Lava Tubes on Mars: Leveraging Volcanic Features to Reduce Exposure to Radiation

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Abstract: Mars is currently at the center of intense scientific study aimed at potential human colonization. Consequently, there has been increased curiosity in the identification and study of lava tubes for information on the paleohydrological, geomorphological, geological, and potential biological history of Mars, including the prospect of present microbial life on the planet. Lava tubes, furthermore, could serve as in-situ habitats for upcoming crewed missions to Mars by providing protection from solar energetic particles, unpredictable high-energy cosmic radiation (i.e., gamma-ray bursts), bombardment of micrometeorites, exposure to dangerous perchlorates due to long-term dust storms, and extreme temperature fluctuations.

This lecture provides insight into a recent investigation of prospective lava tubes at Hellas Planitia, a plain located inside the large impact basin Hellas in the southern hemisphere of Mars, through the use of Earth

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Recent Astronomy Highlights

Spin of Super Spiral Galaxies
Super Spiral Galaxies, like the name suggests, are spiral galaxies, but as much as twenty times bigger and more massive than typical spiral galaxies like the Milky Way or Andromeda. Only about a hundred of these galaxies have been discovered so far. A recent study has also shown that the stars in the outer arms of these galaxies orbit much faster than expected, even faster than their inner arms. This is unlike in most typical spiral galaxies where the inner-arm and outer-arm orbital speeds are similar. This seems to indicate that such super spirals are embedded in massive dark matter haloes up to 40 trillion times the mass of our Sun. More information is at hubblesite.org/contents/news-releases/2019/news-2019-54?news=true

New Evidence that Rocky Planets May Be Common
In a recently published study, evidence for the possibility that rocky planets like Earth are common comes from a most unexpected place – white dwarfs. Scientists studying the light coming from such white dwarfs have found higher than expected concentrations of metals. (Astronomers consider any element besides hydrogen and helium to be a metal.) Such concentrations of metals, the scientists surmise, come from the planets and other bodies that once orbited the white dwarf. The scientists have even detected the presence of iron oxide, which is plentiful in the rocky planets of our Solar System. More information is available at newsroom.ucla.edu/releases/stars-planets-earth-geochemistry

Salt Lakes on Mars
Using data from the NASA Curiosity rover’s exploration of Gale Crater, scientists have found that billions of years ago the crater was the site of salt lakes similar to those on Earth. The evidence also points to episodes of drying and expanding of the lake or lakes. More information is at www.sciencedaily.com/releases/2019/10/191018181051.htm

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analogue structures. The search for lava tubes at Hellas Planitia is primarily due to the low radiation environment at this particular location. Several studies by NASA spacecraft have measured radiation levels in this region at ~342 μSv/day\(^1\), which is considerably less than other regions on the surface of Mars (~547 μSv/day). By analyzing orbital imagery from two cameras onboard NASA’s Mars Reconnaissance Orbiter (MRO) – the High-Resolution Imaging Science Experiment (HiRISE) and the Context Camera (CTX) – the search for lava tubes was refined by identifying pit crater chains in the vicinity of Hadriacus Mons, an ancient low-relief volcanic mountain along the northeastern edge of Hellas Planitia. After surveying 1,500 images from MRO, this investigation has identified several candidate lava tubes in the vicinity of Hadriacus Mons as prospective sites for manned exploration. To complement this investigation, moreover, 30 in-situ radiation monitoring experiments have been conducted at analog lava tubes located at Mojave, CA, El Malpais, NM, and Flagstaff, AZ. The investigation concluded that terrestrial lava tubes can be leveraged for radiation shielding and, accordingly, that the candidate lava tubes on Mars can serve as natural radiation shelters and habitats for a prospective crewed mission to the planet.

\(^1\)μSv - a micro-Sievert, a dosage of ionizing radiation

Biography: Antonio Paris, PhD is the Chief Scientist at the Center for Planetary Science, a former Professor of Astrophysics at St. Petersburg College, FL and a graduate of the NASA Mars Education Program at the Mars Space Flight Center, Arizona State University. He is the author of Mars: Your Personal 3D Journey to the Red Planet. His latest peer-reviewed publications include:

- **El Bahr: A Prospective Impact Crater in Egypt** - a preliminary investigation addressing the discovery of an unidentified crater located south of the Sahara Desert between Qaret Had El Bahr and Qaret El Allafa, Egypt.
- **The Physiological & Psychological Aspects of Sending Humans to Mars** - an extensive research centered on the implications of prolonged spaceflight, which include radiation, the cardiovascular system in space and long-term nutritional concerns in a microgravity environment.
"Exploring the Sky" is an informal program that, for 70 years, has offered monthly opportunities for anyone in the Washington area to see the stars and planets through telescopes from a location within the District of Columbia. Presented by the National Park Service and National Capital Astronomers, sessions are held in Rock Creek Park once each month on a Saturday night from April through November, Beginners (including children) and experienced stargazers are all welcome—and it’s free!

Hosted by: National Capital Astronomers, Inc and Rock Creek Park

With the winter months, the Exploring the Sky program will take a hiatus until April of 2019.

More information can be found at NCA’s web site, www.capitalastronomers.org or the Rock Creek Park web site, www.nps.gov/roro/planyourvisit/expsky.htm. You can also call the Nature Center at (202) 895-6070. For general information on local astronomical events visit www.astronomyindc.org

From the October Exploring the Sky session, Jay Miller reported, “I started to set up, but the clouds started to thicken from the west and I put everything away. Todd Supple and Guy Brandenburg showed up as well as two Park Service Rangers so we would have had great telescopes. About a half dozen cars did stop by and we were able to give them information so it wasn’t a total loss.”

The submission deadline for December’s Star Dust, is November 21st.

Clear Skies!

Sky Watchers

November/December

Jupiter and Saturn continue to be visible in the evening sky, with Venus moving between and meeting up with them (see below). Mercury transits to the morning sky on 11/11, actually doing so by passing across the Sun (also see below). Mars is in the early morning sky, rising just a couple hours before dawn.

11/11

Mercury Transits the Sun - From 7:35 a.m. to 1:04 p.m. EST, Mercury will appear to cross the Sun. Only visible through a telescope or binoculars with proper solar filters.

11/12

Full Moon at 8:36 a.m.

11/17, 18

Peak of Leonids Meteor Shower. Approximately 15 meteors/hour. A quarter Moon may keep some of the dimmer meteors from being visible.

11/24

Conjunction of Venus and Jupiter. Venus appear closest to Jupiter, 1°24’ south of the gas giant, at 11:00 a.m.

11/28

Mercury at Greatest Western Elongation – Our innermost planet will be 20° away from the Sun and its highest in the predawn sky.

12/10

Conjunction of Venus and Saturn. Venus will be 1° 49’ south of Saturn at 11:42 p.m.

12/12

Full Moon at 12:14 a.m.

12/14

Peak of Geminids Meteor Shower – 120 meteors/hour at the peak. The near full Moon will interfere with viewing dimmer meteors, but there still should be plenty of brighter ones to see.

Times in EST
Index for NCA Meetings, Talks and Star Dust Issues

Wayne H. Warren Jr., NCA

Abstract
An index for NCA meetings going back to the first published issue of Star Dust in 1943 and continuing to the end of 2019 is presented. The index contains, in addition to a log of all NCA meetings, other information such as speaker presentations, affiliations, and titles of talks. A remarks column contains miscellaneous information such as meeting locations, certain activities, and other useful comments. The index will be placed on the NCA website and updated periodically.

Procedure and Contents
Prior to the initiation of the project to scan all issues of Star Dust (see Star Dust, 2015 February, p. 3) I completed a preliminary version of the index. Following the completion of scanning the older issues of Star Dust (issues after 2000 were retained in machine-readable form), an extensive review of the complete index was undertaken. Miscellaneous notes inserted during the compilation were checked and questions were resolved where possible. Comments about membership, special meeting locations and activities, and other useful information were added.

The contents of the index are grouped by year rather than by volume. An error in the assignment of volume numbers resulted in volume 47 being assigned to only one issue (Summer 1989). The index is stored on the NCA website in the form of a text file, so it can be accessed and searched with any text editor. It is hoped that the index will be updated on an annual basis. The index can be accessed at capitalastronomers.org/StarDust_Archive.html.

If anyone finds errors in the index, please inform the editor of Star Dust so that they can be corrected.
Occultation Notes

- D following the time denotes a disappearance, while R indicates that the event is a reappearance.
- When a power (x; actually, zoom factor) is given in the notes, the event can probably be recorded directly with a camcorder of that power with no telescope needed.
- The times are for Greenbelt, MD, and will be good to within +/-1 min. for other locations in the Washington-Baltimore metropolitan areas unless the cusp angle (CA) is less than 30 deg., in which case, it might be as much as 5 minutes different for other locations across the region.
- Some stars in Flamsteed's catalog are in the wrong constellation, according to the official IAU constellation boundaries that were established well after Flamsteed's catalog was published. In these cases, Flamsteed's constellation is in parentheses and the actual constellation is given in the notes following a /.
- Mag is the star's magnitude.
- % is the percent of the Moon's visible disk that is sunlit, followed by a + indicating that the Moon is waxing and - showing that it is waning. So 0 is new moon, 50+ is first quarter, 100+ or - is full moon, and 50- is last quarter. The Moon is crescent if % is less than 50 and is gibbous if it is more than 50.
- Cusp Angle is described more fully at the main IOTA Web site.
- Sp. is the star's spectral type (color), O,B, blue; A,F, white; G, yellow; K, orange; M, N, S, C red.
- Also in the notes, information about double stars is often given. "Close double" with no other information usually means nearly equal components with a separation less than 0.2", "mg2" or "m2" means the magnitude of the secondary component, followed by its separation in arc seconds ("), and sometimes its PA from the primary. If there is a 3rd component (for a triple star), it might be indicated with "mg3" or "m3". Double is sometime abbreviated "dbl".
- Sometimes the Axis angle (AA) is given. It is the angle measured around the Moon's disk, from the Moon's axis of rotation. It can be used with a lunar map to tell where a star will reappear relative to lunar features.
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Interstellar Comet 2I/BORISOV Observing Update

Image of 2I/Borisov, taken by the Hubble Telescope on October 12. Image credit: NASA, ESA, and D. Jewitt (UCLA)

Study continues on the second detected interstellar visitor to our solar system. Spectra of the comet show that it has a composition similar to comets from our Solar System’s Oort Cloud. Unfortunately, it may not be observable with anything less than a 10-inch telescope. An animation of 2I/Borisov’s trajectory can be found at www.youtube.com/watch?v=vqMJo3DHOfg.

Nancy Grace Roman Article and Interview

Known as the “Mother of the Hubble Telescope”, longtime NCA member Nancy Grace Roman had many other discoveries and credits which can be read about in an autobiographical article entitled “Nancy Grace Roman and the Dawn of Space Astronomy” that she wrote shortly before her death in 2018. The article was just recently published and is available at www.annualreviews.org/doi/pdf/10.1146/annurev-astro-091918-104446. An interview that took place in August 2018 is also available at www.annualreviews.org/do/10.1146/annurev-astro-061819-095801/abs.
Calendar of Events

NCA Mirror- or Telescope-making Classes: Tuesdays AND Fridays, from 6:30 to 9:30 pm at the Chevy Chase Community Center (intersection of McKinley Street and Connecticut Avenue, N.W.) Contact instructor Guy Brandenburg at 202-635-1860 or at gfbrandenburg@yahoo.com. Additional information is at guysmathastro.wordpress.com/ and home.earthlink.net/~gfbranden/GFB_Home_Page.html

Open house talks and observing at the University of Maryland Observatory in College Park on the 5th and 20th of every month at 8:00 pm (Nov.-Apr.) or 9:00 pm (May-Oct.). Details: www.astro.umd.edu/openhouse

Next NCA Meeting at the University of Maryland Observatory: 13 December 7:30 p.m., Larry Nittler, (Carnegie), A Fossil Comet Found Inside a Meteorite

The APS Mid-Atlantic Senior Physicists Group: “The Kepler Space Telescope” by Elisa Quintana, NASA Goddard Space Flight Center, Nov. 20th at 1:00 pm at the American Center for Physics (1st floor conference room). 1 Physics Ellipse, College Park MD -- off River Rd. between Kenilworth Ave. and Paint Branch Parkway.

National Capital Astronomers Membership Form

Name: __________________________ Date: ___/___/___

Address: __________________________________________________________ ZIP Code: ______

Home Phone: _____-_____ -_____ E-mail: __________________________ Print / E-mail Star Dust (circle one)

Membership (circle one): Student..... $5; Individual / Family.....$10; Optional Contribution.....$___

Please indicate which activities interest you:

- Attending monthly scientific lectures on some aspect of astronomy
- Making scientific astronomical observations
- Observing astronomical objects for personal pleasure at relatively dark sites
- Attending large regional star parties
- Doing outreach events to educate the public, such as Exploring the Sky
- Building or modifying telescopes
- Participating in travel/expeditions to view eclipses or occultations
- Combating light pollution

Do you have any special skills, such as videography, graphic arts, science education, electronics, machining, etc.?

Are you interested in volunteering for: Telescope making, Exploring the Sky, Star Dust, NCA Officer, etc.?

Please mail this form with check payable to National Capital Astronomers to:

Henry Bofinger, NCA Treasurer; 727 Massachusetts Ave. NE, Washington, DC 20002-6007

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Next NCA Meeting:
2019 November 9th
7:30 pm
@ UMD Observatory

Dr. Antonio Paris

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