Space News Update

— March 3, 2017 —

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1. New Plant Habitat Will Increase Harvest on International Space Station

A new, nearly self-sufficient plant growth system by NASA is headed to the International Space Station soon and will help researchers better understand how plants grow in space. The Advanced Plant Habitat will be used to conduct plant bioscience research on the space station, and help NASA prepare crew to grow their own food in space during deep-space exploration missions.

Some of the components of this new system have arrived at NASA's Kennedy Space Center in Florida and are being prepared for delivery to the station on Orbital ATK's seventh commercial resupply mission to the station. The new plant system will join Veggie – NASA's first fresh food growth system already active on station.

Dr. Howard Levine, the project scientist overseeing the development of the advanced system, along with Dr. Gioia Massa, a life science project scientist and deputy project scientist, were two of the researchers who helped design the science requirements for the hardware and the test plan to validate it when it was tested at ORBITEC in Madison, Wisconsin.

"A team of scientists here at Kennedy Space Center have been developing the procedures for the first experiment using a prototype, or engineering development unit, of the plant habitat in the Space Station Processing Facility," Levine said.

Arabidopsis seeds, small flowering plants related to cabbage and mustard, have been growing in the prototype habitat, and will be the first plant experiment, called PH-01, grown in the chamber aboard the space station.

Bryan Onate is the NASA APH project manager in the Exploration Research and Technology Directorate at Kennedy. He described the new plant habitat as a fully enclosed, closed-loop system with an environmentally controlled growth chamber. It uses red, blue and green LED lights, and broad spectrum white LED lights. The

system's more than 180 sensors will relay real-time information, including temperature, oxygen content and moisture levels (in the air and soil, near the plant roots, and at the stem and leaf level), back to the team at Kennedy.

"A big difference in this system, compared to Veggie, is that it requires minimal crew involvement to install the science, add water, and perform other maintenance activities," Onate said. "We are learning how plants grow in space and what levels of commodities, such as light and water, are required so we can maximize our growth with the least resources."

The large, enclosed chamber measures 18 inches square, with two inches for the root system and 16 inches available for growth height. It is designed to support commercial and fundamental plant research or other bioscience research aboard the space station for up to a 135-day science investigation, and for at least one year of continuous operation without maintenance.

"I think that the new plant growth habitat will provide tremendous capabilities to do high quality plant physiology research with a variety of plant types on the space station," Massa said. "The plant habitat will enable much more controlled and detailed studies of plant growth in spaceflight."

The advanced system will be activated by astronauts aboard the space station but controlled by the team at Kennedy, minimizing the amount of crew time needed to grow the plants. The space station crew will still perform plant thinning and harvesting.

"Before PH-01 is initiated, there will be a short grow out of Dwarf Wheat and Arabidopsis as part of the post-installation checkout on the space station," Onate said.

The system's Plant Habitat Avionics Real-Time Manager in EXPRESS Rack, or PHARMER, will provide real-time data telemetry, remote commanding and photo downlink to the Kennedy team. An active watering system with sensors will detect when the plants need water and keep water flowing as needed.

Massa said having Veggie and the advanced system on the station will allow studies of food production in space, from the very simple to the complex and controlled.

When all parts are delivered to the station, the habitat will be installed in a standard EXpedite the PRocessing of Experiments to Space Station (EXPRESS) rack in the Japanese Experiment Module Kibo.

Source: NASA Return to Contents

2. NASA Orbiter Steers Clear of Mars Moon Phobos

NASA's MAVEN spacecraft performed a previously unscheduled maneuver this week to avoid a collision in the near future with Mars' moon Phobos.

The Mars Atmosphere and VolatileEvolutioN (MAVEN)spacecraft has been orbiting Mars for just over two years, studying the Red Planet's upper atmosphere, ionosphere and interactions with the sun and solar wind. On Tuesday the spacecraft carried out a rocket motor burn that boosted its velocity by 0.4 meters per second (less than 1 mile per hour). Although a small correction, it was enough that -- projected to one week later when the collision would otherwise have occurred -- MAVEN would miss the lumpy, crater-filled moon by about 2.5 minutes.

This is the first collision avoidance maneuver that the MAVEN spacecraft has performed at Mars to steer clear of Phobos. The orbits of both MAVEN and Phobos are known well enough that this timing difference ensures that they will not collide.

MAVEN, with an elliptical orbit around Mars, has an orbit that crosses those of other spacecraft and the moon Phobos many times over the course of a year. When the orbits cross, the objects have the possibility of colliding if they arrive at that intersection at the same time. These scenarios are known well in advance and are carefully monitored by NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California, which sounded the alert regarding the possibility of a collision.

With one week's advance notice, it looked like MAVEN and Phobos had a good chance of hitting each other on Monday, March 6, arriving at their orbit crossing point within about 7 seconds of each other. Given Phobos' size (modeled for simplicity as a 30-kilometer sphere, a bit larger than the actual moon in order to be conservative), they had a high probability of colliding if no action were taken.

Said MAVEN Principal Investigator Bruce Jakosky of the University of Colorado in Boulder, "Kudos to the JPL navigation and tracking teams for watching out for possible collisions every day of the year, and to the MAVEN spacecraft team for carrying out the maneuver flawlessly."

MAVEN's principal investigator is based at the University of Colorado's Laboratory for Atmospheric and Space Physics, Boulder. The university provided two science instruments and leads science operations, as well as education and public outreach, for the mission. NASA's Goddard Space Flight Center in Greenbelt, Maryland, manages the MAVEN project and provided two science instruments for the mission. Lockheed Martin built the spacecraft and is responsible for mission operations. The University of California at Berkeley's Space Sciences Laboratory also provided four science instruments for the mission. NASA's Jet Propulsion Laboratory in Pasadena, California, provides navigation and Deep Space Network support, as well as the Electra telecommunications relay hardware and operations.

Source: NASA

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3. Remnants of a Mega-flood on Mars

ESA's Mars Express has captured images of one of the largest outflow channel networks on the Red Planet. The Kasei Valles channel system extends around 3000 km from its source region in Echus Chasma – which lies east of the bulging volcanic region Tharsis and just north of the Valles Marineris canyon system – to its sink in the vast plains of Chryse Planitia.

A combination of volcanism, tectonics, collapse and subsidence in the Tharsis region led to several massive groundwater releases from Echus Chasma, which subsequently flooded the Kasei Valles region around 3.6–3.4 billion years ago. These ancient mega-floods have left their mark on the features seen today.

Sections of Kasei Valles have already been imaged by Mars Express during its 14 years at the Red Planet, but this new image, taken on 25 May 2016, captures a portion right at its mouth.

A 25 km-wide impact crater – Worcester Crater – just left to the centre of the main colour image, has done its best to stand up to the erosive forces of the mega-floods. While much of the blanket of material surrounding the crater – which was originally thrown out from inside the crater during the impact – has been eroded, the section downstream of the flood has survived. Over time this has led to the overall appearance of a streamlined island, with its stepped topography downstream perhaps suggesting variations in water levels or different flood episodes.

By contrast, the debris blanket surrounding the adjacent crater has remained intact. This suggests the impact producing that crater occurred after the major flooding. Moreover, the appearance of the debris blanket tells a story on the nature of the subsurface: in this case it points to the floodplain being rich in water or water-ice.

Indeed, the pattern is reminiscent of a 'splash': the debris ejected from the crater was rich in water, allowing it to flow more easily. As it slowed, the debris behind it piled up, pushing up the material at its periphery into ramparts.

The perspective view shows a close-up of this rampart feature and looks from the associated crater towards the eroded Worcester crater in the background. The large crater at the northernmost part (right, top) of the main image does not appear to have penetrated as deep as Worcester crater and its neighbour. Indeed, it is located on a plateau at least 1 km higher than the plains below.

Nonetheless, there is a small depression in the centre of the crater, which usually implies a weaker layer – such as ice – was buried underneath at the time of the impact.

Close inspection also reveals the faint outline of the crater's ejecta blanket, including a portion that spilled over onto the plains below. The ejecta shows an interesting grooved pattern that the other craters in this view seem to be lacking. This suggests a difference in the nature of the impact itself, perhaps either with the energy imparted during the impact, the way in which the ejecta was emplaced from the crater, or in the composition of the plateau material.

Small dendritic channels can be seen all around the plateau, which perhaps hint at the varying flood magnitudes during numerous episodes of flooding. A number of smaller craters in the flat plains can also be found. These appear to have lighter-coloured 'tails' pointing in the opposite direction to the flow of water coming from Kasei Valles.

These craters were formed by impacts that took place after the catastrophic flooding, their delicate tails created by winds blowing in a westwards direction 'up' valley. Their raised rims influence wind flow over the crater such that the dust immediately 'behind' the crater remains undisturbed in comparison to the surrounding, more exposed, plains. This scene therefore preserves a record of geological activity spanning billions of years of the Red Planet's history.

Source: ESA

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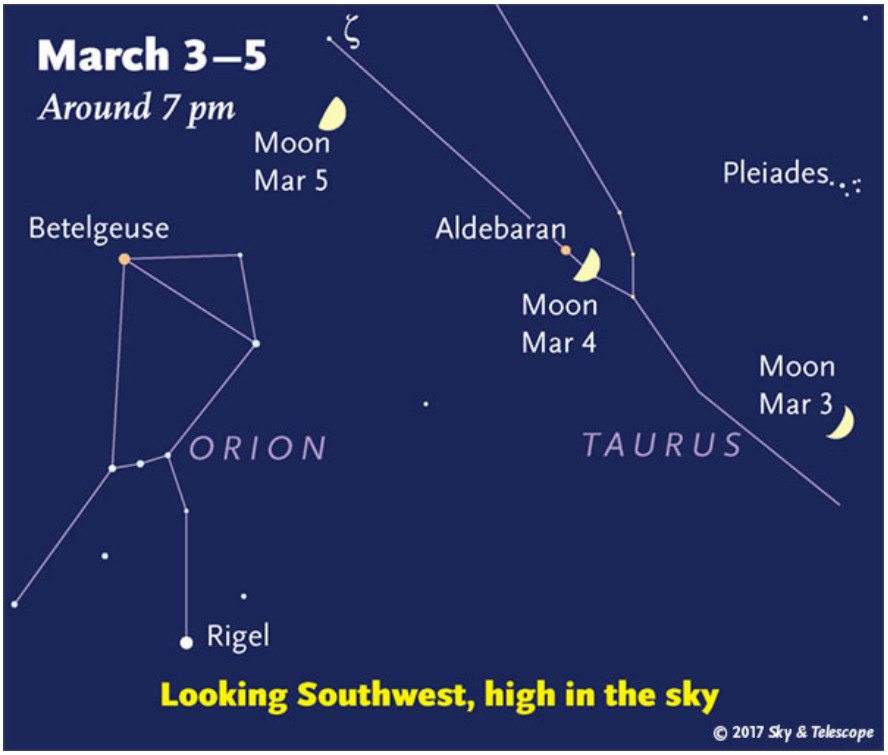
The Night Sky

Friday, March 3



• The Moon hangs below Aldebaran, the Hyades, and the Pleiades in the west this evening. But get ready for tomorrow night, when. . . .

Saturday, March 4

• The dark limb of the first-quarter Moon occults (crosses over) orange Aldebaran for viewers in most of the contiguous United States, Mexico, and Central America. We're calling this the best lunar occultation of 2017. See the March *Sky & Telescope*, page 48, or Aldebaran's Disappearing Act online. Several fainter Hyades stars will also be occulted. Get world maps and local predictions (the UT dates are March 4th and 5th).

In addition, the International Occultation Timing Association has set up a special web page for the Aldebaran graze. It features interactive Google Maps of the occultation's northern limit (graze line) from Rhode Island and Connecticut across upstate New York, the Great Lakes, and along the U.S.-Canada border to the Pacific. (For street-level precision of the graze line, choose the map for your elevation above sea level and follow the adjustment instructions.)

Sunday, March 5

• Now the Moon shines over Orion as the stars come out.

Monday, March 6

• It's early March. So quite soon after dark now, the Big Dipper rises as high in the northeast as Cassiopeia has descended to in the northwest. Midway between them, as always, is Polaris.

Source: Sky & Telescope

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ISS Sighting Opportunities

For Denver:

Date	Visible	Max Height	Appears	Disappears
Sat Mar 4, 4:39 AM	2 min	37°	36° above SSE	24° above E
Sun Mar 5, 3:49 AM	< 1 min	12°	12° above E	12° above E
Sun Mar 5, 5:22 AM	4 min	43°	25° above W	12° above NE
Mon Mar 6, 4:32 AM	2 min	48°	48° above NE	13° above NE
Tue Mar 7, 5:14 AM	3 min	23°	20° above NW	11° above NNE

Sighting information for other cities can be found at NASA's Satellite Sighting Information

NASA-TV Highlights

(all times Eastern Daylight Time)

Friday, March 3

3 p.m., 7 p.m., Replay of SpaceCast Weekly (all channels)

11 p.m., Replay of SpaceCast Weekly (NTV-1 (Public))

Saturday, March 4

1 a.m., 7 a.m., Replay of SpaceCast Weekly (NTV-1 (Public))

3 a.m., Replay of SpaceCast Weekly (NTV-3 (Media))

11 a.m., 3 p.m., 7 p.m., 11 p.m., Replay of SpaceCast Weekly (all channels)

Sunday, March 5

1 a.m., 2. a.m., 7 a.m., Replay of SpaceCast Weekly (NTV-1 (Public))

11 a.m., 3 p.m., 7 p.m., Replay of SpaceCast Weekly (all channels)

Monday, March 6

9:30 a.m., ISS Expedition 50 In-Flight Event for ESA and TMC Television with Flight Engineer Thomas Pesquet of the European Space Agency (NTV-1 with English interpretation; NTV-3 in native language) (starts at 9:40 a.m.) (all channels)

Watch NASA TV on the Net by going to the NASA website.

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Space Calendar

- Mar 03 - Comet 43P/Wolf-Harrington Closest Approach To Earth (1.540 AU)
- Mar 03 - Comet C/2016 A3 (PANSTARRS) At Opposition (3.804 AU)
- Mar 03 - Comet 312P/NEAT At Opposition (3.921 AU)
- Mar 03 - Asteroid 29 Amphitrite At Opposition (8.9 Magnitude)
- Mar 03 - Apollo Asteroid 2016 RZ17 Near-Earth Flyby (0.078 AU)
- Mar 03 - NEW [Mar 01] Apollo Asteroid 2017 DW37 Near-Earth Flyby (0.089 AU)
- Mar 03 - Asteroid 2362 Mark Twain Closest Approach To Earth (1.605 AU)
- Mar 03 - Asteroid 2197 Shanghai Closest Approach To Earth (1.831 AU)
- Mar 03 - Asteroid 18499 Showalter Closest Approach To Earth (2.202 AU)
- Mar 03 - Asteroid 30444 Shemp Closest Approach To Earth (2.257 AU)
- Mar 03 - Asteroid 5281 Lindstrom Closest Approach To Earth (2.306 AU)
- Mar 04 - Mercury Passes 1.1 Degrees From Neptune
- Mar 04 - Comet 73P-AD/Schwassmann-Wachmann Closest Approach To Earth (1.269 AU)
- Mar 04 - Comet 73P-E/Schwassmann-Wachmann Closest Approach To Earth (1.275 AU)
- Mar 04 - Comet 334P/NEAT At Opposition (3.269 AU)
- Mar 04 - Comet C/2016 A3 (PANSTARRS) Closest Approach To Earth (3.805 AU)
- Mar 04 - NEW [Feb 25] Apollo Asteroid 2017 DW34 Near-Earth Flyby (0.049 AU)
- Mar 04 - Asteroid 8129 Michaelbusch Closest Approach To Earth (1.245 AU)
- Mar 04 - Asteroid 3498 Belton Closest Approach To Earth (1.434 AU)
- Mar 04 - Asteroid 580 Selene Closest Approach To Earth (2.226 AU)
- Mar 04 - Robert Emden's 155th Birthday (1862)
- Mar 05 - Moon Occults Aldebaran
- Mar 05 - Cassini, Distant Flyby of Titan
- Mar 05 - Comet 73P-AL/Schwassmann-Wachmann At Opposition (0.965 AU)
- Mar 05 - Comet 73P-M/Schwassmann-Wachmann Closest Approach To Earth (1.255 AU)
- Mar 05 - Comet C/2016 T2 (Matheny) Closest Approach To Earth (1.723 AU)
- Mar 05 - Comet 186P/Garradd At Opposition (3.884 AU)
- Mar 05 - Comet P/2014 U4 (PANSTARRS) At Opposition (3.979 AU)
- Mar 05 - Comet C/2015 V4 (PANSTARRS) At Opposition (4.745 AU)
- Mar 05 - Asteroid 125071 Lugosi Closest Approach To Earth (1.211 AU)
- Mar 05 - Asteroid 35137 Meudon Closest Approach To Earth (1.476 AU)
- Mar 05 - Asteroid 13743 Rivkin Closest Approach To Earth (1.537 AU)
- Mar 05 - Asteroid 100267 JAXA Closest Approach To Earth (1.538 AU)
- Mar 05 - Asteroid 11055 Honduras Closest Approach To Earth (1.645 AU)
- Mar 05 - Asteroid 10050 Rayman Closest Approach To Earth (1.978 AU)
- Mar 05 - Asteroid 78453 Bullock Closest Approach To Earth (2.572 AU)
- Mar 05 - 35th Anniversary (1982), Venera 14, Venus Landing/Flyby (USSR)
- Mar 05 - Gerard Mercator's 505th Birthday (1512)
- Mar 06 - UPDATED [Mar 03] Sentinel 2B Rokot-KM Launch
- Mar 06 - Comet 45P/Honda-Mrkos-Pajdusakova At Opposition (0.321 AU)
- Mar 06 - Comet 334P/NEAT Closest Approach To Earth (3.268 AU)
- Mar 06 - NEW [Mar 01] Apollo Asteroid 2017 DZ108 Near-Earth Flyby (0.028 AU)
- Mar 06 - Apollo Asteroid 5786 Talos Closest Approach To Earth (0.804 AU)
- Mar 06 - Asteroid 6827 Wombat Closest Approach To Earth (1.546 AU)
- Mar 06 - Asteroid 157064 Sedona Closest Approach To Earth (2.114 AU)
- Mar 06 - Asteroid 439 Ohio Closest Approach To Earth (2.127 AU)
- Mar 06 - Kuiper Belt Object 2013 FY27 At Opposition (79.212 AU)
- Mar 06 - L5 in Tandem with L1: Future Space-Weather Missions Workshop, London, United Kingdom

- Mar 06 - Online Seminar: In-Situ Resource Utilization (ISRU) - Construction With Regolith
- Mar 06 - Valentina Tereshkova's 80th Birthday (1937)
- Mar 06 - Gordon Cooper's 90th Birthday (1927)
- Mar 06 - Joseph Fraunhofer's 230th Birthday (1787)

Source: JPL Space Calendar

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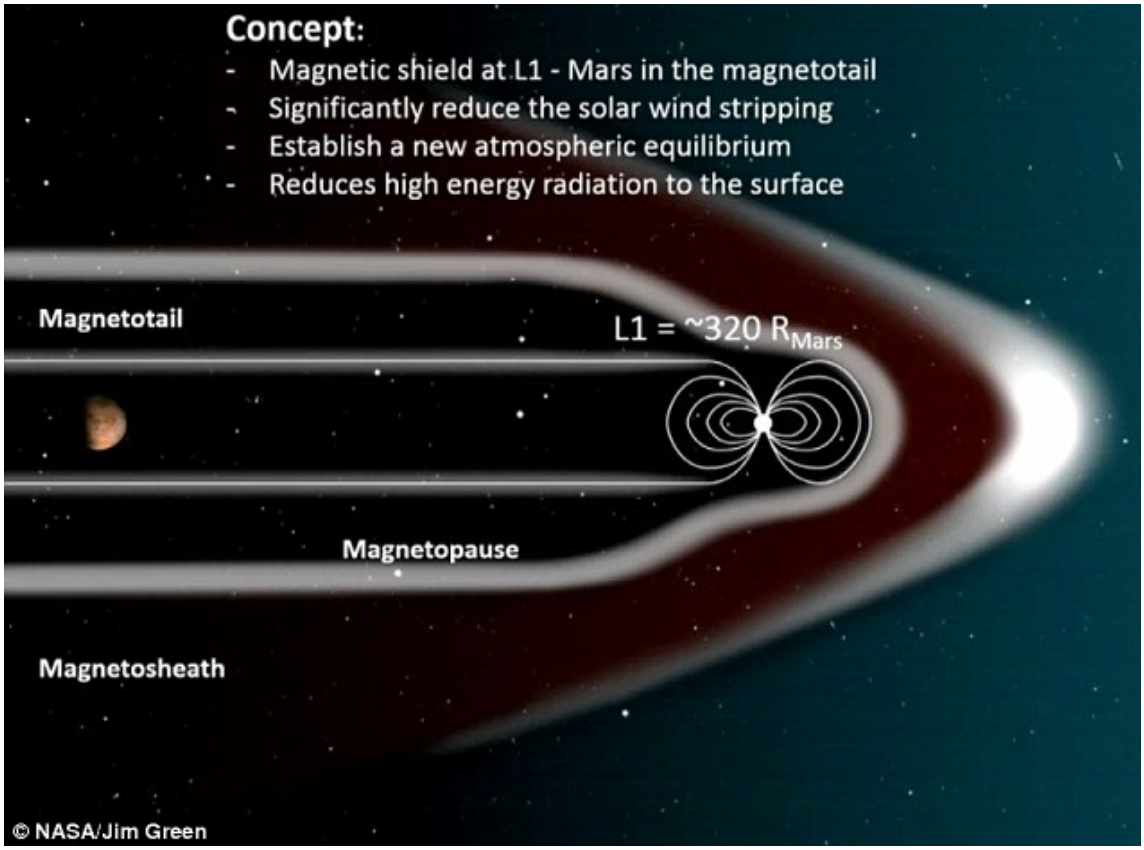
Food for Thought

NASA Proposes A Magnetic Shield to Protect Mars' Atmosphere



This week, NASA's Planetary Science Division (PSD) hosted a community workshop at their headquarters in Washington, DC. Known as the "Planetary Science Vision 2050 Workshop", this event ran from February 27th to March 1st, and saw scientists and researchers from all over the world descend on the capitol to attend panel discussions, presentations, and talks about the future of space exploration.

One of the more intriguing presentations took place on Wednesday, March 1st, where the exploration of Mars by human astronauts was discussed. In the course of the talk, which was titled "A Future Mars Environment for Science and Exploration", Director Jim Green discussed how deploying a magnetic shield could enhance Mars' atmosphere and facilitate crewed missions there in the future.

The current scientific consensus is that, like Earth, Mars once had a magnetic field that protected its atmosphere. Roughly 4.2 billion years ago, this planet's magnetic field suddenly disappeared, which caused Mars' atmosphere to slowly be lost to space. Over the course of the next 500 million years, Mars went from being a warmer, wetter environment to the cold, uninhabitable place we know today.

This theory has been confirmed in recent years by orbiters like the ESA's Mars Express and NASA's Mars Atmosphere and Volatile EvolutioN Mission (MAVEN), which have been studying the Martian atmosphere since 2004 and 2014, respectively. In addition to determining that solar wind was responsible for depleting Mars' atmosphere, these probes have also been measuring the rate at which it is still being lost today.

Without this atmosphere, Mars will continue to be a cold, dry place where life cannot flourish. In addition to that, future crewed mission – which NASA hopes to mount by the 2030s – will also have to deal with some

severe hazards. Foremost among these will be exposure to radiation and the danger of asphyxiation, which will pose an even greater danger to colonists (should any attempts at colonization be made).

In answer to this challenge, Dr. Jim Green – the Director of NASA's Planetary Science Division – and a panel of researchers presented an ambitious idea. In essence, they suggested that by positioning a magnetic dipole shield at the Mars L1 Lagrange Point, an artificial magnetosphere could be formed that would encompass the entire planet, thus shielding it from solar wind and radiation.

Naturally, Green and his colleagues acknowledged that the idea might sounds a bit "fanciful". However, they were quick to emphasize how new research into miniature magnetospheres (for the sake of protecting crews and spacecraft) supports this concept:

"This new research is coming about due to the application of full plasma physics codes and laboratory experiments. In the future it is quite possible that an inflatable structure(s) can generate a magnetic dipole field at a level of perhaps 1 or 2 Tesla (or 10,000 to 20,000 Gauss) as an active shield against the solar wind."

In addition, the positioning of this magnetic shield would ensure that the two regions where most of Mars' atmosphere is lost would be shielded. In the course of the presentation, Green and the panel indicated that these the major escape channels are located, "over the northern polar cap involving higher energy ionospheric material, and 2) in the equatorial zone involving a seasonal low energy component with as much as 0.1 kg/s escape of oxygen ions."

To test this idea, the research team – which included scientists from Ames Research Center, the Goddard Space Flight Center, the University of Colorado, Princeton University, and the Rutherford Appleton Laboratory – conducted a series of simulations using their proposed artificial magnetosphere. These were run at the Coordinated Community Modeling Center (CCMC), which specializes in space weather research, to see what the net effect would be.

What they found was that a dipole field positioned at Mars L1 Lagrange Point would be able to counteract solar wind, such that Mars' atmosphere would achieve a new balance. At present, atmospheric loss on Mars is balanced to some degree by volcanic outpassing from Mars interior and crust. This contributes to a surface atmosphere that is about 6 mbar in air pressure (less than 1% that at sea level on Earth).

As a result, Mars atmosphere would naturally thicken over time, which lead to many new possibilities for human exploration and colonization. According to Green and his colleagues, these would include an average increase of about 4 °C (~7 °F), which would be enough to melt the carbon dioxide ice in the northern polar ice cap. This would trigger a greenhouse effect, warming the atmosphere further and causing the water ice in the polar caps to melt.

By their calculations, Green and his colleagues estimated that this could lead to 1/7th of Mars' oceans – the ones that covered it billions of years ago – to be restored. If this is beginning to sound a bit like a lecture on how to terraform Mars, it is probably because these same ideas have been raised by people who advocating that very thing. But in the meantime, these changes would facilitate human exploration between now and mid-century.

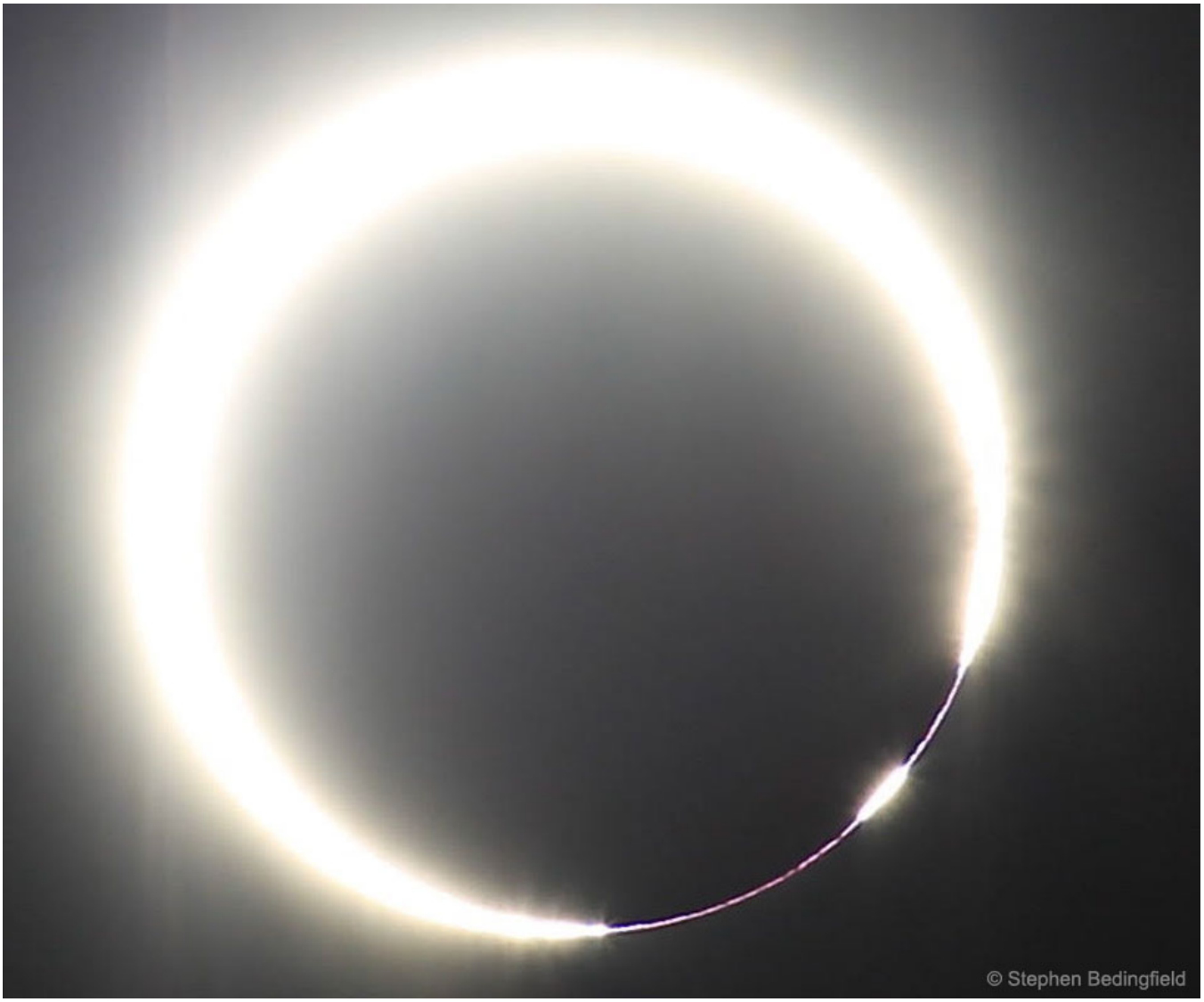
"A greatly enhanced Martian atmosphere, in both pressure and temperature, that would be enough to allow significant surface liquid water would also have a number of benefits for science and human exploration in the 2040s and beyond," said Green. "Much like Earth, an enhanced atmosphere would: allow larger landed mass of equipment to the surface, shield against most cosmic and solar particle radiation, extend the ability for oxygen extraction, and provide "open air" greenhouses to exist for plant production, just to name a few."

These conditions, said Green and his colleagues, would also allow for human explorers to study the planet in much greater detail. It would also help them to determine the habitability of the planet, since many of the signs that pointed towards it being habitable in the past (i.e. liquid water) would slowly seep back into the landscape. And if this could be achieved within the space of few decades, it would certainly help pave the way for colonization.

In the meantime, Green and his colleagues plan to review the results of these simulations so they can produce a more accurate assessment of how long these projected changes would take. It also might not hurt to conduct some cost-assessments of this magnetic shield. While it might seem like something out of science fiction, it doesn't hurt to crunch the numbers!

Source: Universe Today Return to Contents

Space Image of the Week



A Solar Eclipse with a Beaded Ring of Fire

Explanation: What kind of eclipse is this? On Sunday, visible in parts of Earth's southern hemisphere, the Moon blocked part of the Sun during a partial solar eclipse. In some locations, though, the effect was a rare type of partial eclipse called an annular eclipse. There, since the Moon is too far from the Earth to block the entire Sun, sunlight streamed around the edges of the Moon creating a "ring of fire". At some times, though, the effect was a rare type of annular eclipse. Then, an edge of the Moon nearly aligned with an edge of the Sun, allowing sunlight to stream through only low areas on the Moon. Called a "Baily's bead" or a "diamond ring", this doubly rare effect was captured Sunday in the feature photograph from Chubut, Argentina, in South America. This summer a total solar eclipse will swoop across North America.
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Image Credit & Copyright: Stephen Bedingfield

Source: Astronomy Picture of the Day

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