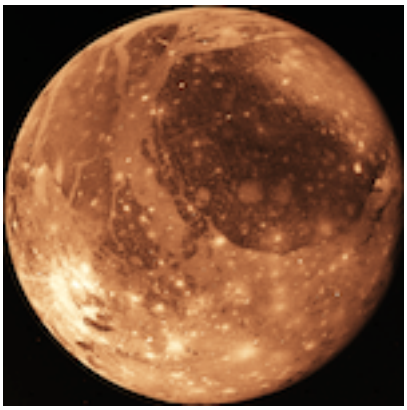
√ **Measure the thickness of global ice sheets** covering Jupiter's moons and

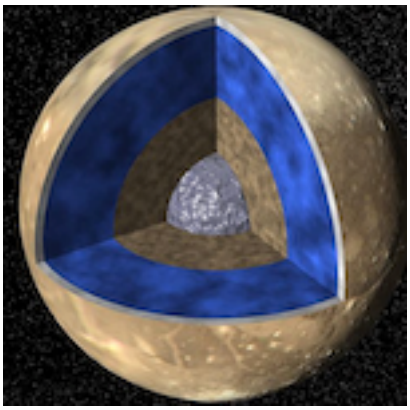
√ **Produce terrain and mineral maps** of Ganymede, as well as of Callisto, Io, and Europa.

Such data should be a rich resource for researchers as well aids for engineers planning missions to explore Ganymede's surface and study what lies beneath it's ice crust on a follow-on mission.

Russia's very ambitious plan is to implement a Ganymede Lander. The Russian mission, not yet named, has captured the interest of Europe's planetary science community.







Left: An illustration of Russia's planned Ganymede lander that could explore the Jupiter moon as part of the European Space Agency's Jupiter Icy Moons Explorer mission. Bigger image: www.space.com/images/i/000/029/930/original/**russia-ganymede-lander.jpg**?1371656908

Center: an image of one face of Ganymede. **Right:** cutaway showing thick ice crust and a voluminous ocean below, most likely the biggest body of water in the entire solar system.

Forging a partnership

If Russia becomes a full partner in Europe's JUICE mission, the development of the lander will need to be accelerated to launch in 2022, if managers want the Russian craft to ride to Jupiter as a piggyback payload. Such a partnership brings difficulties and is far from finalized. Both agencies are concentrating on the Moon and Mars first.

Europa or Ganymede?

Roscosmos initially proposed the lander target Europa, also with a frozen crust, but one thinner than that covering Ganymede. After a NASA mission to orbit Europa failed to materialize, Russia retooled the project to focus on Ganymede, falling in line with the goals of Europe's Jupiter mission.

There are numerous advantages of landing on Ganymede as opposed to Europa. The radiation environment at Ganymede is less severe than at Europa, which lies closer to Jupiter; this is one of the reasons ESA picked Ganymede as the destination for JUICE.

The scope of a potential partnership between Europe and Russia on robotic Jupiter exploration ranges from no collaboration to a completely merged program in which JUICE and the Ganymede Lander would launch from Earth together on the journey into the outer solar system.

Perhaps more likely would be a loose collaboration involving complementary scientific goals, shared development of science instruments, and the use of the JUICE mission to help select a landing site on Ganymede. It's a long way off – a generation away. Stay tuned ##

Ocean Currents Shape Europa's Icy Shell in Ways Favorable for Life:
Hidden Oceans on Jupiter's Icy Moon Europa May Explain Strange Terrain

December 5, 2013 – http://www.spacedaily.com/reports/Model_Suggests_Ocean_Currents_Shape_Europas_Icy_Shell_in_Ways_Critical_for_Potential_Habitats_999.html

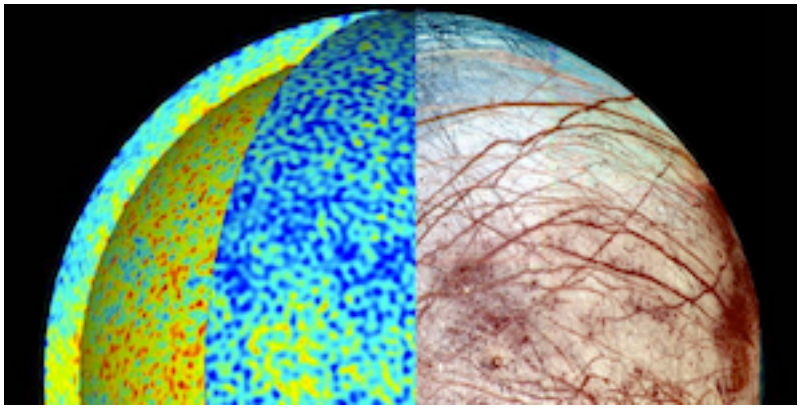
December 9,2013 – http://www.space.com/23880-**jupiter-moon-europa-hidden-oceans**.html

http://www.space.com/17820-**europa-jupiter-s-icy-moon-and-its-underground-ocean-video**.html

Very informative discussion http://www.youtube.com/watch?v=RrjY2BKm-TA

Beneath the icy surface of Europa, churning ocean waters might explain the chaotic jumble of cracks and ridges around its equator. These new findings hint that Europa may be **even more habitable for alien life than previously thought**.

Not much smaller than the Moon, under an icy crust maybe 15-25 km (10-15 mi) thick, Europa is hiding an ocean up to 160 km (100 mi) deep. Since there is life virtually wherever there is water on Earth, researchers have long entertained the notion that Europa could support life.



Full image: http://i.space.com/images/i/000/035/108/i02/europa-ocean-model-1.jpg?1386587964

This rendering of Europa shows the temperature field in a simulation of the icy Jupiter moon's global ocean dynamics, where hot plumes (red) rise from the seafloor and cool fluid (blue) sinks down from the ice-ocean border. More heat is delivered to the ice shell near the equator, consistent with the distribution of chaos terrains on Europa. Image released Dec. 1, 2013.

http://www.space.com/17820-**europa-jupiter-s-icy-moon-and-its-underground-ocean-video**.html

While Europa's ice crust surface hides its ocean from direct view, clues about how this ocean behaves should be evident from Europa's crust, especially in areas known as chaos terrains, where the ice has mysteriously warped and broken into jumbled blocks covering as much as 40 percent of the surface, especially near the equator. The origins of this terrain have been the subject of much debate.

How heat flows in the ocean below could be the clue. Planetary geophysicist Krista Soderlund at the University of Texas at Austin and her colleagues devised computer models of how sea currents might circulate. Past simulations assumed that the currents flowed in a two-dimensional pattern, channeling heat away from the equator. Their new model assumes that these currents flowed in a three-dimensional manner with turbulence and heat flow strongest at low latitudes near the equator.

The team suggests two reasons why three-dimensional patterns of flow would cause ocean heat to concentrate near the equator. First, the ocean currents responding to changes in Jupiter's gravitational tug as Europa is alternately closer and farther from the planet, water will convect more vigorously at the center (equator) than near the edges (poles). Then, just as in Earth's oceans, we can expect warm currents to rise at the equator, then cool and sinks nearer the poles. Ocean heat should drive melting and disruption of the ice. The concentration of heat near the equator could explain why chaos terrain is clustered there. The heat transfer and possible marine ice formation may be helping form diapirs, or warm compositionally buoyant plumes of ice that rise through the shell.

Thus there is not a static ice crust overlying a static deep ocean below. Ocean and ice are in a dynamic relationship. And out of that life could well arise. That this new theory explains the chaotic fracture patterns in the ice crust whereas the static ocean theory does not, is convincing. Now we may find that the new dynamic theory is even more complex and convoluted.

But suddenly, what we see seems less puzzling, and more suggestively intriguing.

A year ago, we had an announcement about The **European Space Agency's JUICE probe** http://www.space.com/15532-**jupiter-icy-moons-space-mission**.html and **NASA's Europa Clipper mission** plan to visit Jupiter [http://www.space.com/18901-**nasa-mission-jupiter-moon-europa**.html] These proposals, if pursued, could help scientists better understand Europa and other icy moons and see if the research team's model of Europa is correct, Soderlund added.

Space.com Europa Infographic

http://www.space.com/22207-**jupiter-moon-europa-water-ocean-infographic**.html

Editor: We predict that as we get further into understanding these ice crust fracture patterns, we will be able to deduce even more about what goes on in the ocean below. And if there is life, we should find relics of it in the ice above, long before we can drill all the way through into the ocean below. PK

New Analysis of Galilleo 1998 data on Europa shows Clay Deposits

Dec 11, 2013 - http://www.jpl.nasa.gov/news/news.php?release=2013-362

A new analysis of data from NASA's Galileo mission concludes that the probe detected clay-type minerals on the surface of Europa that appear to have been **delivered by a spectacular collision with an asteroid or comet**. This is the only such detection to date, but then Jupiter and its moons have not been visited since. We are still mining Galileo data.

The types of space rocks that could deliver such minerals also often carry organic materials such as we find in comets and primitive asteroids. This realization will "open a new chapter in the story of the search for life on Europa."

Europa is the favorite world in our solar system for those hoping to find existing life. "It has a subsurface ocean in contact with rock, an icy surface that mixes with the ocean below, salts on the surface that create an energy gradient, and a source of heat (the flexing that occurs as it gets stretched and squeezed by Jupiter's gravity." These conditions have been in place for billions of years since Jupiter and its moons were formed. Organic material could have arrived by comet or asteroid impacts, and this new finding supports that idea.

The clay-type minerals found are called phyllosilicates, detected in near-infrared images from Galileo taken in 1998. The images are low resolution by today's standards, and scientists are applying "a new technique for pulling a stronger signal for these materials out of the noisy picture."

[**Phyllosilicates** are sheet silicate minerals (silicon and oxygen), formed by parallel sheets of silicate tetrahedra with Si_2O_5 on a 2:5 ratio - Wikipedia]

The area where they appear is in a broken ring about 40 km (25 mi) wide, which is about 120 km (75 mi) away from the center of a 30 km (20-mi) diameter central crater site. This pattern appears to be the splash back of material ejected when a comet or asteroid hit the surface at an angle of 45° or more from vertical. The shallow angle would have allowed some of the space rock's original material to fall back to the surface. A more head-on collision would likely have vaporized it or driven that space rock's materials below the surface. The possibility of this material having come from Europa's interior up through a thick ice crust is nil.

What about the comet or striking asteroid? If the body was an asteroid, it was likely about 1,100 m (3,600 ft) in diameter. If the body was a comet, it was likely about 1,700 m (5,600 ft) in diameter, nearly the same size as the comet ISON.

Bob Pappalardo of JPL, the pre-project scientist for a proposed mission to Europa, says "It will take a future spacecraft mission to Europa to pin down the specifics of its chemistry and the implications for this moon hosting life." ##

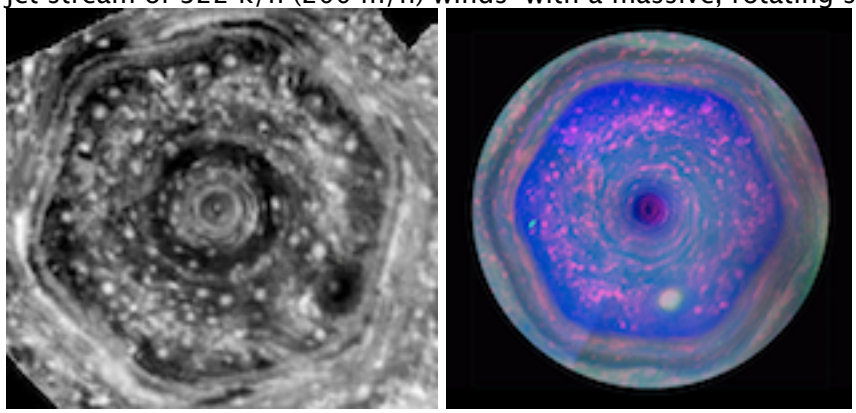
SATURN

Cassini Saturn Orbiter Obtains Best Views of Saturn Hexagon

http://www.jpl.nasa.gov/news/news.php?release=2013-350 (with **Video**)

December 04, 2013 NASA's Cassini spacecraft has obtained the highest-resolution movie yet of a unique six-sided jet stream, known as **the hexagon**, around **Saturn's north pole**.

This is the first hexagon movie of its kind, using color filters, and the first to show a complete view of the top of Saturn down to about 70 degrees latitude. Spanning about 30,000 km (20,000 mi) across, the hexagon is a wavy jet stream of 322 k/h (200 m/h) winds with a massive, rotating storm at the center.



There is no weather feature exactly, consistently like this anywhere else in the solar system. Weather patterns on Earth are interrupted when they encounter friction from landforms or ice caps, but such features do not exist on gaseous Saturn and that is perhaps why this feature is long lasting.

Better views of the hexagon are available now because the sun began to illuminate its interior in late 2012. Cassini captured images of the hexagon over a 10-hour period with high-resolution cameras, giving us a good look at the motion of cloud structures within.

They saw the storm around the pole, as well as small vortices rotating in the opposite direction of the hexagon. Some of the vortices are swept along with the jet stream as if on a racetrack. The largest of these vortices spans about 3,500 km (2,200 mi), twice the size of the largest hurricane recorded on Earth.

Scientists analyzed these images in false color – see image at right, above –, making it easier to distinguish differences among the types of particles suspended in the atmosphere -- relatively small particles that make up haze -- inside and outside the hexagon.

Earth's Antarctic ozone hole forms within a region enclosed by a jet stream with similarities to the hexagon. At Saturn, large aerosols cannot cross into the hexagonal jet stream from outside, and large aerosol particles are created when sunlight shines on the atmosphere.

Approaching Saturn's summer solstice in 2017, lighting conditions over its north pole will improve, and we are excited to track the changes that occur both inside and outside the hexagon.

But why and how this feature is a stable flat-sided hexagon instead of a circle is the big question. That is an aspect never expected.

About Cassini

Cassini launched in 1997 and arrived at Saturn on July 1, 2004. Its mission is scheduled to end in September 2017. The Cassini-Huygens mission is a cooperative project of NASA, the European Space Agency and the Italian Space Agency. JPL manages the mission for NASA's Science Mission Directorate in Washington. JPL designed, developed and assembled the Cassini orbiter and its two onboard cameras. The imaging team is based at the Space Science Institute, Boulder, Colorado, US. ##

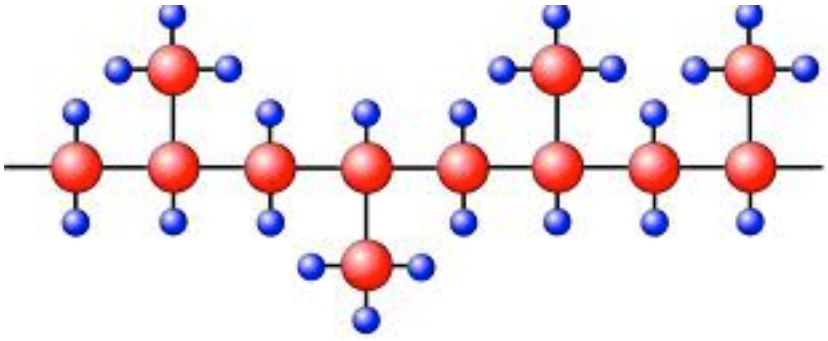
SATURN'S MOONS

Cassini finds Polypropylene Plastic in Titan's atmosphere

http://www.spacedaily.com/reports/
Cassini_finds_ingredient_of_household_plastic_on_Saturn_moon_999.html
http://en.wikipedia.org/wiki/**Polypropylene**

Sep 30, 2013: NASA's Jet Propulsion Laboratory (JPL) in Pasadena, Calif – NASA reports that its Cassini Saturn orbiter has detected **propylene** $(C_3H_6)_n$, an ingredient in household plastics, on Saturn's largest moon, Titan. Propylene is used to make food-storage containers, car bumpers and other products, and its detection on Triton is the first discovery of the plastic ingredient on any moon or planet other than Earth.

Cassini's Composite Infrared Spectrometer identified a small amount of the substance in Titan's lower atmosphere. This instrument measures infrared light emitted from Saturn and its moons much the same way human hands feel the warmth of a fire. This instrument had suggested earlier that propylene mi be might resent in Titan's upper atmosphere but a positive identification wasn't made until now.



"This new piece of the puzzle will provide an additional test of how well we understand the chemical zoo that makes up Titan's atmosphere." said Scott Edgington, Cassiniscientist. The Cassini-Huygens mission is a cooperative project of NASA, the European Space Agency and the Italian Space Agency. ##

Spring on Titan Reveals Amazing Views of Otherworldly Lakes (Photos)

http://www.space.com/23326-**saturn-moon-titan-lakes-photos**.html

[image full size] http://i.space.com/images/i/000/033/776/i02/titan-cassini-annotated.jpg?1382630673

http://www.spacedaily.com/reports/**Cassini_Gets_New_Views_of_Titans_Land_of_Lakes**_999.html

http://phys.org/news/2013-10-**cassini-views-titan-lakes**.html

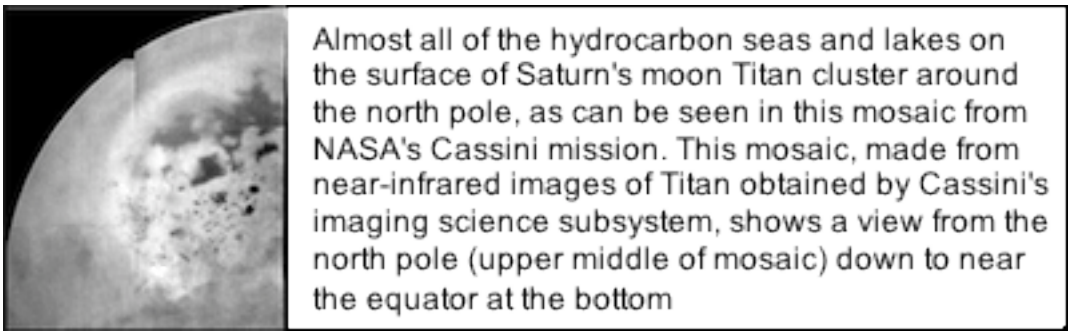


Image credit: NASA/JPL-Caltech/SSI/JHUAPL/Univ. of Arizona
Larger image: http://www.jpl.nasa.gov/spaceimages/details.php?id=pia17472

October 25, 2013 - The Cassini Saturn orbiter is getting a more revealing look at the vast liquid lakes of Titan's north pole, where dense winter clouds are finally retreating thanks to a change in Titan's seasons..

A clearer view of Titan's wet northern region could provide clues about the moon's hydrologic cycle and the evolution of its seas. New images released by NASA this week revealed the Titan equivalent of salt flats surrounding its northern lakes, some of which are as big as the Caspian Sea and Lake Superior combined. Titan's clouds, lakes and rain are made up of hydrocarbons, such as ethane and methane, not water. ##

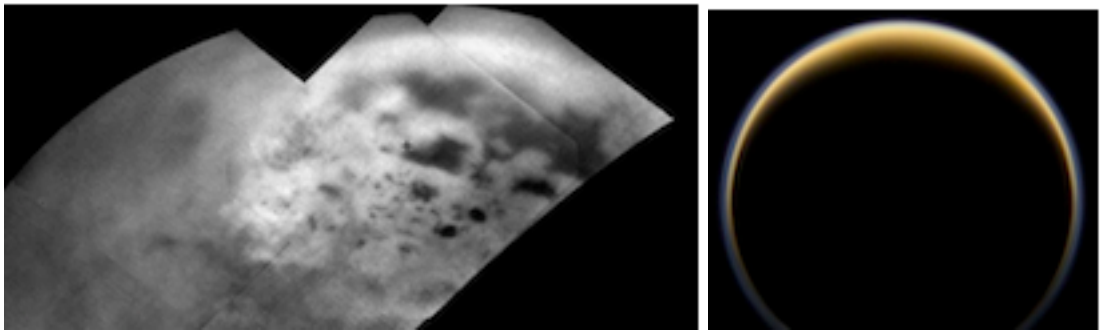
Cassini Finds Unusual Terrain within Titan's North Polar Lake District

http://www.ciclops.org/view_event/195/

October 23, 2013 From Carolyn Porco <cpcomments@ciclops.org> (slightly abridged text of email)

"One of the joys of our decade-long cruise through and around the Saturn system has been the opportunity to watch the seasons and the associated lighting conditions change on moons like Saturn's largest, Titan. With northern spring on this Earth-like, haze-enshrouded world now fully in swing, and the cloudy days of polar winter far behind, the lakes and seas of liquid methane and ethane we discovered dotting its north polar region have come under the gaze of its sensitive, infrared-capable instruments.

Images taken only recently by these instruments of this newly-illuminated region show that many of these northern liquid bodies are surrounded by a bright material not seen elsewhere on Titan. Is this an indication that with increased warmth, the seas and lakes are starting to evaporate, leaving behind a deposit of organic material ... or, in other words, the Titan equivalent of a salt-flat? ## Images below:



L: Dark areas are the Lakes, light areas the "salt flats"

http://twitter.com/carolynporco - http://www.facebook.com/carolynporco - http://carolynporco.com

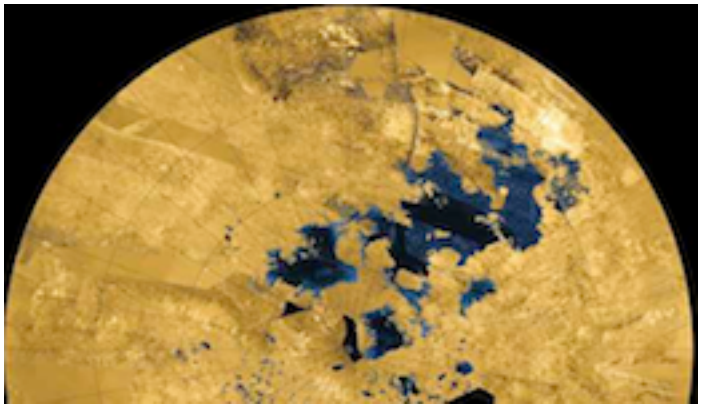
R: http://www.space.com/23245-cassini-toward-night-side-of-titan-space-wallpaper.html

Titan's Great Lakes hold 40 X more Hydrocarbons than Earth's Proven Oil Reserves

http://www.space.com/24028-**saturn-moon-titan-hydrocarbon-lakes**.html

New observations by NASA's Cassini spacecraft suggest that the Great Lakes of Titan hold 40 times more liquid hydrocarbons than are found in Earth's proven oil reserves - about 9,000 km3 (2,000 mi3) of

liquid methane and ethane almost all contained in an area near Titan's north pole that's 1.62 million km2 (660,000 mi2) in size (slightly larger than Alaska). The find indicates something favorable in Titan's geology that restricts most liquid to Titan's northern hemisphere, probably a regional extension of the moon's crust, a process that on Earth created fault lines with depressions and mountain ranges parallel to each other. [Tour Titan's Hydrocarbon Seas (Video)]



full size: http://i.space.com/images/i/000/035/439/original/titan-seas-radar-image-cassini.jpg?1387482177

http://www.space.com/23947-**tour-the-strange-lakes-of-saturn-s-moon-titan-video**.html

Video tour of Titan's Great Lakes District

http://www.space.com/23947-**tour-the-strange-lakes-of-saturn-s-moon-titan-video**.html

PLUTO & BEYOND

On the Path to Pluto, 5 AU and Closing – New Horizons Update

http://**pluto**.jhuapl.edu/news_center/news/20131025.php

October 25, 2013 – Pluto isn't quite the next exit on New Horizons' voyage through the outer solar system, but the destination is definitely getting closer. The spacecraft is now within five astronomical units (AU) of Pluto – within five times the distance between the Earth and the sun, or about 740 million km (460 million miles.

The probe's encounter with Pluto begins in January 2015 – just a year away. Since launch in January 2006, New Horizons has covered about "85 percent" of its journey

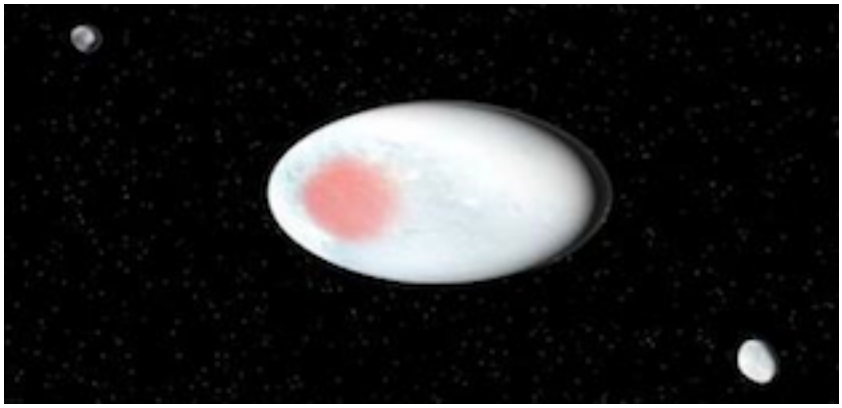
The craft has now joined the exclusive club of deep-space probes that includes Pioneer 10, Pioneer 11, Voyager 1 and Voyager 2 – all NASA craft. New Horizons' path crosses the orbit of Neptune on Augist 25, 2014 — exactly 25 years after Voyager 2 made its historic exploration of that giant planet. ##

Haumea: Fast-Spinning Dwarf Planet

http://www.space.com/23091-**haumea.html**

October 4, 2013 – In late December 2004, a Palomar Observatory team discovered a Pluto-size dwarf planet in images taken the previous spring. The astronomers gave it the nickname "Santa." About the same

as this discovery was published online, a group of astronomers from the Sierra Nevada Observatory announced their prior discovery of the body in images taken in March of 2003. Originally designated as 2003 EL61, the object was classified as a Kuiper Belt Object until the International Astronomical Union reclassified it as the Solar System's 5th dwarf planet, after Ceres, Pluto, Eris and Makemake. When it was reclassified, "2003 EL61" was renamed after the Hawaiian goddess of childbirth and fertility. Its two moons were named for daughters of the goddess, Hi'iaka and Namaka, who were said to have been born from the body of Haumea.



Haumea orbits the Sun in 285 years. At its closest, it comes within 34 times the Earth-Sun distance (1 A.U.), while at its farthest, it ls more than 51 times as far away. Haumea's distance and tiny size, would generally make it difficult for **scientists** to accurately determine its mass and density. But in 2005, the first of the two moons found orbiting Haumea enabled scientists to determine the mass of both bodies.

Haumea is approximately a third as massive as Pluto. It spins on its axis once every four hours, making it the fastest rotating object of its size or larger in the solar system. This rapid spin keeps it from attaining a spheroid shape, instead causing it to look more like a slightly flattened football spinning end over end, as though it had been kicked. Haumea is 1,960 km (1,218 m) across at its longest axis, but only about half as wide — 996 km (619 mi) — at its shortest.

Its rapid spin allowed scientists to calculate its density, because different materials would stretch out differently. As a result, scientists think that Haumea is made up almost entirely of rock. Observations of the planet, however, reveal a brightly gleaming surface. Scientists have concluded that, though most of the dwarf planet's interior is rocky, it is covered by a thin icy shell. Haumea also appears to have a dark red spot that may contain more minerals and organic compounds than the ice around it. ##

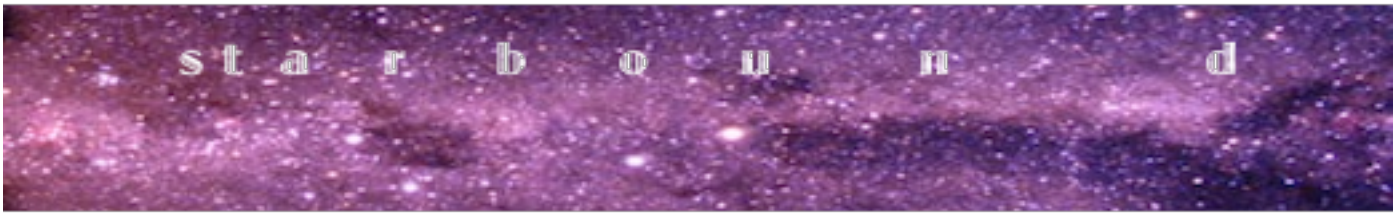
Some other Kuiper Belt Objects for comparison

The **Pluto-Charon double planet** with 4 additional smaller moons, has to be the most interesting! Pluto and Charon (half Pluto's diameter) are locked facing one another (best location by far for a space elevator!) and the New Horizons spacecraft will swoop by them on July 14, 2015 - in a year and a half - but then keep going. To brake into orbit about this double dwarf planet would have required more fuel, and a more expensive mission, less likely to have been approved. We have to take what we get!

A similar spectacular but teasing flyby was that of Voyager 2's Neptune **Triton encounter** early in the morning of August 25, 1988. (US time zones) which the editors (PK, DD) were privileged to watch live.

Video of Triton encounter - http://www.nasa.gov/mov/381305main_triton20090825-640.mov
These 7 "moons" are larger than Pluto: Ganymede, Titan, Callisto, Io, the Moon, Europa. Triton

As of now, 18 months before the Pluto flyby, **Triton is the most distant object in the solar system known to have lava flows on its surface, hence most likely with lavatubes, ready made shelter for outposts.** That could change. The next issue (#7) of TTSIQ will have an article about the potential significance of this fact. ##



[The articles below have been summarized by the editor. For the full text, see the links cited.]

OUR CLOSEST STAR: THE SUN

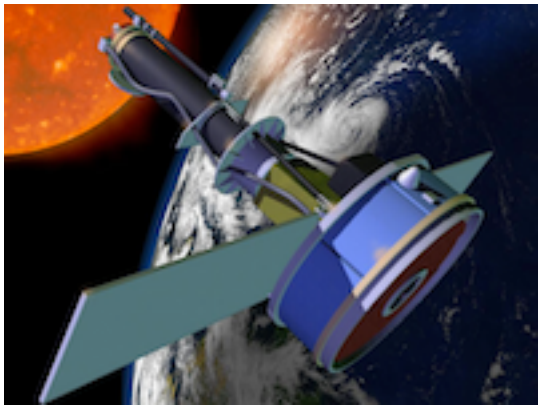
NASA Spacecraft Captures Unprecedented Views of the Sun's Mystery Layer

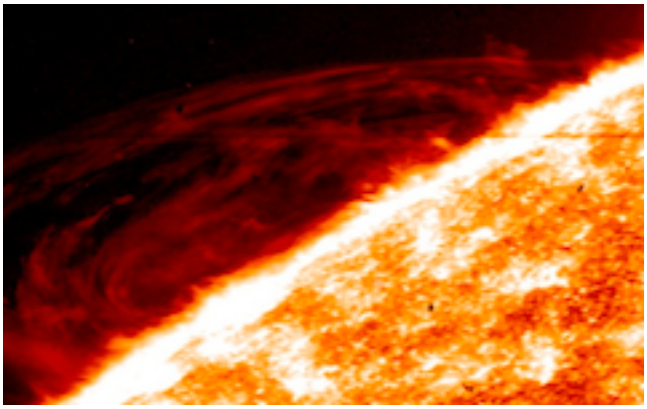
December 10, 2013 - http://www.space.com/23892-**nasa-iris-spacecraft-sun-photos**.html

The IRIS [**I**nterface **R**egion **I**maging **S**pectrograph] Observatory (http://www.space.com/22138-iris-vs-sdo-new-sun-observatory-raises-the-resolution-video.html) launched in June. I is short for Interface Region Imaging Spectrograph. The small spacecraft is designed to collect data on the interface region, a little-understood area spanning the 4,800-9,600 km (3,000 -6,000 m) between the solar surface and outer atmosphere, the corona.

IRIS snaps high-resolution images every few seconds and can capture areas of the Sun as small as 241 km (150 mi). The spacecraft is also equipped with a spectrograph that analyzes the Sun's light in its various wavelengths, to reveal variations in temperature, density and velocity. Supercomputers on the ground check this data against current models of the Sun.

http://i.space.com/images/i/000/029/544/i02/**iris-solar-satellite**-130531b-02.jpg?1370025964





http://www.space.com/21652-**nasa-iris-solar-observatory-mission-photos**.html

http://www.space.com/22138-**iris-vs-sdo-new-sun-observatory-raises-the-resolution-video**.html

IRIS is designed to uncover some of the Sun's secrets: why temperatures shoot from 5,500 °C (10,000 °F) at the sun's surface to about 1 million °C (1.8 million °F) at the corona.

The focus is on two solar features: **prominences** and **spicules**. Extending above the sun's surface, prominences are cool, giant loops of solar material that can lead to solar storms when they erupt. IRIS data reveals that highly dynamic and finely structured flows sweep through these prominences. Spicules, are huge fountains of gas that shoot away from the Sun's surface at 241,400 km/h)150,000 mph) and may play a role in heating up the corona. IRIS data has allowed us to see for the first time how spicules evolve. The discrepancies uncovered between these observations and up till now current models will lead to a better understanding of the Sun. ##

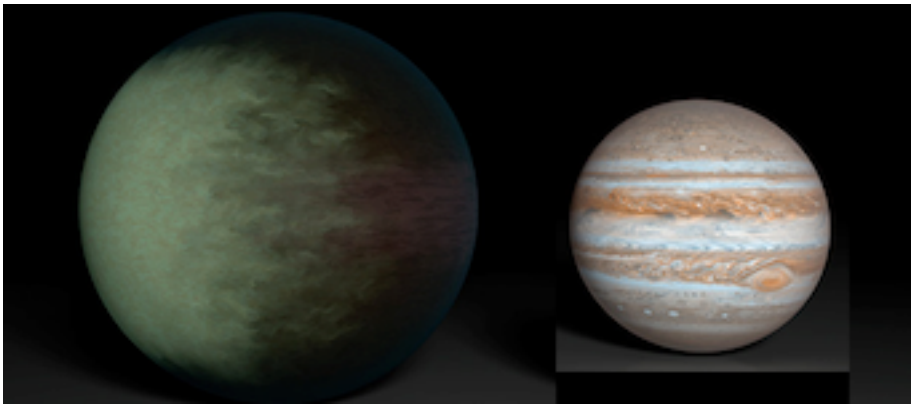
STARBOUND SPACE TELESCOPES

NASA Space Telescopes Find Patchy Clouds on Exotic World

http://www.spacedaily.com/reports/prnewswire-space-news.html

http://www.jpl.nasa.gov/news/news.php?release=2013-296&cid=release_2013-296

Sept. 30, 2013 /PRNewswire-USNewswire/ -- Using data from NASA's Kepler and Spitzer space telescopes, astronomers have created the first cloud map of a planet beyond our solar system, a sizzling, Jupiter-like world known as Kepler-7b, one of the first of more than 150 exoplanets, planets so far detected outside our solar system.. The planet is marked by high clouds in the west and clear skies in the east. Previous studies from Spitzer have resulted in temperature maps of planets orbiting other stars, but this is the first look at cloud structures on a distant world.



Size comparison **Kepler-7b left** with patchy clouds **and Jupiter right**

"By observing this planet with Spitzer and Kepler for more than three years, we were able MIT, Massachusetts Institute of Technology, in Cambridge, MA. Demory is lead author of a paper accepted for publication in the Astrophysical Journal Letters. "We wouldn't expect to see oceans or continents on this type of world, but we detected a clear, reflective signature that we interpreted as clouds."

While the Kelpler telescope's problematic reaction wheels prevent it from hunting planets any more, but astronomers continue to pore over almost four years' worth of collected data.

Kepler's visible-light observations of Kepler-7b's moon-like phases had led to a rough map that showed a bright spot on its western hemisphere. But these data were not enough on their own to decipher whether the bright spot was coming from clouds or heat. The Spitzer Space Telescope played a crucial role in answering this question. Like Kepler, Spitzer can fix its gaze at a star system as a planet orbits around the star, gathering clues about the planet's atmosphere. But Spitzer's ability to also detect infrared light allowed it to measure Kepler-7b's temperature, estimating it between 1,100-1,300 °K (1,500 - 1,800 °F).

This is relatively cool for a planet orbiting so close to its star, within 0.6 astronomical units (90 million km, 56 million mi), and too cool to be the source of light Kepler observed. Instead, light from the planet's star must be bouncing off cloud tops located on the west side of the planet. Unlike clouds on Earth, the cloud patterns on Kepler 7b do not change much over time - a remarkably stable climate."

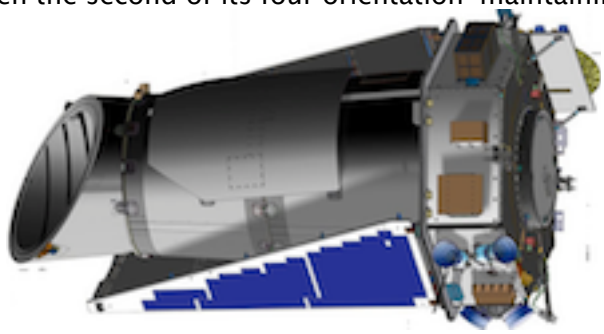
This finding is an early step toward using similar techniques to study atmospheres of planets more like Earth in composition and size. Spitzer and Kepler together give us a multi-wavelength tool for getting a better look at planets many light years away, moving beyond just detecting exoplanets, and into better understanding them.

Kepler identified planets by watching for dips in starlight that occur as the planets transit, or pass in front of their stars, blocking the light. This technique and other observations of Kepler-7b previously revealed that it is less dense than water (as is Saturn). ##

NASA's Ailing Kepler Spacecraft Could Hunt Alien Planets Once Again

http://www.space.com/23760-**nasa-kepler-spacecraft-k2-planets-mission**.html
http://i.space.com/images/i/000/034/842/i02/**kepler-k2-mission-explained**.jpg?1385532793
http://phys.org/news/2013-11-**nasa-revived-kepler-space-telescope**.html

Thanks to some creative troubleshooting, the Kepler Space Telescope, recently "written off," may yet be able to find more extra-solar planets. Mission team members may have found a way to restore much of this lost capacity, when the second of its four orientation-maintaining reaction wheels failed.



Engineers with the Kepler mission and Ball Aerospace, have now oriented the spacecraft to be nearly parallel to its path around the sun so that the pressure exerted by sunlight is spread evenly across Kepler's surfaces, minimizing drift. This strategy is returning some promising results. During a 30-minute pointing test in late October, for example, Kepler captured an image of a distant star field that was within

5 percent of the image quality achieved during Kepler's original mission. This is being seen as a successful first step in a process that may yet result in new discoveries from the telescope. The team is currently conducting tests to see if the spacecraft can maintain such pointing stability over periods of days.
Background: Kepler launched in March 2009 on a mission to determine how frequently Earth-like planets occur around the Milky Way galaxy. Using the "transit method," it notes the telltale brightness dips caused when an alien world crosses the face of, or transits, its host star from the instrument's perspective. In the past four years, Kepler has found over 3,500 planet candidates to date. Just 167 of them have been confirmed so far by follow-up observations, but scientists think 90 percent or so will be confirmed.We can project the percentages to the galaxy as a whole, and thus fulfill the goals of the mission. ##

Signs of Water Found on 5 Alien Planets by Hubble Telescope

http://www.space.com/23814-**alien-planets-water-hubble-telescope**.html
http://www.space.com/23813-**what-s-in-an-alien-planet-s-atmosphere-video**.html

The Hubble Space Telescope has detected water in the atmospheres of five planets beyond our solar system. However, the five exoplanets are all scorching-hot, Jupiter-size worlds that are unlikely to host life as we know it. Yet finding water in their atmospheres still marks a step forward in the search for distant planets that may be capable of supporting alien life, researchers said.

Two research teams used Hubble's Wide Field Camera 3 to analyze starlight passing through the atmospheres of the five "hot Jupiters" known as WASP-17b, HD209458b, WASP-12b, WASP-19b and XO-1b. The atmospheres of all five showed signs of water, with the strongest signatures found in the air of WASP-17b and HD209458b.

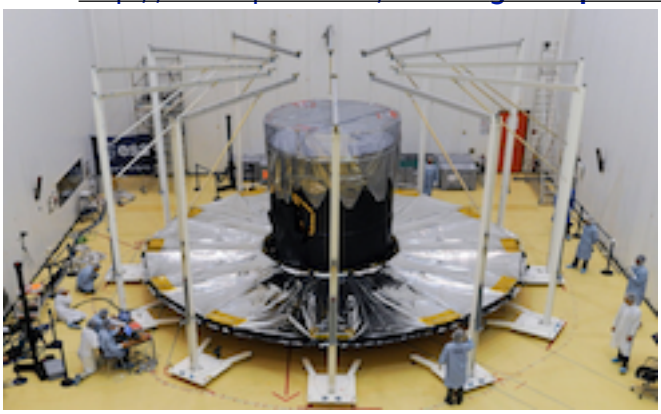
Water is thought to be a common constituent of exoplanet atmospheres and has been found in the air of several other distant worlds to date. But the new work marks the first time scientists have measured and compared profiles of the substance in detail across multiple alien worlds. But the water signatures were less intense than expected in all cases: the five “hot Jupiters” are surrounded by a haze of dust.

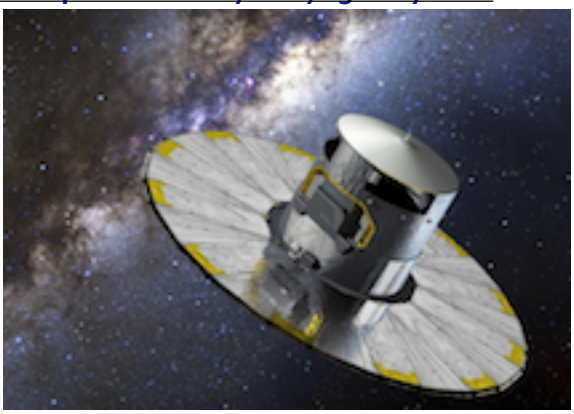
"These studies are showing us that there are a surprisingly large number of systems for which the signal of water is either attenuated or completely absent," Heather Knutson of the California Institute of Technology in Pasadena, a co-author on Deming's paper, said in a statement. "This suggests that cloudy or hazy atmospheres may in fact be rather common for hot Jupiters."

- The study led by Mandell came out December 3, 2013 in The Astrophysical Journal, while the paper led by Deming was published in September in the same journal.

ESA’s Gaia Spacecraft to Map Milky Way Galaxy

http://www.space.com/23854-**gaia-spacecraft-photos-milky-way-galaxy**.html





Stunning Video of the Starry Heavens from Kitt Peak on Hawaii Island

http://www.space.com/23925-**watch-sky-over-mauna-kea-in-stunning-time-lapse-video**.html
Pass this on!

Incredible Technology: How Future Space Missions May Hunt for Alien Planets

http://www.space.com/23534-**alien-planet-search-incredible-technology**.html

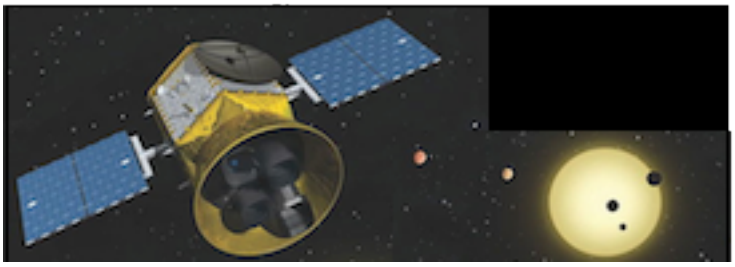
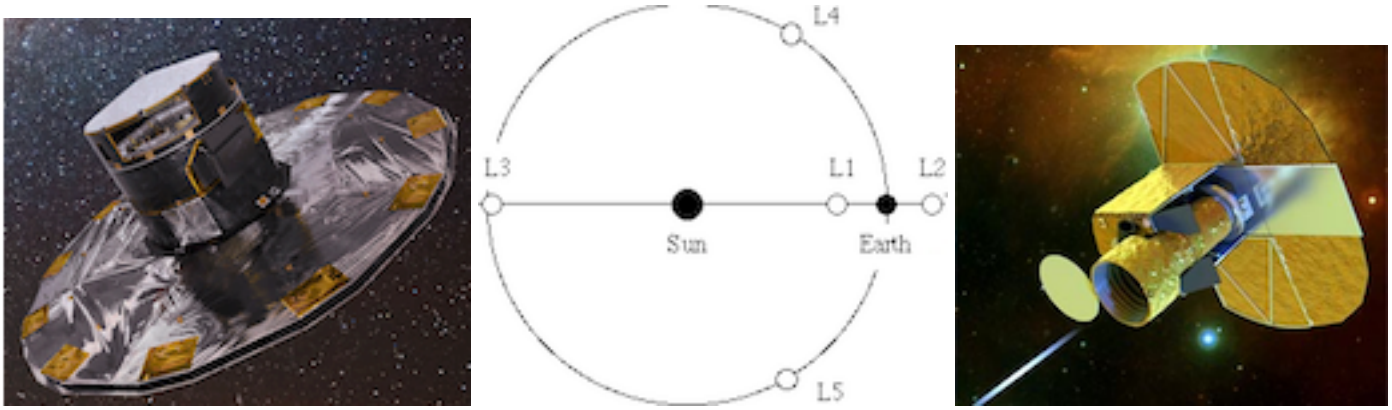


PHOTO: Following a 3-year competition, NASA recently selected the Transiting Exoplanet Survey Satellite (TESS) project at MIT for a planned launch in 2017

NASA's Kepler space telescope revolutionized the study of alien worlds after launching in 2009, and finding 3,500 planets around other stars. Now, even more capable space telescopes are in the works by NASA and the European Space Agency (ESA). They plan to launch space telescopes that should discover thousands more exo-planets and characterize some of the most Earthlike in greater detail.

Kepler's original planet-hunting activities came to an end this past May when the second of its four orientation-maintaining reaction wheels failed, robbing the spacecraft of its ultra-precise pointing ability. But the instrument may continue its planet search in a modified and limited fashion, as part of a proposed mission coded K2. NASA is expected to make a final decision about K2, and Kepler's ultimate fate, by mid-2014. By then, the first of the exoplanet finders should be on the job — Europe's Gaia mission.

Gaia: The billion-star surveyor



Left: Gaia - **Center:** Earth-Sun Lagrange points - **Right:** Cheops

ESA's Gaia spacecraft is slated to blast off from French Guiana in a window from **Dec 17 - Jan 5**. Gaia will head to a gravitationally stable spot about 1.5 million km (900,000 mi) from Earth at the sun-Earth Lagrange Point 2. Over the next five years, the spacecraft will repeatedly measure the position, movement and brightness changes of more than 1 billion Milky Way stars — 1 percent of the galaxy's total.

This huge star census will provide the data needed to tackle an enormous range of important problems related to the origin, structure and evolutionary history of our galaxy, Exoplanet science should benefit. The Gaia mission, whose total cost is 740 million euros (about $990 million), could detect tens of thousands of new planetary systems.

Cheops: A follow-up machine

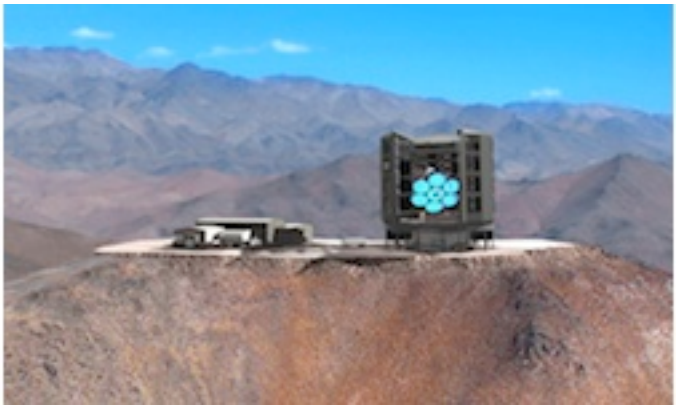
ESA will likely launch another exoplanet mission, called **Cheop**s (short for **CH**aracterizing **E**xo**PL**anets **S**atellite), four years after Gaia is launched. Like Kepler, Cheops will watch for exoplanet "transits," gathering data when alien worlds cross the face of their parent stars from the instrument's perspective. But while Kepler stared at more than 150,000 stars simultaneously, Cheops will target one star at a time. And its chief aim is the follow-up study of known exoplanets, rather than the discovery of previously unknown worlds.

Cheops is expected to be extremely efficient at providing first-step characterization of low-mass exoplanets by measuring accurate radii and densities. Another key goal of Cheops, is to collect the 'golden targets' for future in-depth characterization by the James Webb Space Telescope. Cheops' total cost is about 100 million Euros ($134 million), Formal approval of the mission is expected in the next few months, with launch targeted for late 2017. ##

EARTHBOUND TELESCOPES

Giant Magellan Telescope Construction Update – 3rd Mirror Unveiled

http://phys.org/news/2013-12-**giant-magellan-telescope-mirror-unveiled**.html
http://www.**gmto**.org/overview.html

[From 2nd link] "The Giant Magellan Telescope will be one of the next class of super giant earth-based telescopes that promises to revolutionize our viewand understanding of the universe. It will be operational in about 10 years and will be located in Chile.

"The GMT has a unique design that offers several advantages. It is a segmented mirror telescope that employs seven of today's largest stiff monolith mirrors as segments. Six off-axis 8.4 meter or 27-foot segments surround a central on-axis segment, forming a single optical surface with an aperture of 24.5 meters, or 80 feet in diameter. The GMT will have a resolving power 10 times greater than the Hubble Space Telescope. The GMT project is the work of a distinguished international consortium of leading universities and science institutions."

December 64, 2013 – The Giant Magellan Telescope's third primary mirror was unveiled at the University of Arizona's Steward Observatory Mirror Lab. The combined surface area of the three mirrors created to date surpasses that of any existing telescope (with four more yet to be added) will help enable astronomers to peer more deeply into space than ever before once the telescope is completed.

Primary mirrors are the heart of the modern day reflecting telescopes. The larger their surface area, the more photons they can capture, leading to better images and improved data. The Giant Magellan Telescope will offer the best image resolution yet.

"The Giant Magellan Telescope will be one of the most powerful tools for approaching some of society's most profound questions: where did we come from, where are we going, and are we alone in the universe?" said Patrick McCarthy, Giant Magellan Telescope Project Director. "The technology used to design and construct the telescope is breathtaking, but the answers it may provide as to the beginnings of time itself will be staggering."

The first of a new generation of "extremely large telescopes," or "ELTs," the GNT will have a mirror array consisting of seven 8.4 m (27 ft = 324 in) diameter mirror segments. (That's over 18 x the area of the 200" Mt. Palomar telescope in California, once thought to be the biggest telescope we could ever build!) When complete, it will have ten times the resolution of the Hubble Space Telescope.

The observatory will be operational when the 4th mirror is added.

Each of FMT's mirrors is cast in a custom-built rotating furnace that reaches approximately 1,150 °C (2,100˚F), they each weigh about 18 metric tons (20 US tons), even though internally, they have a honecomb structure that gives them a much lower weight than a solid mirror would have. (Solid mirrors of that size would be impossible to produce because they could not cool evenly, much less quickly.) This honeycomb pattern allows them to regulate temperature quickly while remaining extremely rigid.

Each mirror is meticulously polished to create a surface that is so smooth that no imperfection is taller or deeper than a twentieth of a wavelength of light—one millionth of an inch. Details of the mirror making process can be seen here.

"The mirror surface is so smooth that if we took one 27 foot mirror and spread it out from coast to coast across the U.S., the height of the tallest mountain on that mirror would be only half an inch—an engineering masterpiece," said Wendy Freedman, Director of the Observatories of the Carnegie Institution for Science and Chair of the Board of Directors for the Giant Magellan Telescope Organization.

The Steward Observatory Mirror Lab is the only facility in the world capable of creating mirrors of this size. The University of Arizona is one of ten international partners collaborating in this project. Collectively, the partners have over 1,000 years of astronomy experience.

On Location

The Giant Magellan Telescope will be constructed at the Las Campanas Observatory in the Atacama Desert in northern Chile, where it will be able to work synergistically with other astronomical instruments and surveys. The program to fund and build the Giant Magellan Telescope is a global first, targeting a total of $1 billion from mostly private, philanthropic donors, with some contributions coming from government agencies around the world.

The Giant Magellan Telescope will be largest privately led telescope initiative in history. It is expected to usher in a new era of discovery: whether or not life exists on other planets; how the universe began; how planets and galaxies form; what is dark matter and dark energy. ##

11 Must-See Skywatching Events in 2014

http://www.space.com/24048-**best-skywatching-events-2014**.html

March 20: A Bright Star Winks Out - Asteroid 163 Erigone will obscure is Regulus, in the constellation of Leo, the Lion. Along a 45-mile-wide (72 kilometers) path, the asteroid's shadow will move on a southeast-to-northwest trajectory and will extend from New York City to Oswego in New York State and continue northwest into Ontario, Canada.

April 14-15: An "M&M" Night - Mars will come to within 92.4 million km (57.4 million miles), its closest approach to Earth since January 2008. Later that very same night (actually the early hours of April 15), North America will experience a lunar eclipse when the full moon becomes transformed into a mottled "Mars-lie" reddish ball for 78 minutes as it is completely immersed in Earth's shadow. This total lunar eclipse will be the first one widely visible from North America in nearly 3.5 years.

April 28-29: A "Ring of Fire" Eclipse that Nobody Will See? - It is quite possible that only penguins will witness the annular (ring) phase of this eclipse, as it will occur within the uninhabited region of Wilkes Land in Antarctica. A partial solar eclipse will be visible from Australia.

May 24: A Possible Outburst of Bright Meteors - Perhaps the most dramatic sky event in 2014 could come at the start of Memorial Day weekend. In the predawn hours of Saturday, May 24, our planet is expected to sweep through a great number of dusty trails left behind in space by a small comet (known as P/209 LINEAR). This might result in an amazing, but brief, display of "shooting stars."

Aug. 10: Biggest Full Moon of 2014 - the Moon turns full at 2:09 p.m. EDT, and just nine minutes earlier it will arrive at its closest point to the Earth in 2014 at a distance of 356,896 km (221,765 miles), making this a "supermoon." Expect a large range in ocean tides (exceptionally low to exceptionally high.)
Video of a similar event in 2012 http://www.space.com/15037-**super-moon-return-2012**-video.html

Aug. 12: The Perseid Meteor Shower - Unfortunately, this annual summer performance of this usually brilliant shower will be severely hindered by the light of a nearly full Moon.

Aug. 18: A Brilliant Double Planet - An hour before sunrise, low in the east-northeast sky, Venus and Jupiter, will be strikingly close together. The two worlds will be separated by less than two-thirds of the apparent width of the Moon in our sky, making for a very eye-catching sight.

Oct. 8: Another Total Lunar Eclipse and a chance to see Uranus - in western North America, Hawaii, eastern Asia, Indonesia, New Zealand and the eastern half of Australia. Across central and eastern North America, the Moon will set while still completely immersed in Earth's shadow, but passing to the north of the shadow's center, with totality lasting one hour. Expect a relatively bright eclipse, possibly featuring a coppery red hue across the lower part of the Moon, contrasted by a brighter upper rim. During the totality binoculars and telescopes will reveal a 6th-magnitude greenish point of light near the darkened Moon: the planet Uranus. From central and northern Alaska and northern Canada, the Moon will actually occult (hide) Uranus during totality — a very rare event!

Oct. 19: Near Collision of a Comet with Mars - In October Comet C/2013 A1(Siding Spring) will . The comet will come extremely close to Mars. I Its coma may envelop Mars, as well as create a stupendous shower of meteors as seen from the Martian surface.

Oct. 23: A Partial Eclipse of the Sun - The Moon's penumbral shadow will fall over **much of North America** as well as **extreme eastern Siberia**, producing **a partial solar eclipse**. Greatest eclipse, with more than 4/5ths of the sun covered, will occur in M'Clintock Channel, in Nunavut, Canada. For the Pacific Northwest and the Northern Plains, more than 60 % of the sun will be eclipsed. Across the Ohio, Tennessee and Mississippi valleys, maximum eclipse will coincide with sunset.

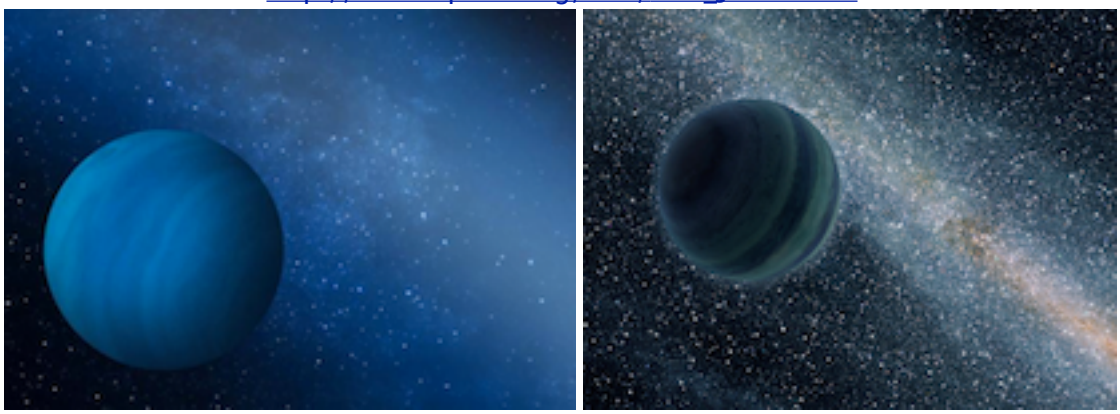
Dec. 13: The Geminid Meteor Shower – The Geminids, regarded by many observers as the best of the annual meteor showers, will ocur during a last-quarter moon, which will pretty much squelch all but the brightest meteors.

SEARCH FOR EXO-PLANETS & LIFE

Lonely Alien Planet Discovered Without a Parent Star

http://www.space.com/23143-**lonely-alien-planet-discovery**.html

http://en.wikipedia.org/wiki/**PSO_J318.5-22**



Artists Impressions of PSO J318.5-22

http://www.slate.com/blogs/bad_astronomy/2012/11/14/**astronomers_find_the_closest_rogue_planet_yet_in_a_cluster_of_stars_near.html**

October 10, 2013 - Astronomers have discovered a lonely planet that's floating by itself in deep space that is not in orbit around any star. The powerful Pan0SRARRS 1 (PS1) telescope at the summit of Maui's Haleakala volcano in Hawaii first detected this solitary world through a faint heat signature 80 light-years from Earth while it was searching for brown dwarfs.

Dubbed **PSO J318.5-22**, the planet is relatively young at 12 million years old. With a mass about six times that of Jupiter, the planet resembles gas giants that orbit young stars.

Astronomers had not previously seen an object free-floating in space that that looks like this, with all the characteristics of young planets found around other stars, but just drifting out there all alone. But most astronomers had long expected that we would eventually find such worlds.

Planets found by direct imaging are incredibly hard to study, since they are right next to their much brighter host stars, but PSO J318.5-22 is not orbiting a star so it will be much easier to study. Studying such rogue planets could provide a unique view into the inner workings of gas-giant planets like Jupiter shortly after their birth.

PSO J318.5-22 was inadvertently discovered during a survey of brown dwarfs, starlike cosmic objects sometimes called "failed stars" because they are bigger than planets but too cold to flare up into a veritable star. In searching for dim red signals of brown dwarfs, the astronomers chose to use PanSTARRS 1 (PS1), short for Panoramic Survey Telescope and Rapid Response System, which takes the equivalent of 60,000 iPhone photos each night.

"We often describe looking for rare celestial objects as akin to searching for a needle in a haystack, so we decided to search the biggest haystack that exists in astronomy, the dataset from PS1." Eugene Magnier of the Institute for Astronomy said in a statement. PSO J318.5-22 is an object redder than even the reddest known brown dwarfs. The researchers watched the planet for two years and concluded that it lies in a collection of 12-million-year-old stars called the Beta Pictoris moving group.

Observations with other telescopes found signatures in the cosmic body's infrared light that are best explained by it being young and low-mass.PSO J318.5-22 is one of the lowest-mass free-floating objects known, the researchers say.

Supplementary material [From Editor] http://en.wikipedia.org/wiki/**Rogue_planet**

> "A **rogue planet** — also known as an **interstellar planet**, **nomad planet**, **free-floating planet** or **orphan planet** — is a planetary-mass object which has either been ejected from its system or was never gravitationally bound to any star, brown dwarf or other such object, and that therefore orbits the galaxy directly. Astronomers agree that either way, the definition of planet should depend on its current observable state and not its origin.

"Larger planetary-mass objects which were not ejected, but have always been free-floating, are thought to have formed in a similar way to stars, and the IAU has proposed that those objects be called sub-brown dwarfs [4] (an example of this is Cha 110913-773444, which may be an ejected rogue planet or may have formed on its own and be a sub-brown dwarf)."

"Rogue Planets" in Science Fiction [Contributed by Editor]

The idea of "rogue" planets, formed around a star but kicked out of its birth system by a gravitational tug of war between the home systems gas giant planets, has been around in Science Fiction for many decades. So this first discovery comes as no surprise to many of us. There may be billions of such rogue planets, smaller than Brown Dwarfs, in just our Milky Way galaxy alone.

Indeed, the concept has been so widespread in Science Fiction as to earn a sub-entry in the Wikipedia address given above. Just scan down to the heading "**In Popular Culture.**"

[http://en.wikipedia.org/wiki/Rogue_planet#In_popular_culture]

What would Rogue Planets be like?

Some will be cold dark gas giants like Jupiter, Saturn, Neptune, and Uranus. With no day vs night, just eternal night with only the light of distant stars, forever. Some might be rocky worlds, like Earth, Venus, Mercury, the Moon, etc.. If any of them have surface oceans, they would be frozen diamond hard.

They might still have hot or warm cores, however, from the heat of accretion, enough to provide the low heat signature that **PSO J318.5-22** shows.

If an intelligent race were to put an outpost on such a body, **geothermal power** would be an attractive option. So while life would be most unlikely to arise on such a body, unless it had done so before the world was gravitationally ejected from its birth system and since been frozen, an intelligent race could conceivably establish an outpost, for whatever reasons, tapping internal heat.

But why? The ultimate exile? **Or the ultimate spiritual Monastery?** Now there's an idea! Nothing to look at except the stars, in the ultimate of Dark Sky conditions, 24/7/365/forever, with a brilliance, however, that can only be imagined!

Additional links

http://www.slate.com/blogs/bad_astronomy/2012/11/14/**astronomers_find_the_closest_rogue_planet_yet_in_a_cluster_of_stars_near.html**

Astronomers answer key question: How common are habitable planets? One in Five Sunlike Stars has an Earth-size Planet in its Habitable Zone

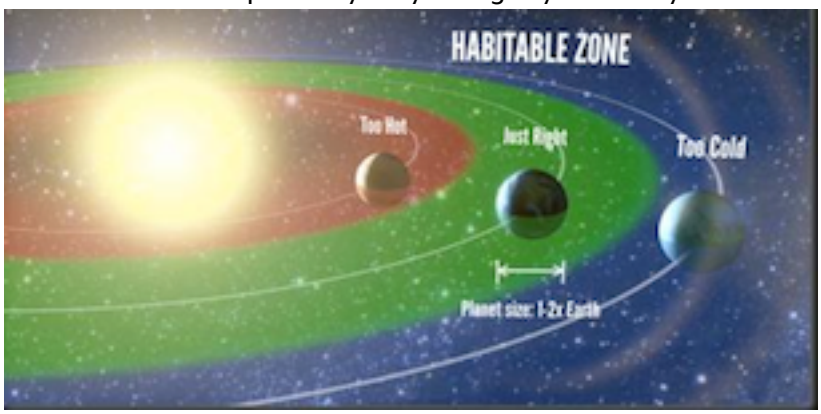
http://phys.org/news/2013-11-**astronomers-key-common-habitable-planets**.html

Milky Way Teeming With Billions Of Earth-Size Planets

http://www.huffingtonpost.com/2013/11/04/earth-size-planets_n_4215873.html

Nov 04, 2013 - University of California Berkeley and University of Hawaii astronomers analyzed all four years of Kepler data in search of Earth-size planets in the habitable zones of sun-like stars, and then rigorously tested how many planets they may have missed. Based on this analysis, they estimate that **22 percent of stars like the sun have potentially habitable Earth-size planets, though not all may be rocky or have liquid water, a presumed prerequisite for life.**

" The nearest sun-like star with an Earth-size planet in its habitable zone is probably only 12 light years away and visible to the naked eye."



Left: Full size image: http://cdn.physorg.com/newman/gfx/news/2013/1-astronomersa.jpg

Right: Kepler's sampling of 150,000 stars has been limited to this small cross-hatched area, 105 square degrees, a tiny part of the whole sky (41 253 square degrees), 1/393rd to be exact.

NASA's Kepler space telescope, now crippled and its mission at an end, nevertheless provided enough data to complete its mission objective: **to determine how many of the 100 billion stars in our galaxy have potentially habitable planets**, about the size of Earth and with a surface temperature conducive to life.

Nearly 2 decades ago we discovered the first planet around another normal star. Since then we have learned that most stars have planets of some size, and that Earth-size planets are relatively common in close-in orbits that are too hot to have oceans of liquid water oceans. Now we know that planets like our Earth are relatively common throughout our galaxy, and probably in other spiral galaxies as well."

Earth-size may not mean habitable

"That every fifth star has a planet somewhat like Earth – is really important, because successor telescopes will try to take an actual picture of a planet, and the size of the telescope they have to build depends on how close the nearest Earth-size planets are. An abundance of planets orbiting nearby stars simplifies such follow-up missions."

The team cautioned that Earth-size planets in Earth-size orbits are not necessarily hospitable to life, even if they orbit in the habitable zone of a star where the temperature is not too hot and not too cold. Note that the team's definition of habitable is that a planet receives between four times and one-quarter the amount of light that Earth receives from the Sun. ##

Twelve "Sun-like" stars within 17 light years

(Odds are that 2 or 3 of them have "Earth Like" planets in their "habitable" "Goldilocks" zone where surface water is stable. The actual number could be less or more than 2.

Note that we have detected a planet around Alpha Centauri B. Keep in mind that by our present methods, we can only detect planets in systems whose plane of rotation is edge on to our own. All of the "suns" below are likely to have planetary systems.)

Nb. **K type (orange) stars** are a bit less bright than **G type (yellow)** stars like the Sun, but live longer.

1,2 4.3 ly **Alpha Centauri A**, (G2)(Ixion*) and **B**, (K4) (Nephthele*) (*unofficial names used by the editor after the King and Queen of the Centaurs in Roman mythology)

3 10.7 ly **Epsilon Eridani** (K2)

4,5 11.2 ly **61 Cygni A** (K5) & **B** (K7)

6 11.4 ly **Epsilon Indi** (K5)

7 11.7 ly **Tau Ceti** (G8)

8,9 16.2 ly **Omicron2 Eridani A**(K0) & **B** (K5)

10,11 16.9 ly **70 Ophiuchi A** (K0) and **B** (K5)

F type (yellow white) suns are likely to die before they reach the age of our Sun and thus offer less time for life to evolve to the stage of present day Earth, but Earth type "hydro-tectonic" worlds around T type suns could be very "colonizable." (see #12 just below for a nearby F system.

READ "**Welcome Matt Worlds**" from MMM #45, reprinted in the Starbound Theme Issue, a free download at: www.moonsociety.org/publications/mmm_themes/mmmt_Starbound.pdf

READ "**Hydrotectonic Worlds:** What is an 'Earthlike Planet?'" MMM #36, reprinted in the Starbound The issue, download location above.

12 11.4 ly **Procyon A** (**F5**) a bright star easy to find in northern skies

Note: the F Spectrum classs noted above, also covers some "white dwarf" stars which are burnt out relics and most unlikely to host "Earthlike" planets, and so are not included in the above list.

Strange New Worlds: The Amazing Alien Planet Discoveries of 2013

http://www.space.com/24082-**most-amazing-exoplanet-discoveries-2013**.html **with VIdeo**

How to Find Alien Life on Dying Planets

http://www.space.com/23737-**alien-life-signs-dying-planets**.html

November 26, 2013 - Astrobiologist Jack O'Malley-James at the University of St. Andrews in Fife, Scotland and his colleagues noted that biosignatures of life on Earth have not remained the same over time, but have altered considerably over its history. How will Earth and other planets look in the future?

"Astrobiology as a field seems to put a lot more focus on the origins of life and how to find life beyond Earth, but less emphasis is put on the end of life, which is what got me interested in finding out more about how biospheres on other planets might meet their ends, and by extension, how long we could expect to detect life on a habitable planet over the course of its habitable lifetime," said O'Malley-James, the lead author of the study. "The idea came about to run this model forward in time to see when all water and all life would disappear from the planet."

The Sun is a middle-aged star, currently about 4.6 billion years old. In the "later stages" of its evolution, about 2 billion to 3 billion years from now, the Sun will grow much hotter, leading to much higher surface temperatures on the future Earth and thus far harsher environments for any last life to grow and survive on the planet. For us humans, that is quite a long way off but the point is that the period of a planet's life when life is likely to thrive, is only during its "middle-aged" period (Editor's description).

We may find many planets suitably placed in their solar systems that might host life, but not necessarily "now." Any planet may be in its pre-life state, or in the state where life is winding down.But the research team modeled the bio-signature gases Earth's biosphere would generate up to 2.8 billion years from the present with the "results ... that suggest that we could potentially detect the presence of life on a planet even "at the very end of its habitable lifetime, when the diversity of life and population sizes are considerably reduced from what they were at their prime.

The article traces the steps we can expect to see in such a decline, and notes that microbial life could hand on long after more advanced life forms had vanished. "The final survivors of Earth could persist either in caves, deep underground, or in relatively cool refuges at high altitudes until roughly 2.8 billion years from now, when the Sun will probably make the planet too hot for astronomers to detect any life from a distance." The article traces the steps of decline that we could expect. Very interesting to read. ##

EXPLORING THE UNIVERSE AT LARGE

Tracing the Growth of Milky Way type Galaxies

http://www.spacetelescope.org/images/opo1345a/

This composite image shows examples of galaxies similar to our Milky Way at various stages of construction over a time span of 11 billion years, arranged according to time. Those on the left reside nearby, while those at the far right existed when the cosmos was about 2 billion years old. The bluish glow from young stars dominates the colour of the galaxies on the right. The galaxies on the left are redder from the glow of older stellar populations. ##

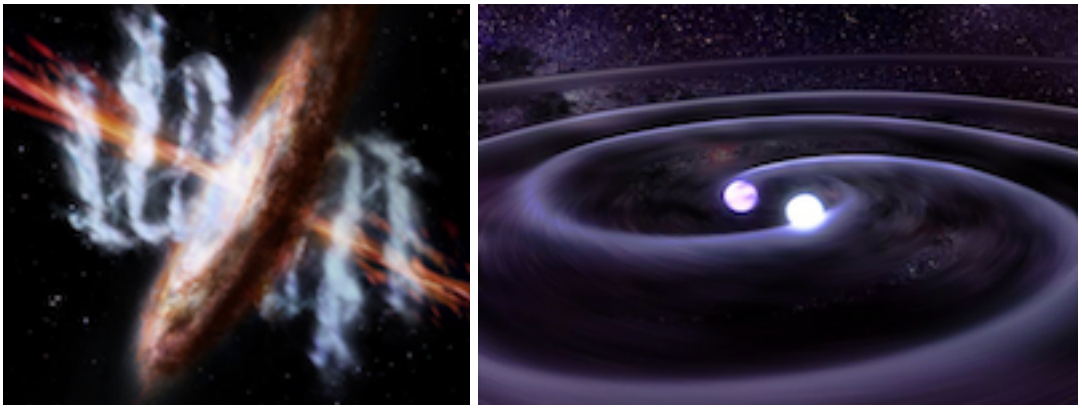
ESA'a New Plans to Study the Invisible Universe

http://www.esa.int/Our_Activities/Space_Science/**ESA_s_new_vision_to_study_the_invisible_Universe**

November 28, 2013 – The **hot and energetic Universe** and the search for **elusive gravitational waves** will be the focus of the European Space Agency's next two large science missions, it was announced today. Both topics will bridge fundamental astrophysics and cosmology themes by studying in detail the processes that are crucial to the large-scale evolution of the Universe and its underlying physics.

The "L2" mission

The theme "the hot and energetic Universe" was selected for L2 – the second Large-class mission in **ESA's Cosmic Vision science programme** – to be pursued with **an advanced X-ray observatory.**



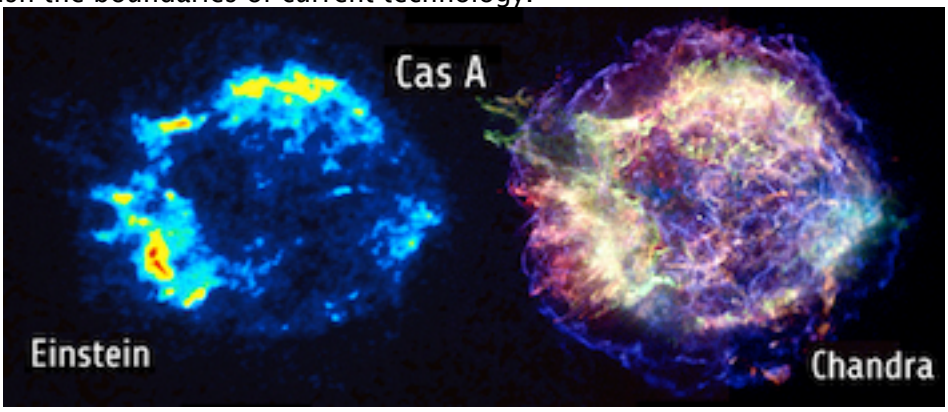
L: Artist's impression of an active galaxy **R:** gravity waves in a binary star system

The L2 mission, with a launch date for c. **2028,** will address **two key questions:**

1. **How and why does ordinary matter assemble into the galaxies and galactic clusters**
2. **How do black holes grow and influence their surroundings?** Black holes, lurking unseen at the centres of almost all galaxies, are hold the keys to understanding galaxy formation and evolution.

The L3 mission, with a launch date c. **3034,** will study **the gravitational Universe**, searching for **ripples in the very fabric of space-time created by celestial objects with very strong gravity**, such as pairs of merging black holes.

Gravitational waves, predicted by Einstein's theory of general relativity but yet to be detected directly, promise to open a completely new window on the Universe. L3 will require the development of **a spaceborne gravitational wave observatory**, or **extreme precision 'gravitometer."** This ambitious enterprise will push the boundaries of current technology.



X-Ray visions: http://chandra.harvard.edu/blog/node/235

The selection process for L2 and L3 began in March 2013, when ESA issued a call to the European science community to suggest the next scientific themes that should be pursued by the Cosmic Vision programme's Large missions. **Thirty-two proposals** were received and assessed by a Senior Survey Committee, and following an extensive interaction with the scientific community two major themes were recommended to the Director of Science and Robotic Exploration.

Missions to study the hot, energetic Universe and gravitational waves are expected to result in discoveries of the greatest importance to cosmology, astrophysics, and physics in general. Early in 2014, a call for L2 mission concepts will be announced to solicit proposals for a next-generation X-ray observatory. A similar procedure will be followed at a later date for the L3 mission. ##

New Technique Could Weigh Planets around other Stars

December 19, 2013 - http://www.space.com/24026-**alien-planets-mass-new-technique**.html

If we could weigh the mass of distant alien worlds that could reveal key details about how suitable they may be for life. In the past 20 years, we have found over 900 extra solar planets and discovered more than 2,300 potential worlds. Now we need to analyze them in detail, to find which might be habitable.

If we know the mass of a planet we can better guess the exoplanet's atmospheric makeup and whether it is a rocky or gassy world, factors relevant to each planet's ability to support life. Knowing the mass of a planet can also lend some insight into how it cools, its plate tectonics, how it generates magnetic fields and whether gas escapes from its atmosphere.

"The mass affects everything on a planetary level," Julien de Wit, a researcher at MIT and the study's lead author, said in a statement. If the mass is unknown many of the planet's properties remain unclear. Current methods for weighing exoplanets are limited. The main technique scientists use now is radial velocity strategy. This method looks for repeated wobbles in a star's movements, which are signs of a planet's gravity and a key to its mass. The radial velocity method does not work on a large variety of worlds that do not visibly tug much on their stars. This includes planets with low masses, those orbiting a fair distance away from their stars, those around faint stars, and those circling highly active stars where a planet's tugging can be masked by disturbances on the star.

Now, a new strategy to weigh a planet just by looking at its atmosphere, has been found. An exoplanet's atmosphere gets thinner with altitude, just as Earth's does, because the strength of a planet's gravitational pull weakens the greater the distance from the planet. We can deduce an exoplanet's mass by seeing how the planet's atmosphere thins with altitude. This involves gazing at exoplanets as they pass in front of their stars and looking at starlight shining through the atmospheres of those worlds to determine the atmospheric pressure drops with altitude. Applied on exoplanet HD189733b, about 63 LY from Earth discovered in 2005 yields a mass close to estimates calculated via the radial velocity technique: about 1.15 Jupiters. This method only works on gas giants — such as Jupiter and Saturn, and could help pin down the mass of gas giants whose stars are too active to allow mass estimates via the radial velocity method.

Space telescopes such as NASA's James Webb Space Telescope and the European Space Agency's potential Exoplanet Characterisation Observatory (EChO) could weigh planets with a mass about the same as Earth's; super-Earth planets with a mass of up to 10 times Earth's mass; and gaseous planets known as mini-Neptunes that have a mass of up to 10 times Earth's mass. This method could be applicable to potentially habitable Earth-sized planets within the next decade. It is beginning to get "interesting!" #

THROUGH YOUR TELESCOPE

Messier Object Sky Wonders – Messier 101

By Aleksandra Voinea

The Messier Object 101, also known as the Pinwheel galaxy, is a face-on spiral galaxy situated at some 21 million light-years away, an equivalent of six mega parsecs. The Millennium Falcon would have certain difficulties taking us there in a human life-span.

The image below is one of the most detailed representations of the Pinwheel Galaxy, rendered by NASA's Hubble Space Telescope after no less than 51 exposures, as well as a few background shots.

Higher resolution:http://www.acclaimimages.com/_gallery/_free_images/0124-0906-2509-2407_hubble_space_telescope_image_of_messier_101_galaxy_o.jpg

Urea Major's galaxy takes up all the lights (or should I say, gives them) when compared to our smaller Milky Way. With a diameter of 170,000 light-years it has been calculated to be larger than the Milky Way by 70%. The Pinwheel galaxy is also a rather accomplished star nursery, with huge and extremely bright H II regions, of a total of around 3000 that can be seen on photographs. H II regions accompany enormous star formation regions, with high density molecular hydrogen gas contracting under its own gravity to form newborn stars.

M101 slightly asymmetric form is due to a former past collision, with a neighboring galaxy. This dynamic event generated immense tidal forces, which in turn emphasized on the spiral arms of the Messier object 101.M101 is not a lonely galaxy however, having found its companions in NGC 5204, NGC 5474, NGC 5477 and last but not least NGC 5585.

Like Messier 101, Messier 102 was discovered by Pierre Mechaic, who initially believed it to be a double observation of M101. It is not yet decided on the object to be M102, among the candidates being M101, NGC 5866 or NGC 5879, NGC 5907 OR NGC 5908.

Of all candidates, the most notable is bound to be NGC 5866, or the Spindle Galaxy in Draco. It fits the lenticular description of Mechain, as well as the location.

For more on M101 see the following: http://en.wikipedia.org/wiki/**Pinwheel_Galaxy**

* **TTSIQ wishes to congratulate Aleksandra Voinea** on her acceptance in **Yale University College of Engineering**, class of 2018. Yale is located in **Ithica, NY, USA.**

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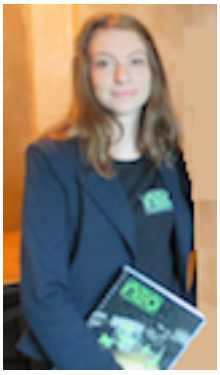

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* **TTSIQ wishes to congratulate Aleksandra Voinea** on her acceptance in **Yale University College of Engineering**, class of 2018. Yale University is located in **Ithica, NY, USA.**

NOTE: Opinions expressed in the Articles & Essays section below
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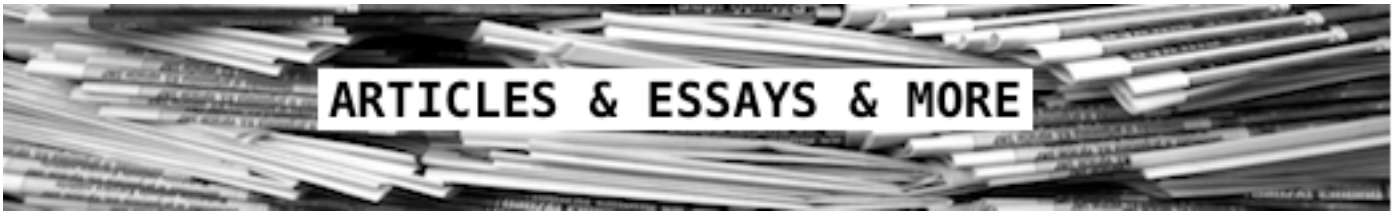


We need to "back up" our Civilization!

"All we have built here on Earth through the centuries and through the millennia."
We can do that **by becoming a multi-planet species**,
And someday, a **multi-stellar species.**"
"**To the Stars!**" "**Ad Astra!**" This is what it is all about! - Editor

Market Economics: Options for the Moon, then Mars, Asteroids

By Peter Kokh

Forward

Perhaps a majority of the public, and of the representatives they elect to Congress, and perhaps even a significant number of space enthusiasts, if not a majority, see the value of space exploration - learning more about the Moon, Mars, the asteroids and other bodies in our Solar System. But they do not see "what's in it for Earth" in the idea of establishing manned outposts on the Moon or anywhere else, let alone permanent civilian settlements.

But when they ask what's in it for Earth, their horizon's are limited to Earth itself. They fail to realize that Earth's economy has already established a significant foothold in space above. The value of operations in orbit above the Earth, particularly in GEO - Geosynchronous Earth Orbit, some x km (mi) above the Earth's surface where satellites take 24 hours to make a full orbit, the same amount of time it takes Earth below to make one full day-night cycle. The result is that satellites in 'GEO' remain "parked' above the same spot on Earth's equator - for the lifetime of the satellite.

This coincidence makes GEO a very valuable ring of "property" in Space. It is here that we park our weather satellites and our communications satellites for radio, telephone, and television. The amount of business conducted in this orbit, GEO, is now approaching $300 billion dollars US annually, and growing at an ever faster rate. That's an amount that exceeds the Gross National Product of many nations.

This valuable real estate in space does have some limits. To avoid interference between satellites in GEO, by international agreement, there are only 180 locations - 2 degrees apart (a circle is 360 degrees) where we can park them. So what do we do if demand for space begins to exceed slot availability?

Host Service Platforms in GEO

One suggestion, that we have made repeatedly, is to put up very large platforms, one at each of the 180 locations, on which platforms an indefinite number of satellites can be parked. Each platform could provide station-keeping service, power, and robotic servicing and repair. The challenge is obvious. We do not have, and may never have, the capacity to launch such platforms from Earth in a ready to go stage. And sending parts up, batch by batch, will be expensive. Further, if we were doing something like this for more than a few of the 180 slots, so many launches may be needed so frequently that atmospheric pollution from rocket exhaust could become a problem. Switching to fuels whose combustion components are environmentally benign will help.

A World-Wide Power Grid

These platforms are not the only large structures that could be of significant economic value to a world whose population continues to expand at a rate that challenges the growth rate of the economy. We could build another kind of large platform in GEO, one to which excess power generated here and there on Earth can be beamed, then reflected to areas on the planet where power availability is short of power needs. Large "rectennas" would receive the surplus power, then beam it to one or more sites where it is needed. We talked about this concept in MMM #210 November 2007 "World Wide Power Grid.*" This would even out power distribution around the world. There are countries whose capacity to produce power, whether by hydroelectric, coal, wind, nuclear, or other means is significantly more than there own national needs. And there are countries who cannot produce all the power for which there is demand. Again, the components for such a grid need to be fixed in space relative to the surface of Earth below, that means that they must be placed in Geosynchronous Orbit. Could these power dispersing structures combine with the large satellite host-platforms we talked about above? That might be a challenge for designers.

* (Republished in MMM Classic #21 - www.moonsociety.org/publications/mmm-classics/)

Solar Power Satellites

An older concept, especially to those who were enthused by the ideas of the former L5 Society in the 1970s and 80s, many of whom are still influential in the National Space Society, is to use materials mined on the Moon and turned into needed components in factories in space and then assembled into giant solar power satellites, again in GEO, to meet Earth's ever growing power needs.

Many space advocates whose interest in space comes after this era, see Solar Power Satellites as too expensive, and the idea of using lunar materials too prohibitive. That assessment does not stand up.

The rationale for lunar sourcing of components needed for construction in Earth orbit

Why not manufacture everything here on Earth? Well there are two killer problems with that idea:

- So many heavy booster launches from Earth, from daily to hourly or even more frequently, might have very serious consequences for our atmosphere upon which all life on Earth must be considered.
- It takes only 1/23rd the fuel to launch something from the Moon's surface "down" to GEO as it does it takes to launch the equivalent mass "up" from Earth's surface to GEO. Now surely, it will cost more to produce components on the Moon, and that will "eat up" some of that 23:1 advantage, but not all of it, probably not most of it.
- There is a formula by which we can decide what parts are best made where. The "MUS/cle" formula: MUS = **Massive**, **Unitary (**one or few of a kind}, and relatively **Simple** to manufacture – even if the materials used are not as sophisticated or ideal as those we'd pick here on Earth – and even if they are heavier than those we could manufacture on Earth, the difference in fuel costs may very well still tilt the selection of components to the Moon, rather than Earth. As to the "**cle**" = **complex, lightweight, electronic** – we can ship these parts from Earth.

  [http://www.moonsociety.org/publications/mmm_papers/**muscle_paper**.htm]

All this considered, if we can manufacture usable simple and heavier items needed for solar power satellite construction on the Moon, that will make SPS systems more affordable as a remedy for Earth's ever increasing power needs. And this goes for components needed for the proposed World Wide Power Grid system as well, should we find it unnecessary to use Solar Power Satellites because of increased efficiencies of power needing systems on Earth, of development of new terrestrial power systems (sea bottom methane? etc.)

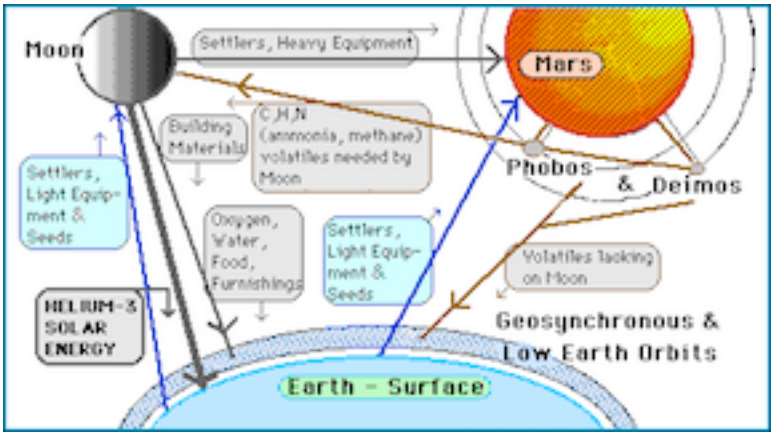
While we may be able to automate raw materials handling and manufacturing on the Moon, we will still need a permanent population there. The Lunar Economy will have become an essential enabler of a brighter future for the much larger population on Earth. To sort all this out, read "The Import/Export Equation" in MMM #32, reprinted in the **"Lunar Economy" theme issue**

(www.moonsociety.org/publications/mmm-themes/)

The Moon will have become an essential part of Greater Earth and the Greater Earth economy

Options for Mars

It is difficult to identify any product that can be made on Mars that could be shipped to GEO (much less to Earth's surface) at a cost savings compared to Lunar sourcing. Even if products produced on Mars small moonlets Phobos and Deimos could be shipped to Earth at a cost advantage compared to lunar products, the fact that launch windows between Earth and Mars open up only every 25.5 months, and remain open for a relatively short time, make lunar sourcing (daily or even more frequently when needed) much more attractive. In fact, there seems to be no realistic practical market for products made on Mars, other than the Moon.



Shipments of liquid ammonia and methane would be welcome on the Moon where carbon, nitrogen, and hydrogen are significantly more scarce than they are on Mars, and possibly on Mars

moonlets, Phobos and Deimos. There is no escaping the fact that without the Moon, a viable Martian economy is most unlikely.- reprinted in the "Lunar Economy" theme issue (www.moonsociety.org/publications/mmm-themes/)

Options for the Asteroids:

Some asteroids have resources that would be invaluable on Earth. Yet that the Moon has been bombarded by asteroids throughout its history, means that the most convenient place to mine asteroids is right on the Moon's surface. More, the cost in consumables for sending human crews on missions taking years, render mining them exorbitantly more expensive than prospecting asteroid debris on the Moon's surface.

Comets are another story, but in general, their orbits are more eccentric, some highly inclined to the ecliptic or main solar system plane, if not also retrograde, orbiting in the opposite direction, than those of most asteroids, making mining comets for volatiles anything but a near term option.

Summary; Unless we want to put unnecessary brakes on Earth's economy and accept unnecessary hardships as a result, we need to build out an integral component of that economy in Geosynchronous Earth Orbit. And to do that, we need people living on the Moon where perhaps the bulk of needed components can be less expensively produced and shipped "down the gravity well" to GEO rather than shipping them "up the gravity well" from Earth's surface. The Moon is an asset. Not to use it, means accepting that we (Earth) must accept an unnecessarily limited future, Further robotic exploration will be helpful in determining what resources are best tapped where on the Moon and that definitely means that we must look beyond the Moon's polar areas. Robotic exploration along with further manned missions, are not an end in themselves. To know and not to use, is not enough. We need to look on the Moon not as a foreign object in our skies, but as **Earth's Eighth Continent**, separated, yes, by a different kind of sea, one we now know how to traverse.

Back Reading Import/Export Equation (MMM #32 February 1990 - reprinted in the "Lunar Economy" theme issue (www.moonsociety.org/publications/mmm-themes/ ##

The "Man in the Moon?"

"M" IS FOR "MAN-IN-THE-MOON"

[Reprinted from MMM #2, February 1987] By Peter Kokh

Illustration by Peter Kokh from quoted article

"Man-in-the-Moon" my foot! Looks to me more like a "fetus in the Moon," the fetus of the human civilization that could arise and flourish there, given the development and utilization of our present capacities and lots of dedicated non-mercenary hard work.

Otherwise, the fetus-in-the-Moon will surely be stillborn, or worse, aborted.

And then we will have the "Ghost-in-the-Moon." PK

Assuring Mental Health Among Future Lunar Frontier Pioneers

Illustration from Television Series "Space 1999 Moonbase Alpha" sporting a "happy face"

Initially published in Moon Miners' Manifesto #212, February 2008
This paper is available online:
http://www.moonsociety.org/publications/mmm_papers/**pioneer-mental-health**.html

By Peter Kokh

Introduction

A central focus of Moon Miners "Manifesto" from the start has been to show how, using lunar resources, pioneers can make themselves "at home" on the Moon. This will include psychological, physiological, social and cultural adjustment to living in the Lunar environment, perceived by outsiders as "alien."

It is crucial that pioneers, people who may or may not have originally come "for a tour of duty" but have decided to stay, must get to that stage where they are "at home" on the Moon, comfortable with it, feeling secure. Staffing a settlement with recruits for limited tours of duty will not promote this transformation into a population of "Lunans" unless there is an aggressive strategy of perks that keep personnel happy, while minimizing homesickness and encouraging an increasing comfort level with this new setting. Without such perks, recruits will be discouraged from "re-upping" or reenlisting or "going permanent."

Once we are building new habitat and activity modules from made-on-Luna building materials, we can get well beyond the "sardine-can" era of early outposts. Real elbow room and ample private space will be essential. We need to emphasize "contact", visual, and activity wise with the Moon: windows, sunshine access, and abundant interior vegetation to keep the air fresh and sweet.

We will need to develop a varied and interesting developing cuisine using plants, herbs, and spices grown on location. Regolith-derived art media will allow us to personalize interior spaces with frontier made accessories of basalt, ceramic, glass, lunar cement, and e made alloys.

We need to invent and develop one sixth-G sports as well dance forms. We need to be able to enjoy uniquely Lunan performances as they will help bond us to the lunar setting. Recreation inside, "middoors", and "out-vac" will allow us to be fully human in any lunar setting.

We need to establish multiple outposts, multiple settings -- "getaway places" with climate variety, flora and fauna variety, different architectural styles, differing cuisines, etc. We all n to "getaway" once in a while, and we need to provide that form of relief on the Moon itself. Settlement alone will not make the Moon a "world!"

It is not enough to humanize our interior living spaces. We need to adopt the surrounding raw lunar surface outside our habitats and integrate it into our living space. If we do not, we will continue to feel feel that we are in a alien environment. In short, we need to feel "at home" on the surface as well as indoors.

We need to be comfortable with the Moon's rhythms, the slow pace of the dayspan-nightspan cycle. Our productive activities will have to get in step with that pace as available energy will wax and wane accordingly. Even if we have a back-up nuke, we will still have more available energy during dayspan when solar energy is also available. This rhythm will impose a fortnightly change of pace, something we bet pioneers will come to cherish.

We need to find ways to counter the "black sky blues." Out on the lunar surface, We will develop ever more enjoyable substitutes for outdoor hobbies and activities that we had to leave behind on Earth. In other words, we need to find, create, or develop substitutes for everything we enjoyed on Earth that cannot be imported "as is" from Earth, simply because the Moon is such a drastically different environment. If we fail to do so, life on the Moon will giver rise to many kids of psychological disorders. We must strip the Moon of its alienness by doing what we can to meet her halfway. I firmly believe we can rise to the occasion!

Introducing "perks" in the first outposts

The most critical moonbase system to success is the human one. Our goal of breaking out of the outpost trap towards settlement, means finding ways to encourage personnel to willingly re-up, stay for "another tour" without limit, so long as health of the individual and of the crew at large is not an issue.

These measures will:

- Increase morale and improve performance
- Promote willingness to re-up so as to give the weight allowance for his not-needed replacement to valuable imports of materials and equipment, especially tools and equipment to fabricate and experiment
- Create a plan for outpost expansion of modules, the facilities they house and activities they enable

We must provide for a full range of human activities:

- Getaway "change of scenery" spaces and out-places both within the outpost and with outlying stations in easy reach.
- Customizing options for personal quarters
- Menu diversity and variety, including fresh salad stuffs and vegetables on occasion
- Schedule breaks (take advantage of the dayspan/nightspan cycle for regular changes of pace such as an alternating types of work and recreation
- Allow fraternization between crew members, without harassment. An outpost should not be a monastery.
- Promote expression of artistic and craftsman instincts using local materials and media. We will remain forever "strangers in a strange land" if we confine ourselves to things made on Earth.
- Experiment with lunar sports and other recreational activities. Lunar-unique sports and performing arts - are things that make crew begin to "feel at home".
- Out-vac sport & recreation on the surface, learning to do so safely, one step at a time.
- An indulgent spa and an exercise gym
- Telecasts to Earth of everything unique and special
- "While you are here" opportunities for excursion exploration and "tourist" experienced memories

All this both presupposes and prepares for an orderly expansion beyond the original core-function and space limits of the original outpost. It's what we need to do to "breakout of the Outpost Trap."

Point by Point elaboration

Made-on-Luna Habitat & Activity Expansion Modules

Lunar concrete, glass-glass composites and iron, aluminum, magnesium, and titanium alloys are materials science technologies that need to be pre-developed now using lunar simulant feedstocks. We cannot afford to expand by bringing these heavyweight structures from Earth. Inflatables may be a stopgap way of providing expansion space early on, but are still too expensive for building real settlements. We need to develop a modular language that will lend itself to a great variety of layouts. That language should be open-ended. The very awareness that one has begun to "live of the lunar land" in this major way will reduce our sense of alienation, and increase our sense of security.

Towards a modular biospherics

This 9 m2 (110 ft2) "living wall" unit purifies all the air within a 700 m2. (7,500 ft2) building

Centralized Biological Life SupportS systems (BLSS) such as Biosphere II involve a lot of effort that quickly becomes useless as it precludes growth. These made-on-Luna modules should each incorporate a significant biospheric element, pretreating toilet wastes and using vegetation to refresh the air. With this design constraint, the growth of the pressurized physical complex will not outpace the growth of the biospheric life support system, and new modules can incorporate improved systems, so that the total biosphere becomes ever larger and more collapse-resistant. With such a system, short term crew as well as the long-term pioneers that follow will grow ever more confident that their presence on the Moon is well-founded and hearty.

Beyond a minimum "balanced nutrition" diet

There have been many studies of how we could provide balanced nutrition with a minimum number of crops. That's certainly a useless dead-end avenue of investigation. Nothing is more essential to good morale than good food. And by good food, we mean tasty food and a goodly variety of it. If we need to trim the list, we should concentrate first on those foodstuffs that can be served and prepared in the greatest variety of ways -- potatoes being near the top in that regard. We also need to grow herbs, spices, and salad stuffs that can be eaten fresh as well as lending themselves to a wide variety of cooked dishes.

We might have to settle for a closet-sized growth chamber for starters, but surely, no-one is going to leave Earth in their rear view mirror something that approximates "Soylent Green" or algae mush. A starter list of choices can always be complemented by privately grown specialty items, even in a small outpost. As the settlement grows, this will become a great opportunity for "cottage industry" - think jams, condiments, etc.

Keeping physically fit

It never ceases to amaze me how many pro-space people equate 1/6th-G with zero-G. The difference, at least mathematically, is infinite. Muscle tone will decay of course, but then level off at a plateau appreciably higher than is the case for those spending many months in Earth-orbit or free space.

At first, "keeping fit" will mean keeping in shape to return to Earth ready to resume normal activities when one gets back. But as temporary crews slowly transition to a population that includes a significant percentage of permanent pioneers, "keeping fit" will mean what it should, able to work and play with relative ease in what will have become one's home environment.

Terrestrial sports transplanted to the Moon will be just absurd caricatures of the sports we now enjoy. We need to invent sports forms that are interesting to watch and fun to play in an environment where gravity and traction are greatly reduced, while momentum and impact force remain the same.

We could start now, with **a computer program** based on those parameters, applied to both sports and dance choreography. The sooner future Lunans can enjoy sports and dance designed for the lunar environment, the less they will miss terrestrial sports and dance. The morale boost will apply to players and performers as well as to spectators. Lunar sports, lunar acrobatics, lunar dance and ice-skating forms may gain an audience back on Earth via live or canned telecasts and the Internet.

We need to provide special gyms and devices whereby one who wants to maintain an Earth-fit state, to do so. It is one thing to appreciate how much one has adapted to the Moon, another to feel trapped on the Moon because one has lost his/her Earth muscles. The simplest way to retain one's original muscle tone is by isometric exercises that pit muscle against muscle rather than muscle against gravity. exercise in a banked floor rotating gym at variable rates to preserve one's "Earth legs."

Settlement climate, flora and fauna, even wildlife are wide open choices

As we are talking about contained climates and ecosystems, we can control settlement climate and seasons. Not everyone enjoys the same climate. While many in colder climate areas yearn to relocate to warmer ones, this writer cannot tolerate heat with humidity, and would rather be further from the equator.

Because settlements will have a great measure of control over these things, even apart from cultural and architectural differences, the Moon **need not** be a world where "once you've seen one lunar settlement, you'll have seen them all." Not only will variety in these areas work to increase the typical length of an Earth tourist visit by lengthening the itinerary, it will give future Lunans more places to get away to for a welcome change of scenery.

It is not enough to be "at home" inside one's homestead and settlement

If this is all one accomplishes, a residual uncomfortableness with the barren, hostile moonscapes outside - "out-vac" - may remain. Some will feel imprisoned, and even dread venturing abroad. But there are ways, analogous to how we are learning to do this here on Earth, to both "bring the outside indoors" and "take the indoors outside." For example we could create indoor garden spaces in Zen fashion, using raw regolith (ultra fine powder fraction sifted out) and lunar stones and boulders, in a cast basalt pan.

Art accessories can be made of carved basalt or cast basalt, lunar raw blackish glass, etc. We could do something similar outside airlocks using stone or cast basalt "patio" furniture and sculptures. Both approaches would help create a visual transition between exterior surface and interior decor. One could

even create a glass enclosed water feature outside. This will be easier in shaded places with greatly reduced thermal exposure.

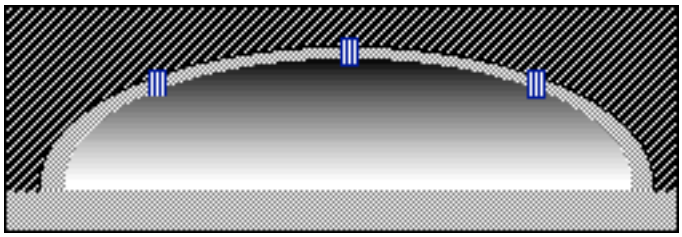
Inside, "middoors", "lee-vac", "out-vac"

Here on Earth, we commonly think of just two spaces, indoors and outdoors. However, we are all familiar with a transition space - the walkway commons of enclosed shopping malls. In this example, "indoors" would refer to the interior of the various shops and stores.

In a settlement with modular residences, offices, schools etc., interconnected by pressurized walkways, vehicular conduits, and pressurized plazas, courtyards, and parks, these interconnecting passages and spacious nodes/hubs form a sort of "middoors" environment. The middoors could be allowed to cycle between cooler and warmer periods in "moderated" synch with the outside or "out-vac" thermal cycles of the exposed lunar surface. While individual homesteads, offices, and other activity spaces could maintain a constant climate, the middoors would moderate the changes occurring on the surface, varying perhaps 36°C (20°F) above and below "room temperature. That is one of many options

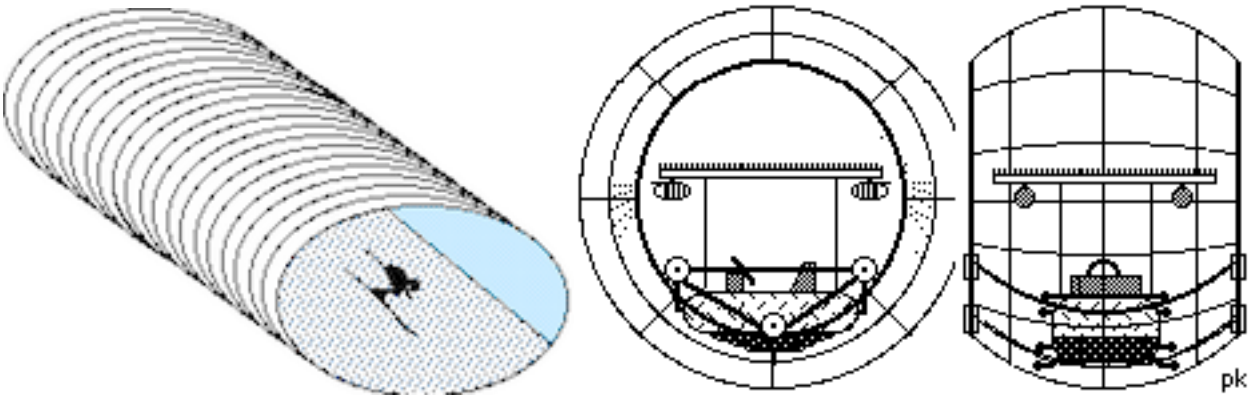
A third kind of environment, which in turn moderates the thermal and radiation extremes of the fully exposed surface is "lee-vac" (leeward of the cosmic weather.) An example is a sheltered but unpressurized structure, canopy, or ramada within which one is protected from the cosmic elements of radiation and micrometeorite rain, as well as from the full heat of dayspan noon on the exposed lunar surface. Lee-vac spaces would be ideal for warehousing items and supplies that are accessed frequently. In such an environment lighter weight pressure suits would be sufficient, allowing much greater freedom of movement, greatly increasing the time one could work without fatigue.

We can see such a sheltered, but unpressurized sports complex. Sports designed especially for this environment would be different from those designed for pressurized play environments. pressurized spectator stands could line the interior side walls of such sheltered and shielded fields could have large windows, protected from meteorite impact. As these sports would be quite distinct from those played in fully pressurized environments, creating such sport environments would increase the variety of sports fare, improving pioneer satisfaction with their adopted home world.



Unpressurized Lee-Vac Sports Arena

Finally, we can see development of various kinds of sports and sporting activities for the naked exposed lunar surface itself - the "out-vac." This great variety of sports fare crossing the boundaries of raw exposed lunar surface and settlement interiors, would help psychologically integrate the lunar surface into the overall pioneer lebensraum - living space. The result would an increase in the average Lunan pioneer comfort zone, a mitigation of a "trapped indoors" feeling, and a slow dissipation of the initial tendency to feel like a "stranger in a strange land."



Left: a pressurized "ski hill" **Right:** a "unicycle ATV

For young people, regular school outings onto the surface would help. And undoubtedly tourist surface excursions will become the specialty of emergent enterprises, serving both visitors from Old Earth and pioneers of the New Moon. Until this familiarity and comfort level with the the raw host environment develops, we can expect some incidence of exophobia to develop, along with a feeling of being trapped.

Adaptations like this are nothing new to humans. Take a person out of his/her native tropics and drop him/her along the arctic coasts, and he/she might soon perish. Eskimos, Inuit, Samoyeds are at home here. They learned to be at home. An initially life-threatening environment is, for them, no longer to be feared. Simply put, the have learned how to cope with the evident extremes and dangers "as if by second nature." When future pioneers have leaned how to cope with conditions once perceived as hostile to life, and those coping measures have become "second nature," they will have become "at home." The Moon, for them, will have ceased to become a hostile, inimical place. It will have become home. Such a transition will be essential for their mental and psychological health. Those who cannot make or resist making the transition will become failed settlers, and will either return to Earth or become a burden to those who have successfully transitioned.

The "Black Sky Blues"

One of the hardest things to get used to in the lunar environment will be the black skies, at high dayspan noon as well as at mid-nightspan. And they are black indeed. When the sun is up, the glare off the moondust forces eye pupils to adjust to the point where one cannot see the stars.

We have evolved in the brilliant blue day lit skies of Earth. Mars also has bright skies because unlike the Moon, it has an appreciable atmosphere. Getting used to that black sky may be harder for some than for others such as night owls who do not like to get up until the sun has set. For the rest of us this could be a problem.

Indoors, ceilings could be vaulted instead of flat, painted a matte sky blue and uplit from cove mounted bulbs. This would create welcome eye relief. This will be especially welcome in high dome ceilinged middoor spaces such as settlement plazas and park spaces.

Uplit matte sky blue awnings mounted on the side of vehicles could give similar eye relief to those traveling across the lunar surface. Remember, that with no air, there is no wind, so unfurled awnings of this type should be no problem.

Taking the monotony out of "Magnificent Desolation"

I have heard my Grandmother say (while in northern New Mexico) that "when you've seen one mountain you've seen them all." For one whose soul has always been in the mountains (and not the beaches, where indeed, one wave looks like every other) I can't empathize with that. But unless we take care to educate future pioneers how to read the shapes of craters, their width and depth, the presence or absence of central peaks, the amount of debris on their floors and on their flanks, they might get to feeling that "when you've seen one crater, you've seen them all." A good course in selenology and feature appreciation will make the "scapes" along the road endlessly interesting and thrilling. If we want our future Lunans to appreciate their adopted home world rather than be forever bored by it, we have to first learn how to appreciate it ourselves, and then learn how to pass those insights and the spirit of endless wonder in others.

I have run into many Moon-enthusiasts who are really not at all familiar with the Moon's surface features, even the nearside ones. Get yourself a good lunar telescope (wide angle, low to modest power) and start exploring, learning names as you go along.

For Lunans, perhaps the most special time to be abroad out on the lunar surface will be during what we call a total lunar eclipse. During full eclipse (the umbra period), the only light reaching the nearside lunar surface is sunlight filtered by the dust in Earth's atmosphere which appears as an orange halo in the lunar sky. But more interesting than the sight of Earth as a lit halo, will be the moonscapes themselves, ruddy in the dim light, looking much more like Mars at dusk or just before dawn.

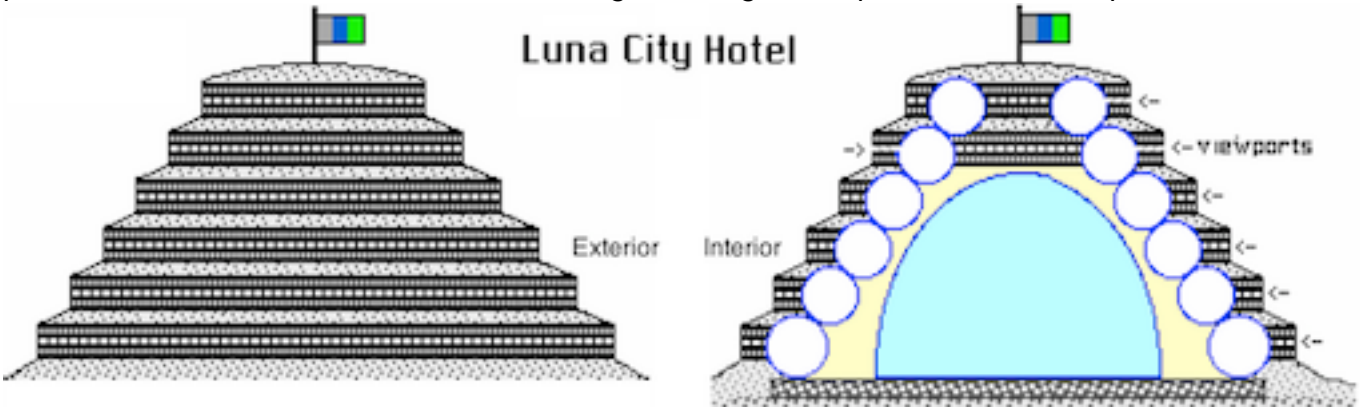
Surface architectures for Lunar habitats that pay homage to the moonscape yet stand proud.

When it comes to visions of lunar settlements, two clichés persist: a complex of molehill-like, mounds of moondust covering trenched-in horizontal cylinders, and giant glass or "unobtanium" domes encasing whole cities, skyscrapers and all. The physical problems of the later make them most unlikely. On a world with an unbreathable atmosphere of a density comparable to what we will want to breath, there is no problem. But that much air pressure facing vacuum outside would rip the dome from any restraints and send it hurtling spaceward.

As to the "molehill" we could conceivably give each the personal touch by simply raking it in patterns, covering it with a lighter or darker variety of moondust, covering it with lunar boulders with or without a pattern, and other means.

The question is "do we want to blend in or stand proud? Our bet is that we can do both, using materials that blend in, but patterns that by sheer regularity and design, stand proud. Our architectures in so far as they show from above should pay homage to the host world, rather than be statements of defiance. If we want to be at home, we need to design accordingly.

Yet it should be possible to build multistory fully shielded pressurized structures above the surface for hotels and other uses, that pay homage in choice of materials and colors, yet stand proud. The hotel below is a pyramid of torus stories of decreasing outer diameter with a vertical elevator-containing cylinder at the middle. An embossed caisson ring holds regolith in place to shield every level.



A bit of Old Earth

It is one thing to leave Earth behind, but quite another to leave one's past behind. As expense as i it is to import anything from Earth, pioneer volunteers should be given a weigh and volume allowance to bring along treasured heirlooms or items of great significance in one's personal history. Say 100 pounds and 2 cubic feet give or take. Pioneers could sell or trade unused weight allowances as some will want more, others need less.

These personal treasures will help tie together their former and new lives. A complete break would be unwise and become the breading ground for neurosis or psychosis. Some things, such as photographs, can be brought along in electronic form. But actual paintings, art objects, pieces of clothing, an heirloom furniture item, must make the journey in the concrete, though with enough shape, texture, and color information some items could be recreated on the Moon as reasonable facsimiles.

A shopper's paradise? Not exactly

With imports from Earth being astronomically expensive, and with initial lunar industries having a relatively small market to serve, there will be few choices. Unless (1) we produce only basic simple "standard issue" items and (2) we design them to serve as is, but also to be modification friendly. Purchasers could then give them a personal touch at their leisure, or, for those with little time and/or talent, "issue" wears and wares could be entrusted to talented craftsman and artists on commission to personalize such items for the customer during free time before or after day job duties.

Such a development could see the early years of a settlement becoming a golden age for lunar craftsmen and artists, all in the name of variety and choice, something we all value as contributing to life satisfaction. Creating a home environment that reflects our one personalities is a basic drive, creating a "safe place" in an otherwise uncaring universe.

Now anything Lunans produce for their own domestic needs are potential exports to other in-space communities (e.g. orbital hotel complexes and industrial parks) at a cost advantage over similar items made on Earth's surface. Thus an initially small lunar market will grow both on and off the Moon, allowing manufacturers to expand product lines. Meanwhile a whole suite of cottage industries may be spawned.

The role of music

We are used to making music with instruments it may be very hard to produce on the Moon. We will have no wood (we will want to recycle all waste biomass back into the biosphere), no copper or brass. However, people are enormously inventive when it comes to making music. The steel drum has to be my #1 favorite instrument (for listening, not playing) We will have glass, ceramics, other metals. Marimbas anyone! Our homegrown instruments will give lunar music a distinctive sound.

Reinforcing our identification with our new adopted world

Learning not to fear the Night(span)

No human has ever been on the Moon at night. unfamiliarity builds fear and timidity. What we fear most about the two-week long lunar nightspan is just that. It lasts for 14 and three quarter days. That's a long time to go without the heat, light, and power of the sun. It requires power storage.

For some strange unfathomable reason, the idea of storing power frightens a lot of people. This is hard to understand given that our whole civilization is bases on stored power, whether it be the potential power of water stored up behind a dam, or the potential power of wood and other combustible fuels. We seem hell-bent on going to the lunar poles where solar power may be available 70-80% of the time. But we will still have to store power for the 20-30% of the time. So why not learn to store power for 50 % of the time and then we can go anywhere. Fuel Cells and flywheels and other means are ready to go technologies.

We may still have to conserve power during nightspan. If we try to reorganize all our mining and manufacturing operations so that we can sequentially do the power intensive things during dayspan and the power-light but manpower-intensive things during nightspan, to the extent that such sequencing is practical,. we will do just fine. This will create an operational rhythm that gives most pioneers a welcome bimonthly change of pace.

Learning to live and work on "Moontime" to the beat of the Moon's own rhythms

Continuing the discussion above, while commerce with Earth would be ruled by the Earth standard calendar. life on the Moon could follow the dayspan-nightspan sequence, with each month (or better, "sunth" would coincide with one dayspan-nightspan cycle, a cycle that will certainly govern mining and manufacturing. A sunth would be 29.53 days long, so a sunth-pair would be 59 days, with an added leap hour every 40 days. We could even schedule "local" weekends to that one would occur during dayspan when we need to concentrate on productivity, one at the start of nightspan, one in mid-nightspan, and the 4th just before dawn. What about weeks. All through history, attempts to assign more or less days to a week than seven have met with strongly resistance. To keep the sunths sequencing on time, we could have a free extra day three weeks out of every eight, and if those were weekend days, I predict there would be little resistance except from fundamentalists who believe Earth time pervades the universe.

We have two similar "lunar calendars" in use on Earth: one Jewish, the other Islamic. No one has figured out a way to mate lunar years (some with 12 months, some with 13) to match up with our standard 365.25 day year-based calendar. Actually as 235 lunar periods equal almost exactly 19 standard years, there is that concordance. But the simplest thing is to use the Earth standard calendar to govern commerce and mark years, and the lunar sunth calendar to govern productive activities.

One further note: on Earth we have 24 time zones offset by an hour each. As the Moon turns so slowly, and dawn at one location can be as much as 24.75 days before or after dawn at another location, sunth-rhythm based calendars will be purely local scheduling aids, and Lunans too will use the Earth standard calendar for marking common dates and events.

Raising the first and future generations of native-born Lunans

The first and future generations of pioneers actually born on the Moon, or at least growing up on the Moon, will take the lunar environment for granted. But unlike the situation facing young people on Earth, they must learn to appreciate the fragility of lunar settlements, not just with regard to maintaining a positive trade balance with Earth and other pockets of humanity as may arise but with regard to maintaining their artificially created mini-biospheres in good health.

For Lunan youth, this will be of much greater concern ad due attention than it is for us on Earth. While our environment, suffering from lack of attention and diffidence appears to be degrading before our eyes, lunar settlement biospheres could hit the skids and collapse in a much shorter timeframe. Inside these oases in the lunar desert, we will be living essentially downwind and downstream of ourselves.

Our lunar ecosystems will need to be maintained within relatively unforgiving tolerances. Unless the health of the biosphere component of our settlements is a factor in the daily life decisions of all Lunans, the prognosis for long term survival is not good.

It will be essential that all Lunans are schooled in how the biosphere works and in what we need to do, not just as a community, but as individuals, to maintain it. Courses about the biosphere and how group and individual behavior can help or hurt in keeping it in good operating condition should be started in the earliest school grade levels, going into greater depth as students advance. On the moon, there will be a "4th R", recycling. Proper recycling begins with proper manufacturing and proper packaging. Assembly should be in "knock-down" fashion so that unlike components can easily be recycled separately. Manufactured items embody the energy of manufacture and elements withdrawn from nature. The less we return to nature as trash, instead of reusing, the more total energy we will consume and the more raw material we will throughput, or to put it bluntly, excrete. Our settlement efficiency index will be a measure of how little energy we consume and how little we excrete to achieve a given standard of living. Lunans must never forget that economic survival is problematic. We are behind the economic eight ball. We need to make the most out of the least in order to go beyond survival to the state of thriving. A well-grounded realization that our are settlements are thriving, will do much to promote a sense of well-being, that we stand to turn our new world over to the next generation in good health.

To the extent that we get low marks in these efforts, the rise of neuroses and psychoses may be appreciable.

The place of youth in all this.

While many believe we should postpone procreation on the Moon until we are sure that our offspring will be healthy, such a position is demonstrably absurd. We cannot know for sure that native-born Lunans will be hale and healthy until we see that the children of native born Lunans have no appreciable physical and health defects. In other words, the only way we can be sure is by taking the plunge, the sooner the better.

To forbid the first generation of settlers to raise families would measurably lower their happiness level, and their satisfaction with life on their new homeworld. It will also negatively affect the happiness level of the first generation of older pioneers, for whom grand-parenting is one of the great rewards of advancing age.

Youth can be entrusted with environmental chores. Collecting, disassembling, and sorting recyclables for instance. Picking up and sorting trash is another. Older children can assemble new artifacts and new toys out of the disassembled, sorted parts of old ones.

Young people coming of age, say 18, could be put to work in a universal service core maintaining the life support systems such as waste water treatment and air refreshing, and farming duties. This would instill in them an appreciation for what makes a settlement biosphere works. The greater the fraction of young people who appreciate such things, the more sure all can be that their settlement will survive and thrive long past their individual deaths. In short properly educated youth will mean a greater comfort and sense of security for all.

The place of retired people and seniors in all this

In the early days of outposts-no-yet-settlements, aging frontier volunteers may be "paroled" to Earth at the end of their "usefulness." While those in their working years may not want to "carry" retired or other older citizens, such attitudes betray a great ignorance about how society works. We've all heard the phrase "it takes a village to raise a child." Grandparents and other seniors are a vital part of any such village. Grandparents can help raise children while parents are busy working in jobs that produce income-earning exports.

The personal knowledge and wisdom that seniors have to impart is a vital complement to what teachers do. And there are light chores seniors can do to free younger people for more productive roles. They can do the lion's share of needed clerical work: bookkeeping, database work, communications: the list goes on. This helps rather than hurts the overall efficiency of an all-generation settlement.

Seniors in general are happier than those of middle age. They are more satisfied with their lives and achievements. They have a better sense of what, when all is said and done, really counts in life. Without them, a settlement would soon be adrift. They are anchors.

The place of pets and "urban wildlife"

The latest evidence tracing the mitochondria trail, is that wolves transitioned to dogs in just one place, somewhere in east asia, about 15,000 years ago. Those wolves who, on spotting a human, fled out of caution from the trash dumps of early stone age villages got less food than those who were less fearful of humans. These got to produce more offspring. Humans in turn selected among these "more hungry than fearful" for more and more tame animals.

Early dogs allowed Siberians, Eskimos and Inuit to settle the high arctic. They allowed mountain-dwellers to tame mountain sheep and goats. Their bark created an early warning system and dogs quickly spread by trade to all peoples around the world. Wolves were became dogs as Cro-Magnon peoples were becoming human.

The growing percentage of people who rent housing from landlords who do not allow pets, is producing an ever larger percentage of youth growing up with no appreciation of these humanized companions. Is there a place for dogs, cats, and other pets on the Moon?

There will be challenges to be sure. I remember seeing a cartoon with a dog in a spacesuit lifting its left over a lunar boulder. But to those who accept them, challenges of any kind become opportunities.

There can be no doubt about the psychological benefits of pet ownership. The benefits for seniors is well-documented. Such seniors live longer, happier, more fulfilled lives than those who do not have pets, and are much less prone to depression and loneliness. In young people, pet dogs who love their owners so unquestioningly, bring out the good social qualities, fostering empathy, compassion and consideration for others.

The question is how they will fit in within size and resource-restricted space frontier settlements. But only those who have not had the fortune to be loved by a pet can question that we will find a way. Speaking for myself, I would not sign up as a pioneer if my right to have a pet was at risk. I cannot imagine in a petless situation being as totally happy with life as I am now.

As to urban wildlife, some are pests, others not. We would miss a lot in a settlement with no butterflies, no birds, no fish, no squirrels. I believe we can share our frontier spaces with carefully selected species, with the balance between advantages and drawbacks decidedly in the positive. If only neutered animals were released into the ecosystem and/or to private ownership, with all breeding stock being securely isolated, there would be no danger of runaway populations.

Temporary Conclusions

We make no claim to have "covered" the field of possible mental health issues and adjustment issues that will affect future lunar settlers, Lunans.

But we trust that this is a good start. One thing we have not touched upon, but have affected pioneers throughout human history, is the recurrent emotions relating to places and people they have left behind, including friends and relatives, favorite hobbies and forms of recreation that cannot easily be replicated on the Moon, etc.. But issues like these have already been widely studied and there is little unique in the lunar frontier situation to warrant revisiting them.

Yet some of those deciding to return to Earth because of things they miss, may in time realize that those things do not matter that much, and instead will come to miss some of the things they did learn to appreciate about life on the Moon. And some of them will then say goodbye to Earth and hello to the Moon for a second time. This is to be expected.

Inevitably, some pioneers will fail to make a healthy transition and may need to return to their home world. It is better that "complainers" leave as no one appreciates people with that mentality.

Application to pioneers on Mars

For future new Lunans, "returning home" will be much easier, and much cheaper, than for future new Martians. That realization may make Martian pioneers more determined to get used to their new world and to make the best of it. In relation to the Moon, as a human habitat, Mars has both advantages and disadvantages. That is another article. But otherwise, much of what we have suggested above will also apply to pioneers on Mars, "mutatis mutandis (changing what must be changed). To The Moon! PK

Also read "**The Moon: Why and How we Should Return**" © 2004
http://www.moonsociety.org/publications/mmm_papers/**moonreturn_positionpaper**.htm

Getting to Mars Faster by Visiting Venus First?

By Peter Kokh

November 2013. ISRO's Mangalyaan Mars Orbiter and NASA's MAVEN Mars Orbiter left one after the other for good reason. Earth and Mars, being in different orbits around the Sun, only line up once every 25+ months. If you are willing to expend more fuel, you can start your journey a few days early or a few days late. Faster rockets will shorten the journey, and perhaps widen the window, but nothing we can do can shorten the two year plus interval between windows.

Either way, before or after window extensions would require much more fuel at both ends. Even with more fuel expenditure, and wider windows, those windows would not be brought closer together. Miss this window and the next one opens at the start of 2016. The same is true of the time between opportunities to rocket back to Earth. Miss an opportunity, and you will be stuck on Mars for another 25-26 months, and lets hope that you have enough food and other provisions, a tall order!

When it comes to human travel between Earth and Mars, if we are not to take foolish risks, we need to travel in "Quiet Sun Years." Every eleven years the Sun becomes more active, giving out stronger and longer burst of radiation which could make long space journeys quite risky. That means that sometimes, "safely usable" launch windows will be 51 months apart at times.

A "detour" as a way out of this predicament?

But this constrained launch window schedule is true only for direct trajectories. Sometimes a detour can pay off, especially **a detour that swings by Venus**. You leave Earth swinging inbound to a close rendezvous with Venus, close enough for Venus' gravity to grab you and throw you into a new trajectory bound outbound, not back to Earth but to Mars. How often do the three planets line up to permit such a trajectory? I'm not the one to calculate that, but the point is that this is an option, at a price, that could get a mission, manned or unmanned, to Mars, or back from Mars at times when a conventional trajectory is not available. The price, of course, is that such detours will require more fuel.

Outlandish! Hardly. NASA has been using "swingby gravitational boosts" for years. In fact it has been common practice as a way to telescope travel times between Earth and Jupiter or Saturn for decades.

Now the "by way of Venus" will cost more in terms of rocket fuel and/or power. That is something that has to be weighed by mission planners. If timeliness is the #1 consideration, the price will be worth it.

The really importance of this option is that when humans are involved, and we either need to get supplies to a crew on Mars before the next conventional window opens, or we need to get them back to Earth before the next conventional window opens, a by way of Venus option just may work. But such booster trips will not always open at convenient times, and in fact, once you get to Venus, a gravitational assist may swing you back to Earth orbit, but not necessarily at the point where Earth will be in its orbit at the time. But wait, there is a fix for that.

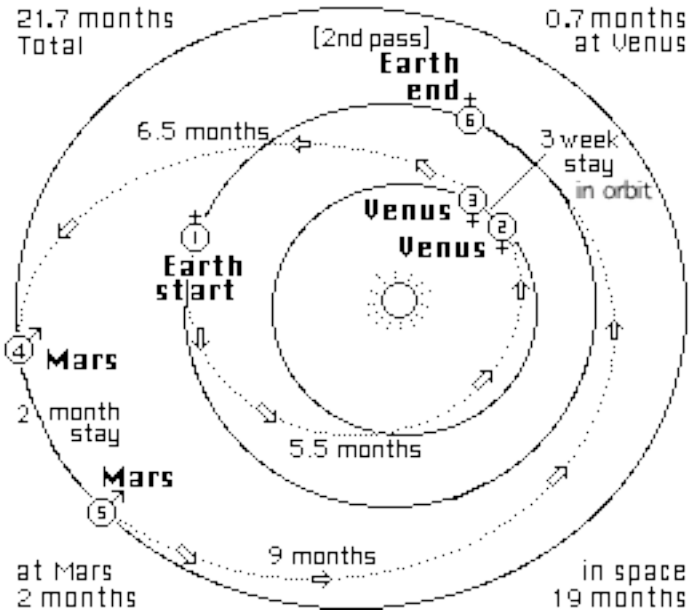
Upon getting to Venus, the craft could go into orbit around the planet, and stay in orbit until a window opens for boosting to Earth or to Mars as the case may be.

The cost in supplies and fuel for that extended visit to Venus will have to be weighed. But that this is an option could be a way of salvaging an Earth-Mars manned mission from tragedy of some kind. Now we need someone more adept at the particulars to calculate what options will open when. It is always good to have options!

Standard Mars Tourist Itinerary — Now let's fast forward to a time when tourists will be welcome to go to Mars. The conventional itineray is Spend 8 or 9 months en route to Mars. Tour till you've seen enough then hibernate for the rest of your 18 month stay until the return launch window opens. Send 8 or 9 months in space. Total time away from Earth two and a half to three years.

(Standard Mars > Venus > Earth Tourist Itinerary — Spend 5 or 6 months on route to Venus. Spend 11 months on an aerostat (blimp-like structure) floating high enough in Venus atmosphere where air pressures and temperatures are benign, looking at Venus' surface features through telescopes on the end of tethers below the cloud, and work for the science crew there until the eleven month wait for your 5 or 6 month return trip to Earth. Total round trip time two years. An Earth > venus > Mars itinerary will be similar. That's the deal using minimum fuel expenditure Hohmann transfer paths to Mars and Venus. And the windows open only every 25 months or so for Mars, and every 19 months or so for forbidden Venus.)

The "2 trips or less than 1" deal — But if you had to get to Mars in between those windows 25+ months apart, there is a way using the so-called "conjunction class" trajectory to Mars, first swinging in toward Venus for a gravitational boost. It takes about a year in space to get to Mars by way of this detour. You'll get there just two months before it is time to return home the ordinary way. Leave from Earth a couple of weeks sooner if willing to pop for the fuel to break into Venus orbit, and then launch out again three weeks earlier, and you get nice length stays at both worlds and still get home in under two years, less time than it takes to visit one. A deal which should prove very popular!' Especially if, once you've been on Mars a few weeks, the monochrome rust colored scenery gets to be too too boring (if there is no way yet to really see all the sights Mars has to offer)



CONJUNCTION CLASS PATH----EARTH>VENUS>MARS>EARTH (PK)

For a creative way to spend your time hovering in the cloud tops of Venus while waiting for your departure window to open, read MMM #60 November 1992, p 3. XITIES: **Aerostat Xities over Venus - reprinted in MMM Classics # 6** (http://www.moonsociety.org/publications/mmm_classics/mmmc6_Jul2005.pdf) and/or **in MMM Solar System Theme Issue** (http://www.moonsociety.org/publications/mmm_themes/mmmt_solarsystem.pdf)

For "immigrants" to Mars, the conventional windows will probably do okay. Most "visitors" would get bored with Mars fairly fast and welcome shorter visits. And for rescue in between it is good to have the swingby options, along with the needed fuel and power to use them, of course.

How would these options be affected by availability of faster rockets - Vasimir and/or nuclear? The windows would widen and that should allow shorter trips. But the window spacing will remain the same.

We would greatly appreciate if someone with vastly more knowledge and expertise would take a look at these ideas.- PK

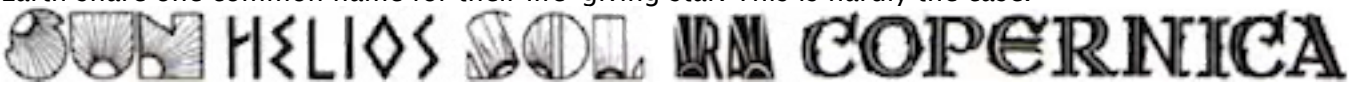
In Ison's wake: Isn't it time to give the Sun, our Star, a proper Name?

[Reprinted from MMM #37 July 1990] By Peter Kokh

[Sun, Helios, Sol, Ra - why not "Copernica?"
SHOULD "THE SUN" HAVE A NAME?

By Peter Kokh

While many could perhaps care less, it seems appropriate to this writer at least, that all peoples of Earth share one common name for their life-giving star. This is hardly the case.



"The Sun" is one single word into which we put two quite distinct references.

1. "The Sun" is our name for a particular star, the one we orbit.
2. "The Sun" is **a vocational relationship** which makes this star special: it centers a planetary system, which it bathes with parental warmth and life-giving energy.

In the first sense, "the Sun" is very unique, our very own star. In the second sense, it is a relationship of fostering paternity (and the origin of the idea of "the Demiurge" with semi-divine co-responsibility for our existence). And this relationship is most likely not unique. Any star with planets is, for them, "the Sun," then is a word a lot like 'Father' and 'Mother,' i.e. **a "title" rather than a "name**."

So long as mankind's horizons and its expectations of spreading domain do not overflow the Solar-System-of-our-Origin, this dual function word serves reasonably well. But as we consider the eventual out-migration forming a human diaspora that could include any number of "solar systems," the need to come up with a non-generic name for our Sun becomes increasingly relevant. After all, any star will be "the Sun" to inhabitants (native or colonizing) on any of that star's planets.

Almost all science fiction writers who have been faced with the problem, have taken to referring to our Sun as 'Sol'. This choice has two burdensome liabilities. First, "Sol" is once more, "the Sun" in another language, ancient Latin. Second, the derivative, "solar," will very likely be used generically of all planetary systems, and of all star-planet relationships. In this light, "Sol" makes a rather poor and unhappy choice.

Other than Latin, we could borrow from the other classic language of antiquity. In Greek, the Sun is Helios. And again, the derivative, "helio-," is also already in use in a general sense (e.g. heliostats) and is likely to go with us to the stars as yet another generic. One way around this particular problem is to coin slightly altered adjectives to refer to out particular parent-star and its realm. For example, we could say Solaric System when we are referring to our own, and use solar systems in the generic. I can't think of a plausible parallel for helio-serving the same specific function, but I'm sure Greek-adepts could coin one. Then it becomes a matter of public education.

What about the ancient Greco-Roman god of the sun, Apollo? Alas, the word has existing currency (manned lunar program of the sixties) making it a confusing choice.

Already well known, simple, and easily internationalized, is "**Ra**" - name of the ancient Egyptian sun god once revered in Heliopolis. But a case could be made for "Bast", another Egyptian deity who represented "the life-giving power of sunlight." Also lees known is the ancient Sanskrit "Ravi" and Hindu "Surya."

Quite a different solution would be to give our own Sun a proper name adapted from that of a figure in world history who played some especially significant role in our understanding of the Sun's place in the scheme of things. My vote would go not to any recent solar astronomer but to Copernicus, the first of our species to teach effectively that the Sun, not our Earth, is the center of our system. Now his name is already given to a very prominent lunar nearside crater. One way to avoid confusion would be to use a variant form of his name. Instead of the original harsh sounding Polish "Kupernik", we could use a feminine form of the common Latinization i.e. "**Copernica**".

Admittedly this last suggestion flies in the face of the almost universal chauvinist convention of using only masculine names for the Sun, with feminine ones reserved for Earth, i.e. the Earth-Mother/Sky-Father theme of folk myths.

Perhaps you would like to suggest yet another choice? My own preference? I would pick "**Copernica**" and "Ra," in that order, over the other options listed above. But it's a wide open question!

PK

Short Report from the October 3-4 Golden Spike Workshop

By Larry Jay Friesen

The Golden Spike Company held a 2-day workshop October 3-4, 2013, hosted by the Lunar and Planetary Institute (LPI) in Houston, Texas.

[http://goldenspikecompany.com - The Golden Spike Company was formed to monetize exploration of the Moon through sales of expeditions and their surrounding media and merchandising revenues."]



Golden Spike was founded by planetary scientist Dr. Alan Stern, once head of NASA's Science Mission Directorate, and he is the Principal Investigator for the **New Horizons** mission, on its way to Pluto and the Kuiper Belt. He is now President and CEO of Golden Spike. Chairman of the Board is Gerry Griffin, known for a distinguished career at Johnson Space Center, including a period as Director of JSC.

Golden Spike's objective is to get humans back to the Moon using private funding. I previously reported on Golden Spike's plans, based on a presentation Alan Stern made at the 2013 Lunar and Planetary Science Conference in March. Golden Spike plans to develop a low cost transportation system capable of taking human crews to the lunar surface and returning them to Earth, then sell rides to nations or companies who want a mission to the Moon. Mission crews would, among other activities, collect lunar samples and deploy experiment packages.

Golden Spike held this workshop to seek input from the lunar and planetary science community. They want to learn what planning, training, and types of scientific investigations planetary scientists would recommend to Golden Spike's customers, to maximize scientific return.

Dr. Steven Mackwell, Director of LP (the Lunar & Planetary Institute, Houston), opened the workshop by welcoming those attending and discussing the context for the meeting.

Gerry Griffin described how the Golden Spike concept and company got started in 2010. After the Obama Administration stopped the Constellation program to put humans on the Moon, Alan Stern asked himself "now what?" and came up with the beginning of the Golden Spike concept.

In August of 2010, a small meeting was held in Telluride, Colorado, to sound out the idea, followed by a 10-week study, August through October of 2010. The Golden Spike Company was then formed.

During the last three years, people in the company have been refining architectures and studying systems requirements. They have -

- **Completed a business plan.**
- **Identified more funding sources, investors, and customers.**
- **Published an architecture description.**

Dr. Clive Neal of Notre Dame University addressed the question of why we need to go to the Moon with humans. One reason is for science. This includes sample return, deploying experiments, making observations, geologic field mapping, and serendipitous science. Could not this be done with unmanned probes? He quoted Steve Squyres as stating that a trained human field geologist could do in hours or days what took the Mars Exploration Rovers months.

One thing no robot can do is **serendipitous science: responding to the truly unexpected**. Humans could also deploy in situ resource utilization (use of on site materials) experiments.

Dr. Neal said that we need to re-learn how to take humans to the Moon and back, and start taking small steps in learning how to live on the Moon.

Dr. William McKinnon is a scientific advisor to Golden Spike. He reminded us that the Moon is key to understanding the solar system, as well as understanding the Moon itself.

Alan Stern was the final speaker Thursday morning. He said that the company has identified three potential markets:

(1) **Nations** (twenty to thirty nations have the means and might potentially be interested)

(2) **Corporations**

(3) Wealthy tourists

Dr. Stern described Golden Spike's mission plan to use:

(1) **Existing expendable launch vehicles**, modified as needed;

(2) **An Earth orbital capsule** modified and adapted for a lunar mission; and

(3) **A new lander and new EVA suits**.

The Plan

The current plan is to use four launches in salvos of two, using Atlases and Falcon-9s. This plan has been published in AIAA's Journal of Spacecraft and Rockets. If the Falcon Heavy becomes available, Golden Spike can do everything with two launches. Another architecture would involve two uprated versions of the Atlas.

Northrop Grumman and United Launch Alliance have devised lightweight lunar lander concepts.

Dr. Stern mentioned some flight systems milestones that lie ahead for Golden Spike. He also discussed some future capabilities Golden Spike might develop if its initial missions are successful, including longer stay times, far side exploration (current plans are for missions to the near side of the Moon only), and a rover for the crew. His talk was followed by a discussion period.

Thursday afternoon, **Dr. David Kring of NASA Johnson Space Center** spoke on "Landing Site Options for Short-Duration EVA Human Exploration and Sample Return Opportunities". For short-duration missions, as Golden Spike's proposed flights would be, geologically simple sites might be preferable. The missions Golden Spike is proposing would be very similar to Apollo H class missions. Apollo 12 and 14 are examples of these.

K. Shearer spoke on human sample return from the Moon. Related topics include:

(1) Planetary differentiation;

(2) Origin and distribution of volatile sources;

(3) The bombardment history of the Moon and inner solar system.

Dr. Pat McGovern et al. spoke on "Lunar Nearside Olivine Exposures as Targets for Human Exploration." Lawrence, Robinson, and Joliffe made a presentation by telecon, on "High Priority Locations for Nearside Lunar Sortie Missions." They used data from the LRO extended mission to aid identification of sites of interest. Candidates, include Mons Hansteen, Marius Hills, Mare Ruemker, and the craters Lichtenberg, Copernicus, Aristarchus, as well as several other locations.

Gruener and Lawrence spoke on a nearside lunar geophysical network. They are trying to identify lunar surface locations which, in combination, would give good coverage for a seismic network.

Stininger et al. presented a method for getting precision landing on the Moon using lidar hazard avoidance and terrain relative navigation (TRN).

Thursday afternoon finished with a panel discussion. Panel members included Gary Lofgren of NASA-JSC, Clive Neal of Notre Dame, and Samuel Lawrence of Arizona State University. Much of the discussion centered around the need for curation (organizing and maintaining a collection of samples), and training for the crew. A point was made that curation really starts with mission planning and equipment selection.

Someone on the panel asked: " are all seismic instruments alike?" If we wish to set up a seismic network for the Moon, it would help if all seismic instruments respond in the same way. The scientific community cannot impose conditions upon Golden Spike's customers, but they <u>can</u> offer recommendations for "best practices".

Thursday included a poster session. Examples I found interesting included: raised relief maps of the Moon; characteristics of the Marius Hills skylight, lunar caving and lava tubes, and Ina-like young volcanic structures. Thursday evening, Alan Stern and Gerry Griffin made a public presentation about Golden Spike at the Lunar & Planetary Institute.

On Friday morning, October 4, Dr. Steven Mackwell summarized thoughts from day 1. He observed there had been a lot of focus on sample collection and network deployment.

Friday paper topics included:

"A Dedicated Small Exploration Orbiter (S-LEO) and Mobile Payload Element." The orbiter would carry scientific instruments to map resources, especially volatiles, and act as a far side communication relay. The mobile payload element would be a lander with a small rover to sample volatiles outside the contamination zone of the lander's rocket plume.

Another paper focused on precision landing and hazard avoidance.

A Multi-Mission Space Exploration Vehicle (MMSEV): a standard cabin that can be kitted with various front and back ends for various applications and destinations; for example, as a lunar surface rover. Its windows offer great observation from inside. Two such rovers can dock together; each has four suit ports and external manipulator attachments.

Lunar swirls as a landing target. (http://en.wikipedia.org/wiki/Lunar_Swirls)

Clive Neal made a presentation on behalf of Dean Eppler, a NASA employee who was unable to be present, about science operations on the lunar surface. Eppler considered the experience of Apollo astronauts and the annual NASA-JSC "Desert Rats" operations where people field test equipment and operational methods proposed for lunar or Mars surface operations. For effective science operations on the Moon, crew members need training in both geology and field communications. Training is needed for the support team on Earth as well as the flight crew.

Eppler sees safety as the biggest operational issue. Voice recognition does not work well; the field environment is very noisy. The Apollo 14 cart turned out to be more a liability than a help; wheels were the main problem. An effective cart for future Moon walkers will need wheels designed for difficult terrain; for example, soft terrain around a crater.

Nagihara et al. discussed heat flow probes for human lunar missions.

Zacny et al. presented on drilling technologies for lunar exploration. They discussed possible difficulties with drill extraction, drilling into hard icy soil to extract water at the lunar poles (it would be like drilling into concrete), and manipulating a drill core after getting one.

Lucey et al. spoke of achieving ten meter resolution of thermal infrared spectroscopy and thermo-physical properties from lunar orbit with instruments comparable to some now aboard spacecraft in Mars orbit.

Dr. T. S. Lee spoke about Korean space plans. Korea plans to send a lunar orbiter and a lunar lander by 2020. Dr. Lee's group has an objective of making a landing pad for a spaceport on the Moon. He spoke about water storage and of making lunar concrete without sand.by using volcanic ash, with enzymes or polymer as binders. He also reported making habitats from soil, using a 3D printer.

William McKinnon and Steven Mackwell presented a summary of the workshop.

Alan Stern was the final speaker. He intends to assimilate what he has learned from the workshop, and will continue to solicit inputs from those interested in the project.

Dr. Stern mentioned future aspirations.

- Golden Spike intends to use the income stream from their missions to fund development of the next-generation systems that would enable longer stay times on the Moon, etc. which he had referred to on day one.
- If Golden Spike is successful, its initial mission scenario will be only the first step for future human activities on the Moon. LJF

Will Hillary Give The Moon Away?
Or will she Reassert US International Leadership in Space?

By Dave Dunlop

This article is being published in January 2014 issue of To The Stars International Quarterly (#6) when not only will momentum be building for the upcoming US Congressional elections in November 2014, but for Americans, horror of horrors, the 2016 Presidential Campaign will also begin its deafening two year acceleration. Is there anyone who doesn't think that Hillary Clinton, barring only illness, or injury or death, will not seek and win the Democratic nomination for the 2016 Campaign? The US economy continues on its slow pace of improvement, and to look at the strength of the stock market and NASDAQ there might even be a more optimistic economic climate during 2015 and 2016. So the prospects for a Democratic candidate might be supported by a stronger economic picture and the economic mandate of heaven may fall on the first woman President of the United States.

While my Republican friends cannot identify any comparable candidate for 2016, I will provocatively take advantage of this Presidential Candidate Gap between the Democrats and Republicans to speculate on what Hillary Clinton might do in space policy as a Presidential candidate, and if she were elected, as President. I would remind those skeptical of this speculation, that Hillary Clinton distinguished herself from the field of competing Democrat candidates in the 2008 Presidential primary election campaign by giving a speech devoted to space.

Hilary selected the talented space strategy advisor Lori Garver, who later was appointed NASA Deputy Administrator by Obama and who championed the successful Commercial Crew and Cargo programs in spite of the opposition of the SLS (Space Launch System) supporters in Congress.

None of the other candidates campaigned on space. Perhaps they were thinking that space has a niche constituency in districts where there are NASA centers or large NASA contractors and that space did not present much of a wedge issue for the general electorate which was much more concerned about their jobs and the cooling state of the economy.

So will the past be prologue to the 2016 campaign of Hillary Clinton? I think so.

I. Hilary Clinton as a candidate for President

Hillary as a candidate must distinguish herself from her predecessor whose popularity has fallen. She must find acceptable ways to repudiate unpopular Obama policies and more importantly provide some fresh ideas and a sense of optimism about why she is running and what she will do if elected.

Space as a national issue presents some opportunities and threats as a wedge issue in this campaign. Some momentous things are happening. NASA has been torn between the Congressional constituency backing the Space Launch System SLS) and the Orion capsule program backed by powerful Republican Senators and the Obama administration's focus on contracted commercial capabilities and technology innovation.

II. The Gift of Commercial Cargo and Commercial Crew

The Obama administration has scored a major success with its Commercial Cargo program to the International Space Station which has successfully provided two contractors, Space -X and Orbital Sciences with successful missions to the ISS by their Dragon and Cygnus cargo vehicles respectively.

The Obama administration has also fought for the commercial crew program with contracts to Space -X for the manned Dragon capsule, to Boeing for the CST-100 capsule, and to Sierra Nevada for the Dream Chaser "mini-shuttle." The Space-X Dragon capsule and the Boeing CST-100 are likely to fly in 2017 just as a new President takes office, presenting another prospect for national pride in a NASA public private collaboration. These commercial programs will also end the huge subsidies being paid to the Russians for the delivery of American astronauts to the ISS.

Hillary can argue that this program should create more American Space jobs and help to revitalize the American Space Industry. Hillary can also campaign on ending the Russian subsidy by making a commitment to all three American commercial crew contractors. Space -X, Boeing, and Sierra Nevada.

III. The Times, They Are A Changin'

There are, however, dark clouds gathering for the NASA kingdom especially in regards to manned spaceflight and heavy lift launches, an area in which it has had a monopoly position since the 1960's.

1 The Space-X company is about to demonstrate its ability to provide a reusable Falcon 9 launch system and dramatically lower the cost of launching things into space.

2 Early in 2014 Space-X is also expected to launch the Falcon 9 Heavy. Space X is also expected to launch another Falcon 9 Heavy for the Air Force in 2015. This is two years ahead of the SLS unmanned launch in 2017and seven years before a manned launch in 2022 with an Orion capsule is anticipated.

3 These developments will create the conditions for the cancellation of the SLS Heavy lift launcher. A Falcon 9 Heavy system launch will cost less than 1/6th the cost of a $2Billion SLS system launch. This is a huge wedge issue for the Republican Red States of Alabama, Texas, and Florida where the SLS and Orion have the most impact. If the Republicans pursue a relentless program of cutting the Federal across the board they set themselves up to see Obama or an incoming President Hillary Clinton reward them with a cancellation of this unsustainable budgetary boondoggle launch system. By perpetuating a boondoggle porkbarrel program they have set up their NASA center constituents for extinction.

4 President Hillary Clinton could counter this reduction in NASA's in-house SLS program with contracts for lower cost space missions in Florida at KSC, in Texas, from a newly developing spaceport that Space-X is developing near Brownsville, as well as the Mid-Atlantic range on Wallops Island, and Vandenberg, in California. Spaceport American in New Mexico will also be another bright spot for the American Space Industry with Virgin Galactic expected to begin commercial service by the end of 2014 and the potential for subsequent Stratolaunch operations.

IV. Extend the ISS to 2028

There is another card that President Hillary can play in response to an SLS cancellation and to differentiate herself from President Obama's space policy. She can build on her experience as Secretary of State and reassert strong Presidential international leadership in space by building on the foundation of the ISS partnership by announcing her support for the extension of the ISS program until 2028 during her campaign. This will please our international partners who have been shocked at the prospect that NASA announced that it would deorbit the ISS in 2016, and who fought vociferously for its extension to 2020.

Russia even announced that it would maintain its components independent of NASA's exit to an ocean dumping. This extension is a policy already being negotiated at present by the ISS partners.

Reusable Falcon 9 missions will greatly reduce the expense of maintaining this ISS program for the US and regain the confidence of our ISS partners in this stable space program commitment. This also keeps much of the NASA HEOMD, the biggest share of NASA's budget moving forward with operations at JSC, Marshall, and KSC.

V. The Next Big Thing: E-M L2 Gateway to Mars and Beyond

Hillary can also build on this announcement with another riposte to the Republicans. She could also announce that the US will use its reusable space launch heavy lift capacity to build an international Gateway Station at the Earth-Moon Lagrange Point 2 and invite our ISS partners to build the highway to return to the Moon and advance to Mars and the asteroids. The US would then joining the existing international consensus of its ISS partners that the Moon is the next destination and stepping stone on the way to Mars. This would also be a program of shared expenses and support building on the success of the International Space Station but also expanding the partnership to include new partners such as India, Korea, Brazil, Mexico, and Ukraine that share both the risks, expenses, and rewards. This would increase American Space jobs by increasing the flight rate at American Spaceports, maintain existing contractors, and develop new contractors such as Bigelow which can reduce the cost of a new space station while doubling its size with inflatable modules.

VI. To Mars via a CisLunar Highway

There is, within NASA, a strong anti-lunar program bias that has resulted in an "Asteroids and Mars First" national space policy that has created strong rifts with our international ISS partners. NASA HQ has preferred to sacrifice the Moon and our position of international leadership for a Mars Program that has had triumphant landings but been shortsighted in starving the development of our space infrastructure for the future. Hillary is going to have to break some eggs to refry the NASA omelet and what NASA's Republican critics and others such as the Space Foundation have criticized as a drift in policy. It is time to replace much of the geriatric leadership at the top of NASA and get some fresh blood with renewed vision in place. Another critical new piece of this strategy is the development of space refueling depots that reduce costs for reusable in-space tubs and ferries from LEO to GEO and E-M Lagrange point and eventually to Mars.

VII. Building Momentum for Clean Energy from Space

Hillary can also address the issue of global climate change and the requirements for clean and sustainable energy by **creating an international initiative to develop space solar power satellites** as the former President of India Dr. Abdul Kalam has advocated in partnership with the National Space Society. China, India, and Japan are interested in the prospects of space solar power and the Chinese have recently devoted more resources to this area. Bold US leadership can create an expansion of the commercial satellite industry from a $200B plus industry to a Multi-Trillion dollar industry over the next several decades that can provide clean energy to the entire world, stop fossil fueled climate change, provide enough energy for continued global economic growth, continue the global rise in living standards, eliminate the scarcity of fresh water supplies, and provide the economic resources to reduce environmental destruction and the human environmental footprint.

VIII. Restore the Vigor of the Space Exploration Program and Science Mission Directorate

The NASA Science Mission Directorate has suffered a slow down in the tempo of it new missions, eliminated new lunar initiatives, and struggled to maintain its position as the crown jewel in the scientific achievements of the United States. With much reduced launch costs this situation can be reversed.

NASA can also increase its use of smaller cube satellite secondary launch missions to permit a new generation of young scientists to initiate a new wave of solar system explanation. New solar electric and ion propulsion technologies will continue to lower costs because many of these missions will have lower mass, lower volume, lower power, and lower temperature capabilities than the older Billion dollar "Christmas tree" deep space missions.

The New Space Technology Mission Directorate will provide the technological innovations to bring a this new generation of spacecraft and explorers into action also with advanced laser optical communications. A "GPS" system for cislunar space is another major international initiative that will provide the US with another position of strong leadership.

A renewed focus on international collaboration with Earth Observations and Environmental Protection systems is another area where the next President can strengthen US leadership and restore its championship of the environmental movement with its Earth science initiatives and funding again benefitting from smaller and less expensive spacecraft systems. This is another area where international collaborations will also make a renewed wave of exploration more affordable and collaborative. Many nations that previously could not afford to participate will now be able have a seat at the table and to collaborate with the US Universities and young scientists.

The NASA Lunar Science Institute with its several international partnerships can be a leading edge in this program that builds global partners and a new generation of young space scientists from around the world. With ts new name Solar System Exploration Research Virtual Institute can be the tip of spear in this regard in partnership.

The NASA Space Grant network in all the states of the Union can be used to distribute these mission opportunities and resources with a reinvigorated NASA Space Grant Program that benefits from the competitive awards to entrepreneurial style of small university based teams. GLXP teams from Carnegie Mellon (Astrobotic) and Penn State (Penn State Lunar lions) are good examples of this model.These teams can also be well aligned with the STMD, SBIR, and TTR programs for commercialization of new technologies and applications.

IX. Space Tourism

The next President will see an expansion of the commercial manned suborbital launch industry. Virgin Galactic is most likely to be the first such commercial service starting in late 2014 or early 2015 if the FAA certification process proceeds apace. Stratolaunch, Blue Origin, and X-Cor are also pushing to join Virgin Galactic in the space tourism industry. The next administration should provide a climate to insure that the place where the global public can get into space is in the United States.

X. Space Debris and Salvage

Hillary Clinton can also shape the future of the global space industry by providing a strong international initiative on the limitation of space debris and the initiation of a new international program to salvage dead satellites and reuse their metals as the low hanging fruit of demonstrating the use of in situ resources. Other technical means such as use of in-space and or ground lasers to deorbit space debris should be negotiated with transparent protocols and technology so that the problems of “dual use” do not prevent tackling and solving this impediment to the safety and security of space operations and facilities.

Summary

I have outlined the opportunities for Hillary Clinton as a candidate and as a successor to President Obama, to redirect US Space Policy. The same program could be adapted by Republican candidates to their own political advantage. If Hillary does not take an activist position on space then the Republicans could use these points as wedge issues in their own campaigns.

Thus far the Republicans have weakened their appeal with conventional pork barrel programs such as the SLS (the genetic successor to the Constellation Ares V Progra) which is financially unsustainable at $ 2 Billion a pop, as the last Augustine Commission clearly reported in 2009.

They have weakened the NASA budget for commercial crew programs which has delayed the advent of US Companies in providing manned access to the ISS by 2015 to 2017 at the earliest. This delay has continued to subsidize the Russians as a result to the tune of $400 Million annually.

Those making mindless budget cuts have practiced a false economy which is destructive of both our short and long term national interests and international space leadership position.

In the 2012 Republican primary race Mitt Romney laughed at the space advocacy of Newt Gingrich, a long time supporter of the US Space Program. Mitt no doubt is not laughing now.

The Republicans under both Bush Presidents did support a return to the Moon and should do so now using all the cost effective new tools at our disposals and with our strong ISS partners and invitations to new partners such as Indian, Korea, Brazil, and Mexico. Their support of the NASA manned space monopoly is inconsistent with the Republican advertised philosophy of private enterprise and entrepreneurial initiatives. And it runs against the strong tide of well known private entrepreneurs Elon Mush, George Allen, Jeff Bezos, Sergei Brin, among others. It is unclear why the Republicans have not identified these investors as “the smart money” in contrast with the over time and over budget government NASA managed systems which they supposedly decry.

Obama's upside down priorities for asteroid missions and Mars First missions have damaged our credibility with our closest partners and made them question our judgement and our leadership. This has provided the Chinese with a position from which they can establish their own international leadership by building their own international space station even as we dump the ISS in the Ocean about the same time as the Chinese finish their first modest station in 2020. The symbolism of one power on the way up and the other on the way down could not be clearer. The substance of US space policy could be one further extending US comprehensive space leadership with the new Presidential leadership space policies that are described above.

President Lyndon Johnson said, ”To be first in Space is to be First.” It was true then and it is more true now. The protection of the Earth, the provision of clean energy and the development of space energy resources offer the world a reprieve from mutual assured environmental destruction from the unbridled growth of the use of fossil fuels and limited terrestrial resources.

The logic of wars based on zero-sum games for energy and other material resources can be eliminated by peaceful and collaborative expansion of an Earth-Moon economy and the use of the resources of the inner solar system asteroids.

The US public is fed-up with a program of deficits, economic decline, lost employment and indebtedness. It will respond positively to a program of growth that rejects a prospective economic defeat from "a race to the bottom" international competition with cheap labor working under conditions of economic slavery and thoughtless depletion of scarce resources. A new President from either party can come out swinging with a hopeful and progressive space program that regains the global economic initiative for the US. This must provide for positive collaborations with the other leading global economies in a global win-win on energy supplies, environmental protection, global economic growth, and expansion of the space economy. It is entirely speculative on my part whether Hillary Clinton will see and seize these opportunities or whether a Republican will alternatively do so. I can hope they all campaign with this in mind in 2016. **DD**

Chang'e 3 Lands Successfully on the Moon's Bay of Rainbows

By David Dunlop

December 15,2013 was for me a day to celebrate as the Chinese Chang'e 3 lander successfully touched down on the surface on the Moon. China has become the third country to achieve this feat. It also successfully deployed it lunar rover from the lander to begin a program of scientific exploration. This landing is both substantive and symbolic. Substantive because landing successfully on the surface of the Moon is not easy and symbolic because this landing is only the most recent demonstration of China's rising capabilities in space.

As a member of the National Space Society, the Milwaukee Lunar Reclamation Society local NSS chapter, and member of both the Moon Society and Open Luna affiliates of NSS I welcome the first return to the lunar surface since the Soviet Union sent its last lander mission in 1976. I trust that this successful landing and rover deployment will be followed by a productive period of roving and a successful operation of the science experiments.

I also anticipate the next mission, Chang'e 4 which is a "back-up mission which will no doubt follow-up Chang'e 3 after a period of time in which the results of this first mission has been evaluated. No doubt sometime in 2014 or 2015 we can expect a second demonstration of Chinese prowess, and another step forward.

For lunar science we can expect the results to be reported at major global scientific conferences, and we can reflect this new information in future editions of TTSIQ.

The Second Round of International Lunar Missions Begins

This landing is also the beginning of "the second round" of international missions planned for the Moon. The LADEE mission, the last of the recently funded US lunar missions is one of two currently orbiting the Moon.

The fortuitous timing of its measurement of the lunar exosphere just before the arrival of Change'e III will give us before and after measurements of the impacts of a significant landing on the lunar atmosphere so that will also increase the value of the LADEE mission. The LRO can also confirm the landing photographically from orbit and provide evidence of this success to those who "question" whether lunar missions have actually occurred.

With the Chinese taking the lead in the second round of lunar landings with Chang'e 3 our appetite is stimulated for even more. Fortunately we should not expect to wait very long for Chang'e IV. Also in the offing for 2015 are a number of teams who are competing for the Google Lunar-X Prize. A number of teams have announced that they expect to land in 2015 including **Astrobotics**, **Moon Express**, **Team Barcelona** (Spain), **Team Space IL** (Israel), **Team Indus** (India), and The **Penn State Lunar Lions**.

We should also see Russian Missions Lunar 25 and 26 Orbiter and Lander perhaps as early as 2015. The Indians are planning **Chandrayaan II** perhaps in 2017. The Japanese are also planning **Selene II**. The NASA has also been working on a Morpheus lander with a Canadian Space Agency drilling rig "Resolve". The Resolve Mission is listed in the Global Exploration Roadmap for 2018.

At the LEAG meeting in October 2013 it was announced that the Office of Management and Budget NASA will not supply the lander for the resolve Mission and that this must come either from industry or international partners. That may also open the door for competitive proposals to supply the lander from either Astrobotics or Moon Express.

So **The Second Round is shaping up to be at least an impressive dozen missions:**

1	Chang'e-3	China	2013
2	Chang'e-4	China	2015?
3	Luna 25	Russia	2015
4	Luna 26	Russia	2015
5	Chandrayaan II	India	2017
6	Selene II	Japan	2018
7	Resolve	US?	2018

GLXP MISSIONS

8	Astrobotics	US private	2015
9	Moon Express	US private	2015
10	Team Barcelona	Spain (on Chinese launcher)	2015
11	Team IL	Israel	2015
12	Penn State Lunar Lions	US private	2015

Some additional Lunar Mission initiatives

13	Lunar Swirls Missions NASA & KARI with UC Santa Cruz and Berkeley	2016-2017?
14	Vermont Technical College, NASA Vermont Space Grant with some support from NASA Goddard and JPL	2017
15	Luna 27	2017
16	Luna 28	2017
17	Selene III	2022
18	Chang"e V	2017
19	Astrobotics	2017-18
20	Moon Express.	2017
21	European Cargo lander	2022
22	European Student Moon Orbiter	2015+?

I hope that the Chinese success will accelerate the International consensus about returning to the Moon expressed in both the Space Exploration Roadmap document produced by 12 nations (not including China). I hope that it will also increase interest and the determination of the GLXP teams to carry on to the goal of landing by 2015.

The first dozen missions listed in this "Second Round" represent a robust international lunar initiative over the next five years. This second lunar round might include as many as twenty missions or more going out as much as eight years from the beginning of 2014.

I think that this number might be significantly increased if a number of the GLXP teams that are unable to land before the December 31, 2015 end of that competition can continue repurposed as science missions in a proposed International Lunar Geophysical campaign.

Falling launch costs and demonstrated commercial transportation for lunar payloads should be in place by the 60th anniversary of the International Geophysical Year of 1957-58. Many additional countries might join this scientific bandwagon with the goal of rapidly expanding the exploration of the lunar surface and of demonstrating that lunar fuels can be practically produced from frozen volatiles present on the lunar surface in the polar areas.

For someone who grew up with the excitement of the Cold War Moon race and the Apollo Missions it has been a long wait to see a tangible return to the lunar surface now realized in the ending days of 2013 by the Chinese. My appetite is whetted for the progress of the next 5 to 8 years. Now there a number of countries as well as privately funded companies engaged in this Second Round. Thank you to China to opening the door to Round Two.

Moon 3.0 is in the Offing

The price of launch is falling. The number of planned mission is dramatically increasing. NASA is not in the forefront of this Second round of funded but it has encouraged the US commercial initiatives and is investing on critical future technology development. The Google Lunar X-Prize has announced itself as Moon 2.0. The Second Round of International Lunar Mission is the larger context of the GLXP. This has been important to set the Stage for Moon 3.0. Those who have not had the money to get to the Moon during the GLXP Moon 2.0 can continue to work toward that goal and hopefully do so with the proposed International Lunar Geophysical Campaign. Commercial Service to the Moon should become routine and should break the almost 50 year tradition of national space agencies monopoly on lunar surface missions. Both Astrobotics and Moon Express are serious entrants into this market.

They will face competition from the Chinese as is shown by their offer of launch services by the Great Wall Company on a Long March 4 rocket to Team Barcelona. Team Space IL would seem poised for launches as a secondary mission on commercial satellite launches as is the case also for the Penn State Lunar Lions. We hope other GLXP Teams can use this affordable route to the Moon to accelerate lunar surface scientific exploration.

In 2014 we also anticipate the success demonstration of a reusable Falcon 9 rocket. In 2014 and 2015 we also will see the first flights of the Falcon Heavy rocket. In 2015 we should see the Bigelow inflatable modules attached to the ISS. By 2017 we should see the first flight of the manned Dragon Capsule and the Boeing CST-100 capsules and shortly thereafter the Dream Chaser providing private US manned space activities into LEO..

Laying the Foundations for Moon 4.0

These developments will further advance Moon 3.0 to Moon 4.0 where humans can once again land on the surface to stay and to further explore our neighbor "planet," the Moon, but to begin to utilize lunar resources, to begin commercial activities as well as to further scientific work. Moon 4.0 however should be a collaborative venture, which shares the capabilities of the growing number of space faring nations to pool their resources, share the risks, and reap the benefits of opening the Moon. If Moon 2.0 is symbolized by the GLXP Moon 4.0 is symbolized by Open Luna. I am cheering for the Chinese success of their Chang'e III missions but I also cheer for the many countries that can participate in Moon 4.0. The United Societies in Space organizations also advocates for international economic collaboration and the development of an Internationally funded International Space Development Authority Corporation to development the Infrastructure. The Shackleton Energy Company likewise also intends to raise private investment to permit lunar development with the production of cryogenic fuels and other services. I hope to see the flags of Canada, China, Chile, Germany, France, India, Italy, Israel Japan, Korea , Malaysia, the Netherlands, Russia, Saudi Arabia, Spain, Ukraine, United Kingdom, United States and others on the Moon in the decade of the 2020's. The Golden Spike Company has thrown their hat in the ring.

These developments can't come too fast in a world that is eager for additional resources of clean energy and other material resources and where the Moon can play a critical role in meeting these global requirements. I see that the excitement and fast pace of the 1960's era of space exploration is now in place to happen again this time with a larger slice of the international community included. **DD**

What A Difference A Year Makes: The LEAG Fall 2013 Meeting

A Flock of New Lunar Mission Proposals Moving Down the Track and an ISECG International Stealth Campaign to the Moon

David Dunlop, October 2013

The LEAG meeting of the Fall of 2012 was bittersweet occurring in the brief aftermath of the death of Neil Armstrong and with an appearance by Buzz Aldrin. The "lunar mission sands" of the NASA hour glass were almost at the bottom. LRO was in an extended mission to 2014. GRAIL was on the way, and LADEE was a year out. After that there was really not much more than the cloud of the size of a man's hand on the NASA horizon. NASA's budget was in retreat and the lunar agenda was seemingly at the bottom of NASA's pool of priorities. There were a few GLXP presentations, slender reeds indeed for those who had seen a major revival of hope and a flurry of new missions approved and funded in the first decade of the millennium. NASA's Deputy Administrator has told the AIAA 2012 fall conference that, contrary to the opinion of many, NASA had not abandoned the Moon by carrying forward these missions but continued looking forward as well.

LEAG Braves the NASA Shutdown

A year later fresh winds seem to be blowing even as the Comedy of the Congressional Federal Government shutdown was playing havoc with the economic lives and jobs of citizens in the interest of the political parties game of chicken. LEAG as an advisory body to NASA might have stood down but instead chose to stand up and meet anyway. This was an upbeat way by LEAG Jeff Plescia to celebrate the successful docking of the Cygnus spacecraft with the ISS and the successful launch of the LADEE mission towards the Moon.

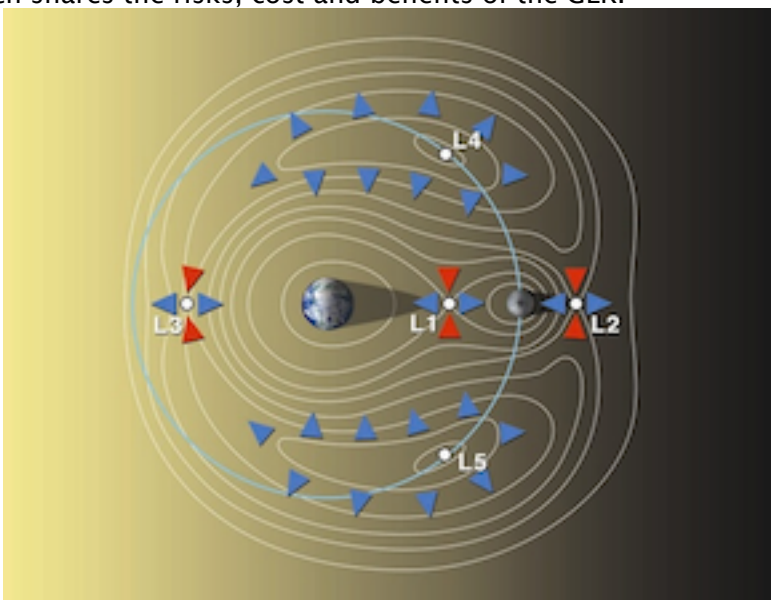
The Global Exploration Roadmap

A bit of light under the door leaked through when the 2013 edition of the **Global Exploration Roadmap (GER)** was released in August by the International Exploration Coordinating Group. In addition to prior 2011 edition of the GER with international lunar lander missions by the Indians, Japanese, and the Russians, the NASA **Resolve Mission** was listed in the 2017-2018 time frame in the 3013 GER. Previously two potential pathways toward the driving goal of Mars were identified:

The first was NASA's "Asteroid Next" agenda versus most other international space agencies "Moon Next" agenda. By 2013 this divergence had been replaced by a single reference mission scenario. "it reflects a coordinated international effort to prepare for collaborative space exploration missions" with an evolutionary progression "beginning with the International Space Station (ISS) and continuing to the Moon, near Earth asteroids, and Mars." The new reference mission reflect a determination to advance beyond Low Earth Orbit in cislunar space with "a variety of missions in the lunar vicinity", building the partnerships required for sustainable space exploration. These missions involve analogs, ISS utilization, robotic missions, advanced technologies, and next generation capabilities and a new focus on human health and performance risk mitigation. The ISECG also published a statement about the benefits stemming from space exploration.

A Next Big Thing"

An scenario developed previously in the NASA Lunar Science Institute team lead by Jack Burns identified the utility of an **Earth-Moon Lagrange Gateway station at E-M L2** as a location where human telepresence could provide an affordable construction of a lunar radio telescope on the lunar farside. The GER introduces its new jargon "Lunar Vicinity" for timeline of coordinated Earth-Moon Lagrange activities. This can emerge as a "Next Big Thing" for the nations supporting the ISS, and including an expanding partnership of countries such India, Korea, Ukraine, and the United Kingdom which were not in the "ISS originals" but now part of the GER development. It seems that the cold economic winds that have affected the United States, the European Union, Canada, and Japan have made them huddle together and welcome an expanded effort which shares the risks, cost and benefits of the GER.



This expanded partnership tangible expression is an E-M L2 Gateway Station variously described as "Extended Duration Crew Missions" with "potential commercial opportunities emerging in the mid 2020s" an "Evolvable Deep Space Habitat" and later in the Decade as "A Staging post for Crew to Human Surface". Notable is the identification of "human assisted sample return" from the lunar vicinity. Later in the 2020's a humans to the surface continuing initiative is identified.

Transportation Initiatives

Shown on the GER is the NASA developed Orion and SLS system, the Russian Piloted System, and Advanced Electric Propulsion.

A "Flurry of Missions Proposals To the Moon"

A succession of Moon missions in the GER includes:

1	LADEE (Orbiter),		
2	Luna 25 (lander) ,	(Lunar Glob)	2015
3	Chandrayaan-2 (Lander-,		2017
4	Luna 26 (Orbiter),	(Lunar Resurs)	2016
5	Luna 27 (Lander),	(Lunar Resurs)	2017
6	Resource Prospector (lander),		2018

ISECG LEAG 2013

2013	**Presentations**	
NASA	R. Elphic	
Roscosmos	I. Mitrofanov	
ISRO		
Roscosmos	I. Mitrofanov	7022pdf
Roscosmos	I. Mitrofanov	7022pdf
NASA	A. Colaprete	7017pdf
CSA&MDA &SSLoral	N. Ghafoor	7058pdf
NASA-JHAPL	D.G. Chavers	7053pdf

7	SELENE-2 (lander),	JAXA		
8	Luna 28/29 Lunar Polar Sample Return 2020	Roscosmos	I. Mitrofanov	7022pdf
9	Selene-3 (Lander), and an afore mentioned	JAXA		
10	Human-Assisted Sample Return.	(NASA?)		
11	Moon X First Mission 2015		P. Spudis	7032pdf
12	Astrobotic-Griffin First Mission 2015 Oct -Dec		S. Huber	7055pdf
13	Mighty Eagle ILN Prototype for Small Payloads	NASA	B. Cohen	7033pdf
12	E-M L2 Waypoint	NASA	J. Burns	7007pdf
13	Cislunar Exploration Platform Using SLS	NASA	K. Klaus	7027pdf
14	Lunar Flashlight CubeSat Solar SailMirror	NASA JPL MSFC	P.O. Hayne, B. Cohen	7045pdf
15	Lunar Water Distribution Orbiter Cube-Sat	NASA	P. Clark	7015pdf
16	Orion/MoonRise E-M L2 Sample return	NASA	L. Alkali	7034pdf
17	Intrepid: Lunar Roving Prospector	ASU	E. J. Speyerer	7049pdf
18	Past Present and Future Drilling Technologies	Honeybee	K. Zacny	7010pdf
	Cargo missions in the 2020's			
11	Cargo Delivery Missions	Russia		
12	Small Cargo Lander	ESA?		
13	Human Surface Mobility	NASA		
14	Crewed Lunar Lander	NASA		

Missing Elephants in the Room of the GER

The GER is a very optimistic document. It really presents, (among others things we have omitted like missions to the asteroids and Mars,) a spectacular campaign to return to the Moon. This vision however is very much soft pedaled with obfuscating descriptions of what would be accurately and more bluntly described as a major international return to the Moon campaign. The simple reason for this "obfuscation" is that this program might be a hard sell given the hard economic times among the partner nations in Europe, the US, Canada, and Japan, which nevertheless retain ambitions to move forward in space.This description also pays lip service to potential commercial opportunities but rather hides this potential in the bushes. Other strategically important developments are also omitted:

The Google Lunar X-Prize is not described or its impact in two areas:

A. Small cube-satellite scale lunar mission initiatives:

1 Vermont Technical College has had a cube scale lunar mission initiative along with its Vermont Space Grant partners with some assistance from NASA Goddard and JPL. This mission has a projected price point in the single digit to low tens of millions of dollars.

2 Team Space IL has adapted this same cube scale lunar mission architecture and strategy for its GLXP lander. This mission has a price point in the low tens of millions of $.

3 The University of California Santa Cruz and Berkeley campuses, NASA AMES, and Hung Yee University in Korea with KARI support are developing a Lunar Swirls mission. This mission has a price point of approximately $35M.

4 Another GLXP team The Penn State Lunar Lions is developing a small lunar lander, and this mission has a price point in the low tens of millions of dollars.

5 Lunar Flashlight is a 6U Cubesat with an 8 meter Solar Sail mirror to test permanently shadowed regions for the presence of frozen volatiles by directing sunlight into the cold traps and observing reactions with an infrared imaging spectrometers.

Lunar Cube Hitchhiker Missions are generating increased attention and excitement with numerous conferences and workshops from U of CalPoly, Utah State U., MIT, Cornell, Moorehead State U, Flexure Engineering, NASA AMES, and JPL, Baylor University and others. We might describe this small low cost end of the continuum the Micro lander end.

6 Because these micro lander technologies also present low cost mission opportunities a number of organizations have called for an International Lunar Geophysical Campaign to encourage a coordinated but affordable effort to advance lunar scientific coordination.

B. Small commercial lunar lander initiatives:

Small commercial landers may play a significant catalyzing role in the lunar vicinity campaign.

1 Moon-X, also a GLXP competitor, has developed the "common lunar bus" under a NASA space act agreement and has two mission planned on it docket, neither of which is mentioned in the GER. These Moon-X lander missions have a price point above $100M. Moon-X has indicated that they expect to land their first mission by the end of 2015.

2 Astrobotics, another GLXP competitor, also has ambitions to provide a commercial service to the Moon with a mission that has a price point above $150M. Their deadline is the same.

The Chinese Space Program

Another missing elephant in the GER is the **Chinese Space Program** with its own space station and lunar exploration program initiative. The Chang'e III Lunar Mission is expected to launch before the end of 2013 or early in 2014 if this initiative slips. The Chinese have also identified a Chang'e 4 Mission which is no doubt a back-up successor to Chang"e III and a Change V sample return mission in 2017. They are also developing a Long March V Launcher which should further their operational capabilities in developing their space station, pushing outward in cislunar space and beyond. Geo-political competition has been a major driver of space initiatives from the very beginning of the Space Age with the launch of Sputnik as the Soviet contribution to the International Geophysical Year in 1957-8. A forward learning program by the Chinese with International participation will provide competition to the GER members nations and that may provide additional forward financial and political momentum to the lunar campaign.

Large Potential Commercial Opportunities

The GER does mention potential commercial opportunities with commercial owned platforms in LEO, in lunar vicinity, and on the lunar surface. Bigelow and Excalibur Almaz have ambitions to build commercial LEO stations. Bigelow, Moon-X, Astrobotic and Golden Spike, and Shackleton Energy want to provide services on the lunar surface including transportation, habitation, and lunar In Situ Resource development. Similar potential exists with regard to a fuel depot in conjunction with the E-M Lagrange 2 Extended Duration Gateway Station and Staging Post. Also highly significant is the emergent role of space tourism commercial initiatives most notably in the near term by Virgin Galactic starting services expected in 2014 but with other companies such as Blue Origin, X-Corp also moving forward.

Commercial Heavy Life and Reusable Rockets

Also of huge significance to the near term future of lunar access is the encouraging rapid development by Space X of the reusable Falcon 9 rocket, termed the Grasshopper. In addition in early 2014 a Falcon 9 Heavy mission will be launched with another Air Force Mission purchase of a Falcon 9 Heavy in 2015. These disruptive developments may accelerate the affordability of the ambitious plans laid out in the GER and accelerate the ability of both government and commercial companies in accelerating the lunar campaign. I believe that we are at the edge of a "breakout" era because of lowered costs to access space.

LEAG Program Elements: Getting down to ISRU

Two specific missions are mentioned on the LEAG 2013 program as advancing the potential for lunar mining and ISRU by Gerald Sanders #7054. These are the NASA Resource Prospector Mission discussed by Colaprete #7017and the Russian Luna 27 Resource discussed by Mitrofanov #7022. The Keck Institute has sponsored two studies on the challenges and potential of findings ice deposits that are "operationally useful." Discussed by P.O. Hayne #7043.

In addition, Cohen # 7033 and Clark #7015 proposed additional orbital missions to detect water concentrations and distribution and the lunar surface. Clark lunar cube proposal also discusses the role of game changing new flight dynamics software to create "readily available families of low energy transfer routes." More such assay work will be needed.

Summary

The 2013 LEAG Fall meeting provides a wealth of lunar mission proposals and activities which fit into the context of a revised Global Exploration Roadmap recently released in August of 2013. When taken in the context of additional activities and opportunities in conjunction with the Lunar GLXP competition , the new lunar cube low cost mission paradigm, the Chinese Space program, and commercial lunar exploration Initiatives one can see an optimistic change in tone and a plethora of new creative of mission proposals in comparison with the tone of a year earlier. Persistent efforts to coordinate exploration programs, lower the cost of operations, and advance scientific understanding are making headway. Taken as a whole the prospects for a well coordinated return to the Moon with further exploration and development is excellent. DD

ONLINE OP-ED ARTICLES FROM OTHER WRITERS WORTH READING

[Editor: this is the start of a new feature in TTSIQ. We will be on the lookout for more such articles, and we invite readers to call such articles to our attention: kokhmmm@aol.com]

Space Exploration Can Drive the Next Agricultural Revolution

By Nikolaus Correl, University of Colorado, December 06, 2013
http://www.space.com/23872-**space-exploration-can-drive-the-next-agricultural-revolution**.html
(Learning how to reinvent agriculture so that it can feed people on the Moon, Mars, and elsewhere, could help us reinvent agriculture here on Earth to feed an ever increasing population.)

Some quotes:

"Habitation of outer space needs solving air, water, energy and food supplies within a tight space."

"Bioregenerative life support system for long duration human space missions ..."

"Going to Mars is a 'rucksack problem'"

"Growing food in space becomes advantageous for missions exceeding two years in space. For shorter missions the additional launch mass required to grow plants would be better used by bringing additional resources."

"Using space exploration as a driver to solve our most pressing grand challenges: air, energy, water and food is a strong narrative to gain public support."

"Research in space-based agriculture should focus on three fronts:

√ Increasing our knowledge of in-space plant growth
√ Solving the key challenges to plant maintenance
√ Understanding the impact that such kind of living has on humans in the isolation of space.

"A high degree of automation and robotic assistance are essential."

Read the whole article at the link above.

Allow NASA to Do Great Things Again

By R. D. Boozer, December 10, 2013 - http://www.space.com/23898-**let-nasa-change-course**.html

Some quotes:

"insufficient funding of Commercial Crew may cause an even longer delay of the first crewed flight — to 2020. That puts the first expedition near the end of the ISS's life expectancy, and adds five extra years of sending money to Russia.

"Though the Space Launch System (SLS) wouldn't fly astronauts until 2021 under the most optimistic estimates, certain powerful legislators ensure that this program suffers little compared to Commercial Crew. Indeed, the size of the SLS program's budget in recent years has largely come at the expense of Commercial Crew. Meanwhile, the former executive secretary of the National Space Council under the G. H. W. Bush administration has dubbed the SLS technology and contracting methods "too expensive, too slow, and too old."

"NASA is supposed to work on daring, cutting-edge technology that it is not profitable for industry to develop. It made sense for NASA to create its own rockets in the 1960s and 1970s, when producing boosters was a new and highly experimental field. But now, industry has taken the booster tech that NASA developed back then and adapted it; today, the private sector can develop such vehicles more economically and efficiently than NASA can."

"NASA could be working on real advancements instead of the obsolete monstrosity that is SLS/Orion — advancements that could lead to exciting deep-space missions. The money would come from the budget savings made available by using commercial market vehicles."

"NASA should also pursue in-space filling stations to top-off spacecraft propellant tanks. Instead, the money-hungry SLS/Orion now takes political precedence over everything else."

"The solution would involve allowing NASA's engineers and technicians to do something worthy of their talents, something that involves 21st-century breakthrough technology rather than just another launcher that industry can now do better. "Reinventing the wheel" with SLS is an insult to the fine people at NASA when you think of the new technology and human exploration missions they could be working on with the money saved by using commercial launchers. NASA is being set up for failure via SLS/Orion, as it was with Ares 1 crew launch vehicle and Constellation spaceflight program."

International Space Advocacy Organizations Encouraging Student Participation

National Space Society (US) – http://www.nss.org – NSS
NSS currently has chapters in Australia, Canada, Germany, France, Netherlands, Brazil, and India
http://chapters.nss.org/a/lists/

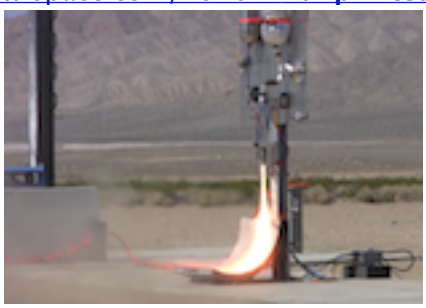
NSS' International Space Development Conference – ISDC
The "ISDC" is usually held the weekend of the last Monday in May (Memorial Day weekend) in various locations, hosts students from around the world, many of them presenting their entries to NASA's annual Space Settlement Design Contest. Usually, The Moon Society and SEDS participate in this conference.
http://isdc.nss.org

The Moon Society – http://www.moonsociety.org – TMS
The Moon Society has informal relationships with the Calgary Space Workers, Calgary, Alberta, Canada and with the Sociedad Espacial Mexicano, Mexico. The Society has individual members in many countries. The Moon Society's **Moon Miners' Manifesto India Quarterly (M3IQ)** – the "older sister" to To The Stars International Quarterly, has been going to students and others in India and Elsewhere since August 2008. Older issues are available as free pdf downloads at: http://www.moonsociety.org/india/mmm-india/
NOTE: With this issue, TSSIQ replaces M3IQ

Students for the Exploration and Development of Space – http://www.seds.org – SEDS
SEDS has had greater success in setting up chapters around the World than any other Space organization.
How to Stars a SEDS Chapter – http://wiki.seds.org/index.php?title=Start_a_SEDS_Chapter
http://seds.org/chair/ChapterExpansionKit30.pdf
SEDS-Earth – http://earth.seds.org/index.php – This is the international chapter.
There are chapters of SEDS around the world: (USA), **India, Nigeria, United Kingdom, Philippines**, and more; SEDS-Earth is a central node for communication between these worldwide chapters.

3D-Printed Rocket Engine Built By Students Passes Big Test – Video

www.nbcnews.com/science/**3-d-printed-rocket-engine-built-students-passes-hot-fire**-8C11363473
http://www.space.com/23107-**3d-printed-rocket-engine-student-video**.html



Private groups and NASA have been exploring how to use additive manufacturing, or 3D printing **to cut the time, cost and design constraints of making complex rocket parts**."Tri-D" was printed from **cobalt chromium** using a technique known as **direct metal laser sintering (DMLS).** The rocket engine measures just 17 cm (7 in) long. It is the 3rd and smallest — of a 3-stage cubesat launcher. CubeSats typically weigh no more than 1.3 kg (3 lb). The team plans to design and print the 1st-stage rocket engine next and eventually build a flight-capable rocket.

Tri-D burns kerosene and liquid oxygen with 200 pounds of thrust. The total cost for manufacturing the engine and completing the test was just $6,800. Besides funding, one of the biggest hurdles is the current state of a technology. The students have worked closely with NASA's Marshall Space Flight Center inHuntsville, Alabama, US

Abstracts of USC Student Papers on a Variety of Space Topics

M3IQ Co-editor **Madhu Thangavelu** conducts the **Space Exploration Architectures Concept Synthesis Studio**, Department of Astronautical Engineering, Viterbi School of Engineering & the School of Architecture, at the **University of Southern California** (USC) in Los Angeles, California.

Abstracts of the Papers submitted This Term by his Students (unedited)

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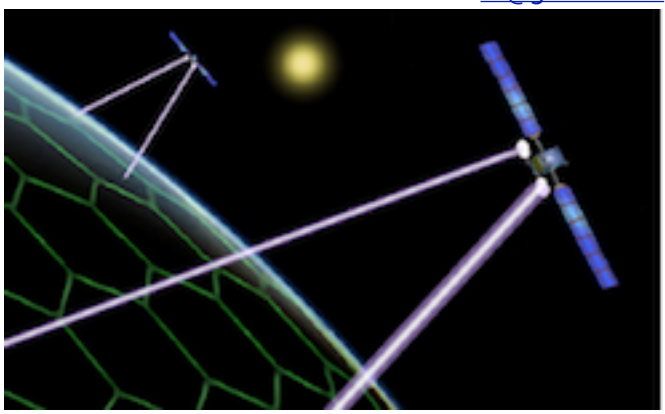
Satellite De-Orbiting Swarm

Chelsea Dutenhoer chelsea.dutenhoer@gmail.com



Manmade orbital debris is a growing problem around Earth. Even with the current suggested spacecraft deorbiting guidelines in place, some of Earths most useful orbits are becoming crowded with derelict satellites and rocket upper stages. These large intact objects can collide with smaller debris fragments or other large spacecraft resulting in catastrophic amounts of new debris being generated. Simulations show that active debris removal is necessary in order to stabilize the environment, and that it should begin by the year 2020.

Some non-operational spacecraft contain hazardous materials or are so large that they wont entirely disintegrate upon reentry into Earths atmosphere, so they will require a controlled deorbit. However, many of these spacecraft no longer have functioning attitude control systems and are tumbling freely through space, which makes a controlled deorbit di cult. Additionally, these spacecraft often have antennas or instruments covering large portions of the spacecraft bus which makes rendezvousing with them a challenge.

A swarm of cubesats is uniquely equipped to address this problem. Individual swarm members have the agility to rendezvous with a tumbling spacecraft, temporarily stabilize its attitude, and provide thrust in the necessary direction for deorbit. A variety of different cubesat designs are available to assist in stabilizing and deorbiting, depending on the needs of each target. A mothership can be used to ferry and coordinate the cube sats, as well as to provide larger amounts of thrust to deorbit more massive objects.

The cubesat swarm architecture is flexible and scalable to deorbit many different shapes and sizes of spacecraft in various orbits. As an integration of largely proven concepts into a new system, the swarm would be able to launch and begin its cleanup mission by 2020.

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Quantum Communications Satellite Network

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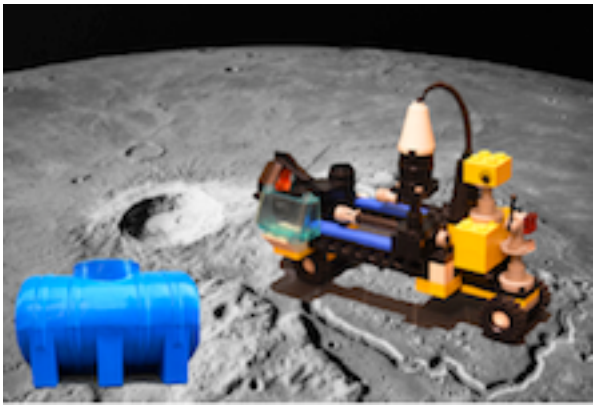
The Information Age has created one of the largest paradigm shifts in human history its dawning brought more than just revolutionary technology; it changed how humans communicate and conduct business on a day-to-day basis. Computers and mobile devices have become increasingly persistent in our daily lives when accessing the Internet and information technology continues to accelerate at an exponential pace.

The constant exposure to this open network can yield many benefits to everyday life, but it also comes with risks. Some consider the information exchanged to be of high-value and sensitive and therefore encryption is necessary to protect the privacy of these exchanges. Unfortunately, modern encryption is slowly being beaten by Moore's law and faster processors, so scientists and engineers are looking to the basic particles in our universe for a solution.

Quantum encryption and communication is the next step being explored in the eld of electronic cryptography. It employs the quantum phenomenon of particle entanglement to serve as the key for data encryption.



With a tested track record on the ground, this concept proposes to extend, analyze, and theorize its existence in space to create a secure global network. In ground tests, information has been securely exchanged using entangled photons but there are limitations. The concept of a space-based network provides a solution to many of these limitations, while also providing global coverage. Ground stations could send secure messages using the satellites which would generate and exchange entangled photons through lasers. The communication between the two stations remains classical and antenna-based, requiring no advanced or highly theoretical technology.

Unbreakable encryption is the Holy Grail of cryptography, and this satellite network could potentially provide it to anyone in the world for any intention. Whether the implementation of the network is used for military, commercial, or public purposes, quantum communication will soon be a reality and revolutionize the eld of encrypted communications.

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Liquid Skins, Membranes and Pillow Cushion Technology for a LLTHC (Lunar Lava Tube Habitation Complex)

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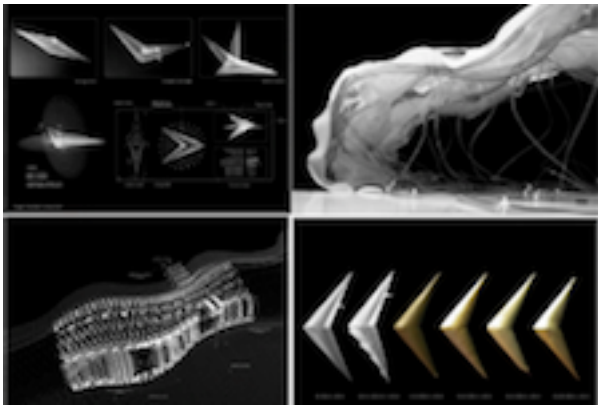

The concept explores a rapidly deployable habitation system for the Marius Hill lunar lava tube. The proposed system deploys a pneumatic material system in combination with a liquid skin. The focus is on devising alternative strategies for a Lunar Lave Tube Base. The proposed system deploys a unique hybrid pneumatic-tensile fabric structure system in combination with a highly compact, towable (hence space mission friendly) shape memory technology referred to as "liquid skin".The focus is on devising alternative strategies employing this unique hybrid for rapidly deploying structure in order to establish an initial operational capability of a Lunar Lava Tube Habitation Complex.

This project employs two different fabric materials: liquid skins and inflatable pneumatic membranes which comprise a smart system. Important to the design considerations are the extreme environmental conditions on the lunar surface. The pneumatic system and textile skins are used to generate varying performance potentials in relation to the extreme environmental context for nominal habitation of the lunar surface crew over extended periods.

This smart system works by quick deployment and commissioning of a shelter that accommodates differentiated conditions. These conditions relate to issues such as adaptable rigid/exible membrane morphology, optimal pressure maintenance, thermal stability, insulation and exterior/interior light control which employ both solar and artificial means. Furthermore, this hybrid concept explores possible strategies including collection and use of regolith within the pillows and differentiated skin patterns that aid in providing foundational structural stability, as well as thermal inertia for controlling interior temperature and complex textures for varying lighting conditions. The aim is to prove that it is possible to create a smart system for shelters constructed from pneumatic cushions facilitated by the use of regolith as a material that can modulate and adjust the system to the extreme extraterrestrial environmental conditions found on the Moon. These pillows would be used primarily within the interior of the lunar lava tube as a thermal barrier to the elements. In addition, differentiated liquid skins, because of their foldable, stowable nature they would be ideal for ease of construction on extraterrestrial surfaces. Both systems are affordable options for transporting to the Moon because they are lightweight, pliable and neatly packed in modular collapsible container units.

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D-SASS: Dual-Segment Active SETI System

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As of 2013, approximately 12-36 exoplanets" have been identified beyond our Solar System as being within the “habitable zone", a region surrounding a star that could support the development of life. As the search continues for more habitable worlds, the probability of communicative extraterrestrial civilizations existing in addition to our own begins to grow.

In an effort to more effectively search for extraterrestrial civilizations and ultimately answer the eternal question of “Are we alone in the universe?" an “active" Search for Extraterrestrial Intelligence (SETI) system, in which communications are sent specifically to draw the attention of intelligent life beyond our planet, is needed to increase the chances of discovery.

The Dual-Segment Active SETI System (D-SASS) develops the idea that an active SETI system should serve two purposes

1. Reach out to exoplanets that have a higher probability of harboring extraterrestrial civilizations, and
2. Provide a lasting record of humanity’s existence and communicate this existence to the galaxy.

To achieve those purposes, the proposed system contains two segments: an Active Communicator segment, to serve the primary purpose and an Artifact Segment to serve the secondary. The Active Communicator, as a network of Earth-based or Space-based transmitters, would target identified habitable exoplanets with a repeated, pre-developed message, optimized for detectability and decipher-ability. The Artifact Segment, consisting of a small constellation of autonomous beacons within proximity of Earth, would be designed with ultra-high reliability and ultra-long life in mind in order to transmit a repeating simple, but poignant message to the galaxy: “Hello. We are here. You are not alone."

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The Power Cell-evator: A Lunar Space Solar Power Elevator

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The main barrier to space industrialization is high launch costs. A space elevator has been proposed as a low-cost alternative to launch vehicles. On Earth, the elevator tether requires a new class of ultra high strength materials to be developed. Carbon nanotube fiber is a leading contender, but requires much further development before it can be a practical tether material.

Alternatively, the moon has many resources valuable to space development and a lunar space elevator tether could be built with present-day composites and in situ resource utilization. With new additive manufacturing and mining techniques, many useful components for a lunar space elevator system can be assembled on the lunar surface - structural elements, photovoltaic arrays, antennas, integrated circuits, and perhaps even the elevator tether.

Solar power satellites (SPS) have been proposed for green, baseload power that can be delivered anywhere on a planet. No power grid is required, just a receiving antenna. On the moon, a SPS would open up base locations without a peak of eternal sunlight to power them during the long lunar night. Since microwave SPS requires kilometer-sized structures, long enough material is a major barrier to construction.

An architecture for a lunar space elevator that also integrates a lunar space solar power system is presented. This proposal argues that a solar power station is a more valuable and versatile counterweight than the inert counterweights favored by other concepts - a captured asteroid, climbers after a one way trip, or simply more tether. It also argues that the combined architecture would be more effcient to construct and operate than either structure alone. Rectenna-powered climbers have a higher payload mass fraction than solar-powered (PV) climbers. Climbers sent one-way are disassembled and added to the solar power station, reusing lift vehicle mass as useful payload. Once built, excess power can be sold to lunar customers. Climbers and components are constructed at the base of the elevator, requiring only mining and manufacturing infrastructure and seed components to be launched from Earth.

By combining the strengths and overlapping functions of two space megastructures, this concept increases the feasibility and effectiveness of both.

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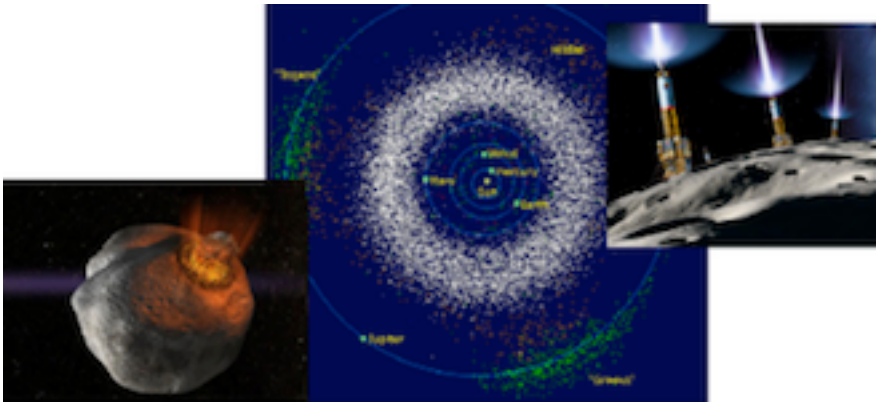
The Trojan Defense

Will Britton wlbritto@usc.edu

The asteroid impact in Chelyabinsk, Russia on 15 February 2013 precipitated renewed interest in planetary defense from small Solar System bodies scattered about the asteroid belt as well as extrasolar objects. This new found interest culminated in NASA announcing a \Grand Challenge" on 18 June 2013 whereby industry, academia, and even members of the general public were solicited for ideas on how to improve current rogue asteroid contingency plans.



Geological evidence indicates that the extinction of the dinosaurs over 65 million years ago was the result of an asteroid impact. While the probability of an extinction-class body colliding with the Earth is extremely small, the consequences of such an impact are cataclysmic. For the first time in history, the human species has the knowledge and means to mitigate the impact risk of a global killer. This concept aims to prevent mankind's extinction through timely detection of a threatening body.

Instead of trying to destroy an oncoming object, the goal is to detect the body just enough to alter its trajectory to avert impact with Earth. This concept will utilize small (10m diameter) Trojan and Hilda asteroids to engage an oncoming object in essentially a game of cosmic billiards.

Pre-selected Trojans will be equipped with propulsion devices that, when activated, will propel the Trojan on an intercept course with the oncoming object. The kinetic energy transferred to the body will result in a small amount of change in velocity, which will in turn alter its course.

One or many pre-positioned Trojan defenders will be deployed depending on the size, trajectory, location, and composition of the body. In addition, other factors such as orbital geometry and intercept trajectory as well as precise Earth miss time and distance analysis will be employed to determine the final attack strategy.

For the next phase of the concept, the propulsion device anchored to the Trojan will be examined. A high-thrust engine is essential in order to generate as most kinetic energy as possible. Another important trade space consideration includes propellant that is easily (and safely) stored for long periods of time.

Lastly, additional areas for concept refinement are selection of the initial launch vehicle for of the propulsion devices, identification of a range of asteroidal assets including suitable, strategic Trojan and Hilda defenders, extremely long-life, agile and reliable spacecraft systems, and a robust communication architecture with the defenders.

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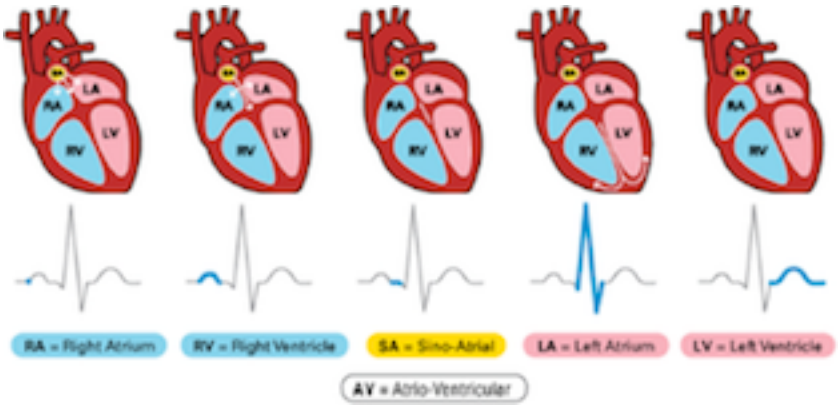
Monitoring Astronaut Health: Homeostasis of the Habitat

Dr. Stuppy w.stuppy@adelphia.net



Astronaut crew are constantly monitored for their health and mission fitness. Heart rate variability (HRV) is the gold standard by which inflight crew are assessed. Recent studies show that all anomalies cannot be resolved or predicted using HRV alone. Complex feedback loops that sustain the dynamic equilibrium within the human physiology suggest that the Autonomous Nervous System(ANS) along with yet to be determined attractors play a ergodic yet significant role in homeostasis, or dynamic equilibrium of the active crew. There are variables in action that point to Metabonomics: the study of transient metabolite products resulting from the action of gut bacteria that play a significant role in maintaining the homeostasis of the crew during

This proposal argues that Metabonomics is the next step in Astronaut Crew Health monitoring and seeks to build the case to observe, detect and suggest real time remedial measures in astronaut crew physiology through the use of a variety of new tools and systems that are sensitive to signatures of trace activities down to the molecular level, including high resolution laser mass spectrometry and chromatography.

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Chain Brain: A Neural Network for Solar System Awareness

Madlenne Bach mbach@usc.edu

Rapid advances in the computing power of processors and algorithms, including the agility of data banks, continue to vastly improve the versatility of state-of-the-art information systems. Much effort is spent trying to get computers to mimic the human mind and senses, while augmented analysis takes a hybrid approach in using a brain computer interface (BCI) to leverage the innate abilities of the brain in image processing.

Experimentation in augmented analysis can be extended further with synthetic teamwork. Advances in medical science will soon allow us to 3D print organs and cultivate neurons, essentially building task oriented organic computer components dedicated to image processing. A minimal staff of people could then work with artificial teams in a macro neural network to analyze large volumes of data for threat detection. Combining developments in supercomputing, bioengineering, and the biosimulation arena, we could commission an effective and highly dependable mulitlayler information, command and control system that would enhance our ability to "sense changes in the vicinity of our solar system and would trigger highly complex instruction sets in a reliable and timely manner to avert an imminent asteroidal or cometary fragment impact. ##

You can Try Docking a Soyuz Crew Capsule to the Space Station

(includes Video) - http://www.spacedroider.com/?p=soyuzSim

Soyuz Simulator is an unique **Android app** that lets you mimic an actual cosmonaut during the manual final approach and docking of the Soyuz spacecraft to the International Space Station (ISS).

With its fine orbital mechanics calculations, realistic 3D visualizations, and 36 possible starting scenarios, **soyuzSimulator** makes each simulation an enjoyable challenge !

Enjoy the experience of leaning how to manually fly this 50-years-old piece of space engineering, and still today the most reliable access-to-space system in human spaceflight history.

Above are file photos: Photo at left is of the European Space Association Soyuz Simulator

Features

- Provides a simple abstraction of the Soyuz spacecraft's manual control panel, as a set o finger controllers, buttons, and basic flight data.
- 36 possible starting simulation scenarios. You can choose the target ISS docking port, the ISS attitude, and the initial ISS/Soyuz relative distance.
- Realistic 3D visualizations, including sun lighting.

App Information

Target devices; Tablets, Cell Phones (Android 2.3.1 or higher; openGL ES enabled; English; landscape screen, screen resolution 640x400minimum and higher)

Linked Tutorials on YouTube

1. Soyuz Manual Command Panel
2. Short-range Approach and Docking
3. Fly-around Manoeuvre

SPACEHACK: a Directory of 37 Ways to Participate in Space Exploration

http://spacehack.org

1. Spirit of Innovation Awards – http://spacehack.org/project/**spirit-aerospace-exploration**
2. University Rover Challenge – http://spacehack.org/project/**university-rover-challenge**
3. Space Warps – http://spacehack.org/project/**spacewarps**
4. LHC@home – http://spacehack.org/project/**lhcathome**
5. Night Rover Challenge – http://spacehack.org/project/**night-rover-challenge**
6. Exploration Design Challenge – http://spacehack.org/project/**nasa-exploration-design-challenge**
7. Planet Four (Mars) – http://spacehack.org/project/**planet-four**
8. Polares (Mars) – http://spacehack.org/project/**polares**
9. Citizens in Space – http://spacehack.org/project/**citizens-in-space**
10. Milky Way – http://spacehack.org/project/**milky-way-project**
11. Einstein at Home – http://spacehack.org/project/**einstein-at-home**
12. S.E.T.I. Live – http://spacehack.org/project/**setilive**
13. Space Log – http://spacehack.org/project/**spacelog**
14. Constellation – http://spacehack.org/project/**constellation**
15. Planet Hunters – http://spacehack.org/project/**planet-hunters**
16. Galaxy Zoo – http://spacehack.org/project/**galaxy-zoo**
17. NASA Whirl Wind – http://spacehack.org/project/nasa-**world-wind**
18. Citizen Sky – http://spacehack.org/project/**citizen-sky**
19. TubeSat Kit – http://spacehack.org/project/**tubesat-ps-kit**
20. Moon Zoo – http://spacehack.org/project/**moonzoo**
21. MilkyWay@Home – http://spacehack.org/project/**milkywayhome**
22. Solar Storm Watch – http://spacehack.org/project/**solar-stormwatch**
23. Stardust@Home – http://spacehack.org/project/**stardustathome**
24. Radio JOVE (Jupiter) – http://spacehack.org/project/**radio-jove**
25. INSPIRE Project – http://spacehack.org/project/**inspire-project**
26. SETI@Home – http://spacehack.org/project/**setiathome**
27. Global Telescope Network – http://spacehack.org/project/**global-telescope-network**
28. My NASA Data – http://spacehack.org/project/**my-nasa-data**
29. Flight Analogs Project – http://spacehack.org/project/**fap**
30. Vision Workbench – http://spacehack.org/project/**vision-workbench**
31. Telescope Makers Workshop – http://spacehack.org/project/**telescope-makers-workshop**
32. Mars Student Imaging Project – http://spacehack.org/project/**mars-student-imaging-project**
33. DASH Link – http://spacehack.org/project/**dashlink**
34. Celestia – http://spacehack.org/project/**celestia**
35. ISS EarthKAM – http://spacehack.org/project/iss-**earthkam**
36. Great World-wide Star Count – http://spacehack.org/project/**gwwsc**
37. Night Sky Network – http://spacehack.org/project/**night-sky-network**

Do not dismiss the need for "Shielding" on the Moon, on Mars, or elsewhere

Attention young Artists and Illustrators!

A "Caveat" by Editor Peter Kokh

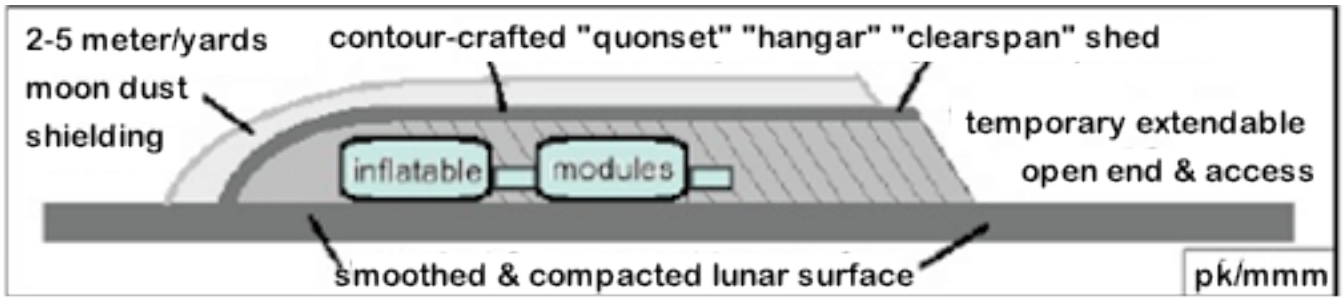
Question: Why, if Mars has no radiation shielding Van Allen Belts, will explorers on Mars surface receive less than half the radiation that those in transit between Earth and Mars will recieve?

Answer: In space, one is exposed to radiation coming from all directions - from 41,263 square degrees. On Mars surface, one will be blocked from a little more than half this amount of sky, given that no where is the surface perfectly flat. The safest place on Mars, for someone on the surface without any shielding, would be in a deep narrow canyon. Valles Marineris is very deep but also very wide. But in some sections there is a mini-canyon within the larger one.

However: While it will take you a tad over twice the time to get a critical dose of radiation on the surface, if you stay on Mars for more than twice the time spent in transit from Earth and back, you could end up getting a bigger dose during your stay on the surface, **unless**...

The lesson: Any time you see an illustration of a habitat on Mars that is left unshielded (the habs of Robert Zubrin's Mars Direct, modeled at the Utah and Arctic analog stations or the growing row of smaller habitat modules in the illustrations of Mars One), you know that as an explorer, your health and safety does not count much to those who will have sent you there.

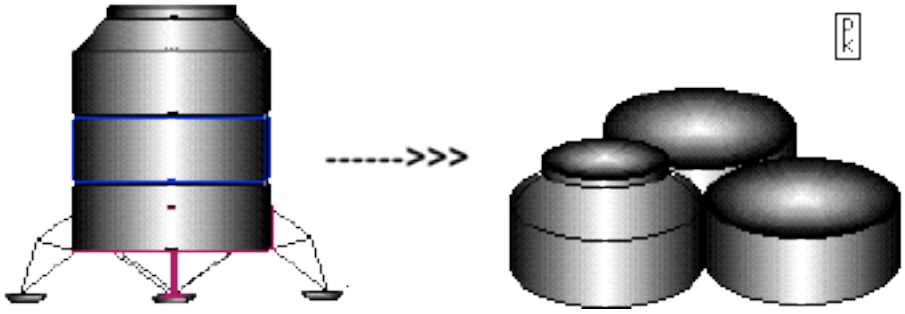
Artists take heed: You should **illustrate Moon and/or Mars outposts**, even temporary ones, **as shielded one way or another by a pile of lunar/Martian soil (regolith), a few meters thick**. Now we can have the arriving explorers shield the base, given the right equipment, or we can land the outpost structures unmanned, and have robotic equipment pre-shield them so that they are "occupation-ready" when human explorers arrive. Excavating tunnels or operating out of a nearby lavatube will also work. As will building a large "clearspan" "hangar" which is then shielded, and under which any number of modules of any configuration can be parked and/or connected together for "shirtsleeve" passage.



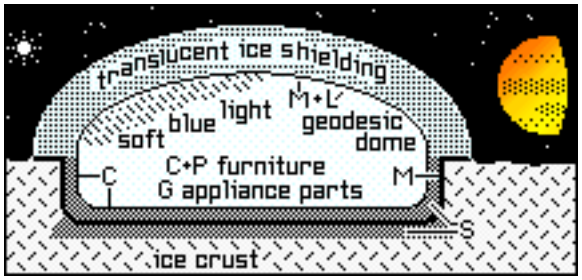
Clearspan structures can be built by contour crafting, the building size version of 3D Printing.

On both Moon and Mars, for long duration missions, time out on the surface in just space suits, should be carefully rationed. Surface chores that can be done by teleoperation from crew safely shielded inside a habitat or "operations center" will be safer. We will spend too much money getting astronauts to Mars to then leave them exposed. We don't need to make them "heroic martyrs" to the cause. **Let's stop showing artwork of exposed outposts on the Moon, Mars, or anywhere else.** Of course, cut-away sections that allow us to see a bit of what's under those shielding mounds are fine.

Note: the shielding requirement means that **habitat structures from Earth should be designed with shielding needs in mind.** Although there are ways multistory buildings can be shielded, one floor will be easier to shield than two or more, two floors easier than three or more, etc.

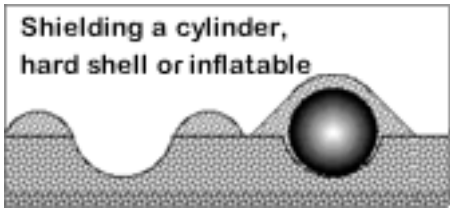


If for shipping/transportation reasons, we send a 2- or 3-story structure, it should be designed so that on arrival, **each stacked floor is separable and can be placed side by side, for easier shielding**. as in the illustration above. Call it lunar or Martian "ranch style!"



This goes for artwork of stations on Europa as well, where ice makes fine shielding!

As for inflatalbes, a module on its side may be easier to shield than a one placed vertically.



The role of artists and illustrators

The good artist is one who does more than attract the attention of viewers, and goes beyond to give viewers **a realistic glimpse into the future**. An educated public is one that is aware of risks and disadvantages, **and the means by which any disadvantages can be overcome**.

Well-informed artists and illustrators can help people visualize the possibilities and to realize that, **yes, settling the Moon and Mars is feasible**. PK

Sunsat Design and Visualization Competition

http://**sunsat**.gridlab.ohio.edu

If you are a space scientist, engineer, academic, business or digital media professional with an idea for moving space solar power closer to implementation, consider forming a team to join in this effort. And please forward this message to others.

In the first cycle of this competition, two First Place prizes of $10,000 US and three Second Place prizes US are expected to be awarded at the May 2014 International Space Development Conference in Los Angeles, California, US. For registered teams successfully completing the Feb. 2014 "significant progress point," an additional $1,000 US incentive can be earned, and $1,000 travel assistance will be awarded to winners

Winning entries of 2014 and 2015 will be published in the Space Journal Space Journal as Issue No. 18: Top SSP Designs at the SunSat Design Competition website. To learn more, check the SunSat Visualization Guidebook and look at the. To see where the idea of a SSP Design Competition came from, take a look at SpaceJournal Issue No.16: Solar Power Satellites.

To see how Ohio University's Game Research in Immersive Design (GRID) Lab, with the help of Georgia Institute of Technology, University of North Dakota and others in academia, has experimented with making the advanced science and technology concepts of SSP more accessible to the public, view SpaceJournal No.16: Solar Power Satellites.

This competition is managed by Ohio University, Columbus, Ohio, US, the host institution for the Online Journal of Space Communication, but guided and juried by members of the National Space Society and the Society of Satellite Professionals International. ##

NASA Seeking Student Science Experiments for Balloon Flights

www.nasa.gov/press/2013/october/**nasa-seeking-student-science-experiments-for-balloon-flight**/

NASA is accepting applications from graduate and undergraduate university students to **fly experiments to the edge of space aboard a high-altitude scientific balloon**.

This balloon flight competition is a joint project between NASA and the Louisiana Space Consortium (LaSPACE) in Baton Rouge, Louisiana, US.

NASA (Wallops) & JAXA (ISS-Kibo) help launch student-built satellites

http://www.nasa.gov/press/2013/november/**nasa-helps-launch-student-built-satellites-as-part-of-cubesat-launch-initiative**/

http://www.space.com/23711-**how-to-deploy-tiny-satellites-from-space-station-video**.html

NASA Taps Student Teams To Simulate Human Exploration of Other Worlds Mars-focused Human Exploration Rover Challenge

Nov. 29, 2013 - http://www.spacedaily.com/reports/prnewswire-space-news.html?doc=201311291023PR_NEWS_USPR____DC25436&

NASA is debuting a new engineering design challenge to engage students worldwide in the next phase of human space exploration. The NASA Human Exploration Rover Challenge is a more complex follow-on to the successful NASA Great Moonbuggy Race.

The competition is open to high school and college students and challenges them to create a vehicle designed to traverse the simulated surface of another world.

Registration closes Jan. 10, 2014 for international teams and Feb. 7, 2014 for U.S. teams.

During its 20-year run, the Great Moonbuggy Race engaged more than 10,000 students and demonstrated these budding scientists and engineers were capable of even more complex undertakings. The NASA Human Exploration Rover Challenge will provide that complexity through an authentic engineering experience. The student teams will design, build and test technologies that enable vehicles to perform in a wide variety of environments. Their results and findings will inform the design process for NASA's next generation space systems.

This engineering challenge is designed to align with NASA's commitment of sending humans to Mars by the 2030s. Student teams will be timed, ranked and scored based on design, safety and how well they traverse the set course. It is NASA's hope that the competition results will contribute to the design process for NASA's future exploration goals.

This student design challenge continues NASA's effort to use the appeal and intrigue of its space missions and programs as catalysts for engaging students in STEM - science, technology, engineering and mathematics. Students will create their own vehicles to power around a rugged course at the final competition. The obstacles around the course will mimic some of the real terrain challenges of solar system exploration, so students must design robust and durable rovers with the traction to scale obstacles and meet other challenges.

The culminating event of the NASA rover competition is scheduled for April 10-12 at the U.S. Space and Rocket in Huntsvillel. Corporate sponsors will award prizes for winning components of the challenge.

The planned course for the competition will require teams to traverse a terrain that includes a simulated field of asteroid debris - boulders from 5-15 inches across; an ancient stream bed with pebbles about 6 inches deep; and erosion ruts and crevasses in varying widths and depths.For more information about the NASA Human Exploration Rover Challenge, visit: **http://www.nasa.gov/roverchallenge**

Kapi'olani Community College (Hawaii) Wins CanSat Competition

http://www.cansatcompetition.com/Main.html

Teams in the US, Iran, Canada, and India (2) win prizes

Kapi'olani Community College (Honolulu, Hawaii) place first in the 8th Student CanSat Competition held in Abilene and Burkett, Texas, June 7-10, 2013

Second place award went to Amirkabir University of Technology (Tehran, **Iran**).

Third place to Ryerson University (Toronto, **Canada**);

Fourth place to the University of Petroleum and Energy Studies (Dehradun, **India**)

Fifth place to SRM University (Chennai, **India**). Twenty-five teams from 9 countries participated in this year's competition.

Amazing New Technologies - Ideas for students to "get involved"

- http://www.tested.com/tech/concepts/458513-**disney-research-uses-friction-simulate-textures-touchscreens**/?ncid=webmail27 - **includes a must watch VIDEO**
- **Video alone** - http://www.youtube.com/watch?v=zo1n5CyCKr0#t=76
- **5 Steps to Cutting Costs Through Open Source: "Do It Yourself Drones"** By Peter Diamandis https://plus.google.com/+PeterHDiamandis/posts/7uJ3BXxDxL6
- **Create a "Flip Magazine" version of TTSIQ** that can be read on smart cell phones and tablets which are more widely used by young people than computers. **Google "Flip Magazine software"**
- Create various "**Space Apps**" for the same market. Google "Space Apps" to see what is already out there.

ESA Student Robot Challenge: Unload a Spacecraft

http://www.esa.int/**Our_Activities/Human_Spaceflight/Education/Robot_challenge_unload_a_spacecraft**

http://www.esa.int/Our_Activities/Human_Spaceflight/**Volare/Space_Robotics_competition**

October 17, 2013 -More than 50 students from five countries gathered at ESA's Science Mission headquarters in Noordwijk, Netherlands yesterday to show and demonstrate their robotic creations for the finals of the Volare Space Robotics challenge.

Seven secondary school teams attempted to control their robots by remote control on a mock-up of the International Space Station, next door. Their challenge was to unload as much cargo from ESA's Automated Transfer Vehicle (ATV) as possible in a given time.The robots came in many shapes and designs. Motive power and steering were important design issues.

The challenge called on skills from many areas, and was designed to mimick the steps ESA engineers follow when developing a spacecraft. "The teams had to work together and divide tasks to tackle robot design, communications and control as well as making sure all the paperwork was in order for the competition and delivering progress reports and videos to ESA on time".

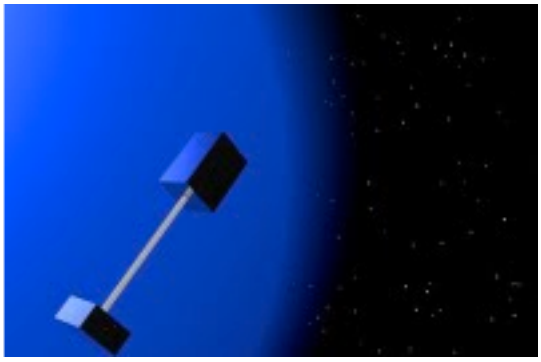
The highlight for many was a first day ESA's laboratories and a live call with ESA astronaut Luca Parmitano on board the International Space Station. Afterwards, they began setting up their robots. Some teams worked late fine tuning their robots and repairing shipping damage.The rivalry was friendly and the various teams supported each other, praising the designs of rival teams.

Space Raiders from Manchester, UK won in the 11-13 year age category and **TecnoRoisTres from Spain** were the winners of the 14-16 year age category. ##

French Mars Society Chapter- Successful Artificial Gravity Experiment

http://www.marssociety.org/home/press/tms-in-the-news/
frenchmarssocietyconductssuccessfulartificialgravitydemonstration

October 22, 2013 - **Association Planete Mars** (http://www.planete-mars.com) (APM), **the Mars Society's French chapte**r, has announced that it had successfully conducted an **artificial gravity test** during a parabolic flight and were able to demonstrate an artificial gravity system during a flight of a zero-gravity airplane from Novespace http://www.novespace.fr/en,home.html over Bourdeaux, France on October 9th."



Proposed two years ago by APM to engineering students from Ecole Centrale de Lille, the project was sponsored by APM and CNES, the French space agency, which selected it as part of the framework of its annual student zero-g flight program. CNES provided funding for the flight demonstration and technical and operational support to participating students. French school teachers and Novespace representatives were also involved.

"The project design allowed the use of electric power rather than propellants to deploy the composite. A bearable initial rotation is given to the composite, which is then overstretched under the free action of centrifuge; then, a reduced supplemental impulsive rotation is given to the 2 linked mobiles; and finally an electric motor reduces the length of the tether until the desired g-level is obtained."

Post flight report

The main difficulty was to design a launching and releasing system which, while giving a good rotational speed, imparts as little as possible perturbations at release.

Another problem was the quite reduced space allocated to the experiment in the plane, which put undesirable constraints on the dimensioning (why the mobiles look over-sized with respect to their separation). But it was still possible to have representative accelerations and to observe the dynamics.

Releases were performed on 20 parabolas (for a total of 30), with movies captured from several different cameras and acceleration measurements recorded aboard one of the mobiles.

This data is presently under scrutiny by the students."

Participating students will give a presentation of their work during the 13th European Mars Society Convention, scheduled for October 25-27 in Ivry-sur-Seine (Paris).

The idea of undertaking a small-scale demonstration of an artificial gravity system was originally proposed to the Mars Society by Tom Hill, a member of the organization's Maryland chapter, under the title of the TEMPO3 mission. It was embraced by the Mars Society in 2008 as the winning entry in its "Mars Project Challenge" contest. Following work done by a team led by Mr. Hill in 2009, the project was adopted by APM in 2010. ##

NASA Enhances 'Space Station Live' - Launches New Weekly Web Series

www.nasa.gov/press/2013/november/**nasa-enhances-space-station-live-and-launches-new-weekly-web-series/**

As of December, 2013, NASA has begun showing the public the International Space Station in new ways that will highlight all the scientific research, cutting-edge technology testing and even the wonder of living and working in space.

NASA has enhanced its daily NASA Television "Space Station Live" program and has launched a new weekly web series called "Space to Ground."

"Space Station Live" continues to air weekdays at 11 a.m. EST, now in a 30-minute format as of Dec 2. It features live views from the Station, updates on the crew's daily activities, enhanced content and interviews on space station science and features on how that science benefits life on Earth.

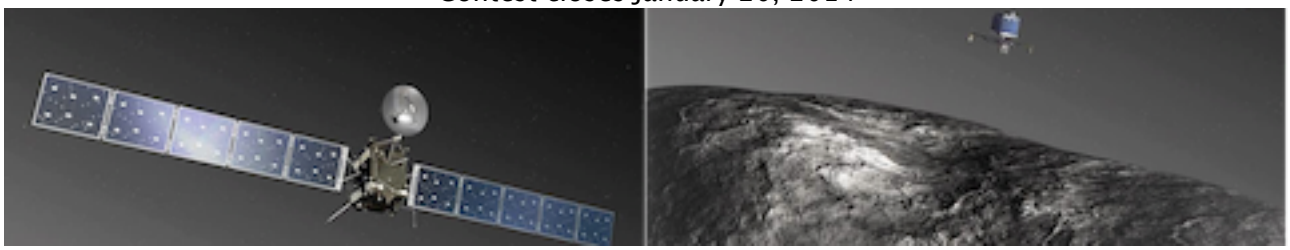
The "Space to Ground" web series is available every Friday as of Dec. 6. This series is a short wrap-up of the week's activities aboard the station that showcases the diversity of activities taking place on board. These videos are also posted to the agency's social media accounts and can be shared and downloaded by the public.

To view "Space to Ground" visit: http://go.nasa.gov/spacetoground]

ESA Launches Wake-Up Call Contest for Comet-bound Spacecraft

Dec 11, 2013 - http://www.space.com/23933-**rosetta-comet-spacecraft-wake-up-call.**html

Contest closes January 20, 2014



In August 2014, the ESA's **Rosetta** Spacecraft [Left, above] will rendezvous with **Comet 67P/ Churyumov-Gerasimenko** and deploy its **Philae lander** [Right, above].

The European Space Agency is **asking comet fans around the world to create a special video message to rouse the Rosetta spacecraft under the new 'Wake Up Rosetta' campaign.**

The project invites everyone to create and share **a video clip of themselves, alone or in a group, shouting "Wake Up, Rosetta!"**

The top 10 selections will receive prizes, including **having their message transmitted to Rosetta as it closes in on its target.** Contestants can post their videos to ESA'a Facebook page, where other users can vote. **https://www.facebook.com/EuropeanSpaceAgency**

www.space.com/23932-**how-esas-rosetta-comet-probe-wakes-up-in-deep-space-video**.html

##

List of Recent Feature Articles and Essays in Our Sister Publications

Ad Astra [Latin (ancient Roman): "To The Stars"]

Sent to all National Space Society Members as a primary membership benefit
(with choice of print hardcopy or downloadable pdf file)

FALL 2013 issue

Kalpana One: What will it be like to live in space? By Al Globus
Laid Back Impatience: ISDC 2013 Update: By Cliff McMurray
Island Hopping to Mars: By Michael Raftery
If Apollo Happened Today: By Marianne J. Dyson
ESA's Multifunctional Spaceship: By Mark Williamson
Making the Business Case for Space at the Space Tech Expo: By Jim Plaxco
World Space Week 2013: Exploring Mars, Discovering Earth: By Luisa Fernanda Zambrano Marin

WINTER 2013 Issue

Distant Skyline: A Vision for What's Beyond ISS: by Doris Hamill
Choosing for Science: The Farside of the Moon: By Marianne J. Dyson
A Modular Paradigm for Exploration: By James Van Lock
In One Giant Leap: Shackleton Energy Company's Strategic Vision: By Clifford R. McMurray
Commercial Cargo Competition: Dragon turns up the heat; Cygnus trumpets Test Flight: By John F. Cross
A Bold New Mission: Asteroid Redirect with Sample Return: By Marianne J. Dyson
A Summer in New Space 2013: By Dale S. Skran
Closer Every Day: An Interview with George Whitesides: By Clifford R. McMurray

www.MMM-MoonMinersManifesto.com

October 2013 - MMM #269

In Focus: Turning the Annual Shrinkage in NASA's Budget into "a Good Thing" - by Peter Kokh
Covering Up Lunar Habitats with Moondust - Precedents here on Earth - by Peter Kokh
New NASA Composite Cryogenic Fuel Tanks could help open the Moon - by Peter Kokh
The future of NASA human space flight and space commerce - by Phillip Crume
International Politics: America's two-faced Collaboration with China - by Peter Kokh
How can we Stimulate Greater Use of the International Space Station? - by Peter Kokh

November 2013 - MMM #270

In Focus: MMM has a new domain name: www.MMM-MoonMinersManifesto.com
Priorities: Just getting back to the Moon? International Lunar Research Parks? Settlements? - Peter Kokh
Integrating Cycling Orbits to Enhance Cislunar Infrastructure - Al Anzaldua
AAC - Autoclaved Aerated Concrete: a 2nd Look - David Dietzler & Peter Kokh
Cycling Orbits for Earth<->Moon "Cruise Ships"? - Peter Kokh

December 2013 - MMM #271 - 27th Anniversary issue

In Focus: "Backing up" our Civilization - Peter Kokh
Market Economics: Options for the Moon, Mars, and the Asteroids - Peter Kokh
Lunar Spaceport Salvage Yards and the path to Permanent Residence - Peter Kokh
Lavatube and Space Settlements have common design challenges - Peter Kokh
The Challenges in Producing Aluminum on the Moon - Dave Dietzler

Moon Miners' Manifesto Resources

http://www.MMM-MoonMinersManifesto.com

MMM is published 10 times a year (except January and July. The December 2011 issue began its 26th year of continuous publication.

Most issues deal with the **opening of the Lunar frontier**, suggesting how pioneers can make best use of **local resources** and learn to **make themselves at home.** This will involve psychological, social, and physiological adjustment**.**

Some of the points made will relate specifically to **pioneer life** in the lunar environment. But much of what will hold for the Moon, will also hold true for **Mars and for space in general.** We have one Mars theme issue each year, and occasionally **other space destinations** are discussed: the asteroids, Europa (Jupiter), Titan (Saturn), even the cloud tops of Venus.

Issues #145 (May 2001) forward through current are as pdf file downloads with a Moon Society username and password. Moon Society International memberships are $35 US; $20 students, seniors – join online at:

http://www.moonsociety.org/register/

MMM Classics: All the "non-time-sensitive editorials and articles from past issues of MMM have been re-edited and republished in pdf files, one per publication year. A 3-year plus lag is kept between the MMM Classic volumes and the current issue. **As of December 2011, the first twenty-two years of MMM, 200 issues, will be preserved in this directory,** These issues are freely accessible to all, no username or password needed, at:

www.moonsocietyorg/publications/mmm_classics/

MMM Classic Theme Issues: introduced a new series to collect the same material as in the Classics, but this time organized by theme. The first MMM Classic Theme issue gathers all the **Mars** theme articles from years 1-10 in one pdf file. A second pdf file collects all the Mars Theme issues from year 11-20. The 2nd Classic Theme is "**Eden on Luna**," addressing environmental issues underlying lunar settlement. **Asteroids**, **Tourism, Research**, **Select Editorials, and Analog Programs** have been added. New Theme Issues will be coming: Lunar Building Materials, The Lunar Economy, The Lunar Homestead, Modular Architecture, Modular Biospherics, Frontier Arts & Crafts, Frontier Sports, Other Solar System Destinations, and so on.

www.moonsociety.org/publications/mmm_themes/

MMM Glossary: The publishers of MMM, the Lunar Reclamation Society, has published a new Glossary of "MMM-Speak: new words and old words with new meaning" as used in Moon Miners' Manifesto.

www.moonsociety.org/publications/m3glossary.html

The initial addition includes over 300 entries, many with illustrations. Additional entries are under construction. It is hoped that new members will consider this to be a "Read Me First" guide, not just to Moon Miners' Manifesto, but to our vision and goals.

All of these resources are available online or as free access downloads to readers.
But TTSIQ does need your help!

To The Stars International Quarterly Advisors, Liaisons, Contributors, Reporters, Illustrators

If this publication is to help spread the word about Space worldwide, among the public at large, especially among the students and younger people, it must become a truly International publication. We need people from many fields to join our team.

If you think that you can add to the usefulness and vitality of this publication, in any of the ways listed above, or in fields we had not thought of, write us at: ttsiq@moonsociety.org [This email address goes to the whole editorial team]

Tell us about yourself; your interest in space, and how you think you can make this publication of real service in the education of the public in India, and in the education of young people on whom the future of the world rests.

Guidelines for Submissions **TTS**IQ is intended for wide public distribution to encourage support for space research and exploration and development.TTSIQ is not a scholarly review or a technical journal for professional distribution. Submissions should be short, no more than a few thousand words. Longer pieces may be serialized editorials and commentary, reports on actual developments and proposals, glimpses of life on the future space frontier, etc. Articles about launch vehicles, launch facilities, space destinations such as Earth Orbit, The Moon, Mars, the asteroids, and beyond, challenges such as dealing with moondust, radiation, reduced gravity, and more.

Help Circulate To The Stars International Quarterly

If you know someone who might enjoy reading this publication, send us their email address(es) so that they receive notice when a new issue if published. Readers are encouraged to share and to distribute these issues widely, either as email attachments, or via the direct download address (for all issues):

http://www.nss.org/tothestars/ and http://www.moonsociety.org/international/ttsiq/

To The Stars International Quarterly #6: January 2014 Index

NOTE – with this issue,
To The Stars International Quarterly replaces older sister publication Moon Miners' Manifesto India Quarterly
This is logical as TTSIQ #s 2–5 and M3IQ #s 18–21, except for the first 2 and last 2 pages,
Included the same news reports, the same essays and articles, and the same layout.
This issue, in PDF format, can be downloaded from:

http://www.nss.org/tothestars/ &/or http://www.moonsociety.org/international/ttsiq/

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To The Stars International Quarterly #6

Engage! And Enjoy!