Space News Update

— October 10, 2017 —

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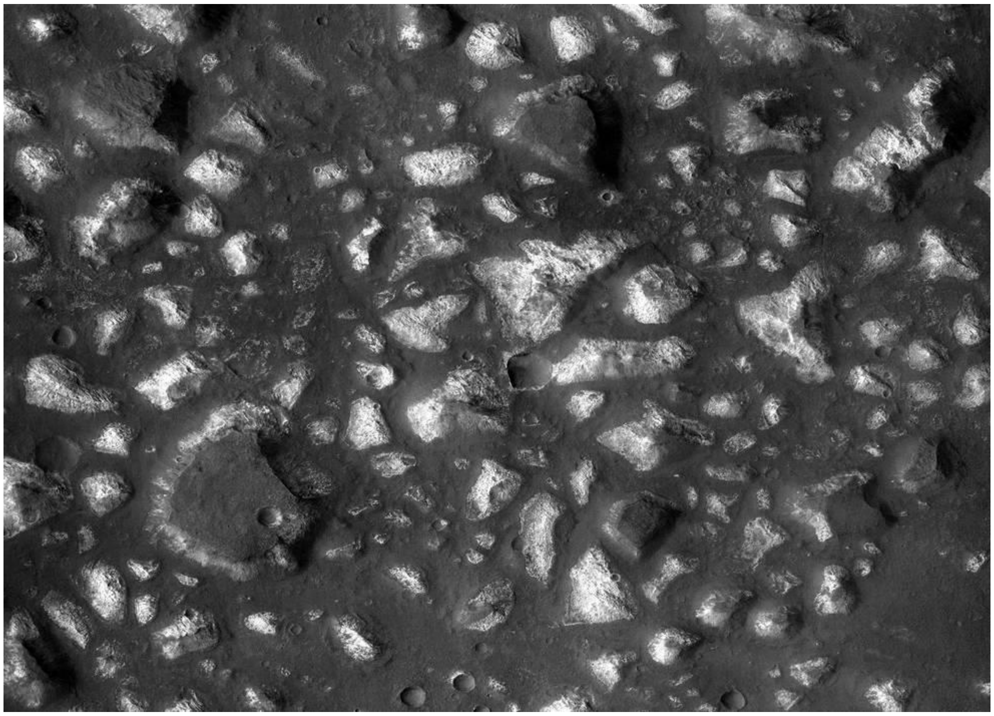
1. Mars Study Yields Clues to Possible Cradle of Life



This view of a portion of the Eridania region of Mars shows blocks of deep-basin deposits that have been surrounded and partially buried by younger volcanic deposits. The image was taken by the Context Credits: NASA/JPL-Caltech/MSSS

The discovery of evidence for ancient sea-floor hydrothermal deposits on Mars identifies an area on the planet that may offer clues about the origin of life on Earth.

A recent international report examines observations by NASA's Mars Reconnaissance Orbiter (MRO) of massive deposits in a basin on southern Mars. The authors interpret the data as evidence that these deposits were formed by heated water from a volcanically active part of the planet's crust entering the bottom of a large sea long ago.

"Even if we never find evidence that there's been life on Mars, this site can tell us about the type of environment where life may have begun on Earth," said Paul Niles of NASA's Johnson Space Center, Houston. "Volcanic activity combined with standing water provided conditions that were likely similar to conditions that existed on Earth at about the same time -- when early life was evolving here."

Mars today has neither standing water nor volcanic activity. Researchers estimate an age of about 3.7 billion years for the Martian deposits attributed to seafloor hydrothermal activity. Undersea hydrothermal conditions on Earth at about that same time are a strong candidate for where and when life on Earth began. Earth still has such conditions, where many forms of life thrive on chemical energy extracted from rocks, without sunlight. But due to Earth's active crust, our planet holds little direct geological evidence preserved from the time when life began. The possibility of undersea hydrothermal activity inside icy moons such as Europa at Jupiter and Enceladus at Saturn feeds interest in them as destinations in the quest to find extraterrestrial life.

Observations by MRO's Compact Reconnaissance Spectrometer for Mars (CRISM) provided the data for identifying minerals in massive deposits within Mars' Eridania basin, which lies in a region with some of the Red Planet's most ancient exposed crust.

"This site gives us a compelling story for a deep, long-lived sea and a deep-sea hydrothermal environment," Niles said. "It is evocative of the deep-sea hydrothermal environments on Earth, similar to environments where life might be found on other worlds -- life that doesn't need a nice atmosphere or temperate surface, but just rocks, heat and water." Niles co-authored the recent report in the journal Nature Communications with lead author Joseph

Michalski, who began the analysis while at the Natural History Museum, London, and co-authors at the Planetary Science Institute in Tucson, Arizona, and the Natural History Museum.

The researchers estimate the ancient Eridania Sea held about 50,000 cubic miles (210,000 cubic kilometers) of water. That is as much as all other lakes and seas on ancient Mars combined and about nine times more than the combined volume of all of North America's Great Lakes. The mix of minerals identified from the spectrometer data, including serpentine, talc and carbonate, and the shape and texture of the thick bedrock layers, led to identifying possible seafloor hydrothermal deposits. The area has lava flows that post-date the disappearance of the sea. The researchers cite these as evidence that this is an area of Mars' crust with a volcanic susceptibility that also could have produced effects earlier, when the sea was present.

The new work adds to the diversity of types of wet environments for which evidence exists on Mars, including rivers, lakes, deltas, seas, hot springs, groundwater, and volcanic eruptions beneath ice.

"Ancient, deep-water hydrothermal deposits in Eridania basin represent a new category of astrobiological target on Mars," the report states. It also says, "Eridania seafloor deposits are not only of interest for Mars exploration, they represent a window into early Earth." That is because the earliest evidence of life on Earth comes from seafloor deposits of similar origin and age, but the geological record of those early-Earth environments is poorly preserved.

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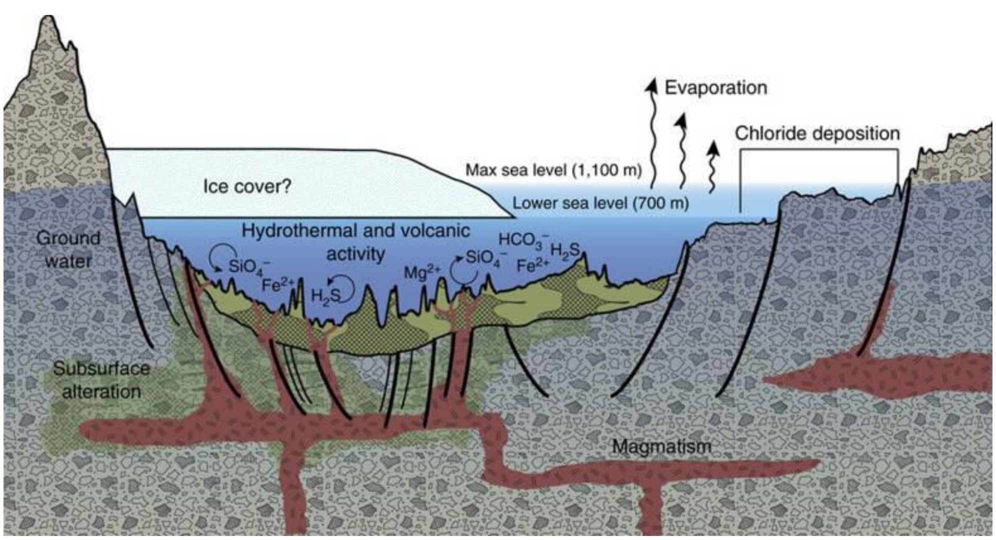

This diagram illustrates an interpretation for the origin of some deposits in the Eridania basin of southern Mars as resulting from seafloor hydrothermal activity more than 3 billion years ago. Credits: NASA

Source: NASA

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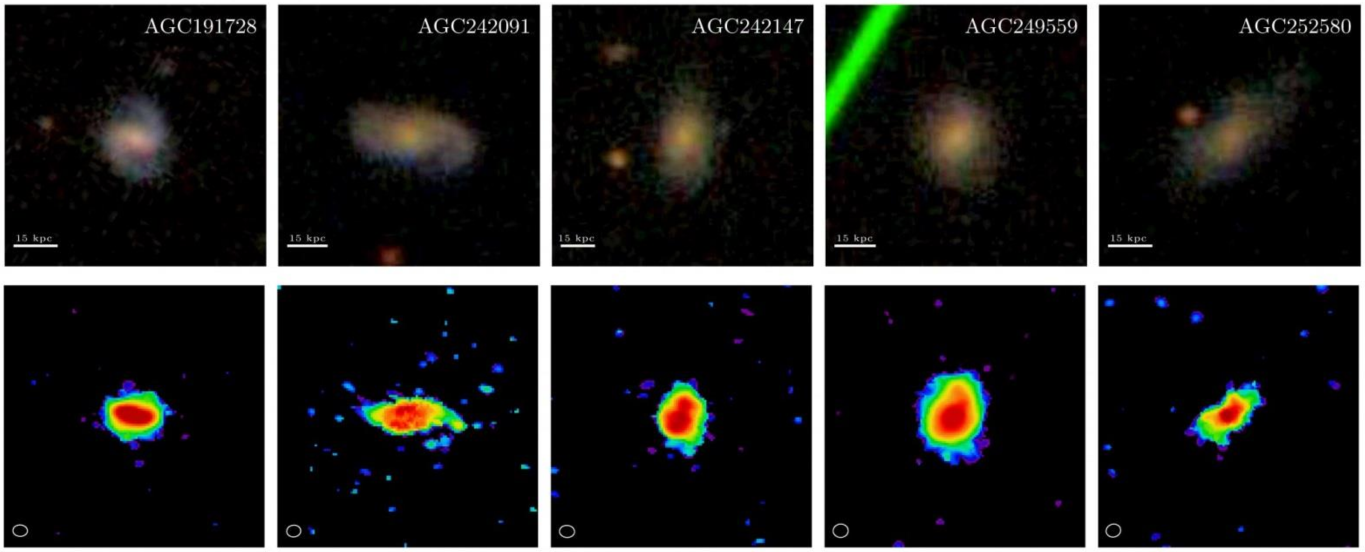
2. Scientists Discover More about the Ingredients for Star Formation



Comparison between the stellar (top) and molecular hydrogen (bottom) distribution in very gas-rich galaxies three billion years younger than the Milky Way. Optical data is from the Sloan Digital Survey whereas molecular hydrogen maps have been obtained using the Atacama Large Millimetre Array. Credit: ICRAR

Astronomers have shed fresh light on the importance of hydrogen atoms in the birth of new stars.

Only hydrogen molecules are thought to directly fuel star formation but research published today shows there are more hydrogen atoms than molecules even in young galaxies that are making a lot of stars.

Astrophysicist Dr Luca Cortese, from The University of Western Australian node of the International Centre for Radio Astronomy Research, said new stars are constantly forming in the Universe.

"New stars are born in dense clouds of gas and dust that are found in most galaxies," he said.

"Our own Milky Way forms about one new star a year on average."

In the local Universe close to us about 70 per cent of the hydrogen gas is found in individual atoms, while the rest is in molecules.

Astronomers had expected that as they looked back in time, younger galaxies would contain more and more molecular hydrogen until it dominated the gas in the galaxy. Instead, they found that atomic hydrogen makes up the majority of gas in younger galaxies too.

This is true even in galaxies under conditions similar to 'cosmic noon', a period about seven billion years after the Big Bang when the rate of star formation in the Universe reached its peak.

Dr Cortese said that in the last decade astronomers have discovered young, star-forming galaxies at cosmic noon with 10 times more hydrogen molecules than the Milky Way.

With such large reservoirs of molecular hydrogen, no room seemed to be left for a comparable amount of cold atomic gas. Unfortunately, it is currently impossible to detect hydrogen atoms at such large distances and verify this expectation.

Instead, Dr Cortese and his team discovered a population of galaxies three billion years younger than the Milky Way hosting gas reservoirs at least as large as those of galaxies at the cosmic noon.

"What we found is that despite hosting 10 billion solar masses of molecular gas these young galaxies turn out to be very, very rich in atomic hydrogen as well," Dr Cortese said.

"The balance between atomic and molecular hydrogen is pretty much the same as in the Milky Way. In other words, it's still dominated by atomic gas."

The research used data from two of the world's most powerful radio telescopes, the Arecibo Observatory in Puerto Rico and the European Southern Observatory's Atacama Large Millimeter/submillimeter Array in Chile.

ICRAR astrophysicist Dr Barbara Catinella, who was a co-author on the research, said the findings have tremendous implications for our understanding of the early Universe.

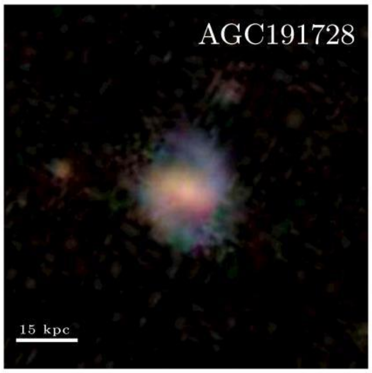
"It shows that we cannot neglect atomic hydrogen even in galaxies that contain tens of billions of solar masses of molecular hydrogen," she said.

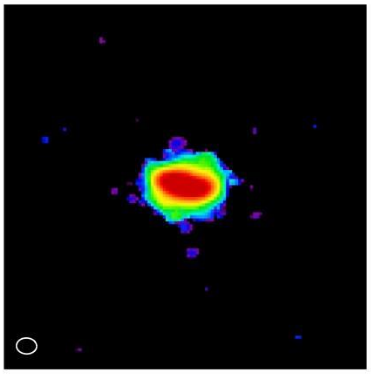
"Only the advent of future radio telescopes such as the Square Kilometre Array will allow us to get a complete picture of the role of cold gas in the star formation cycle."

A further finding from the study is that the galaxies rich in molecular hydrogen were not very turbulent.

Usually, these galaxies would be expected to be very turbulent to prevent the collapse of the gas into stars.

The research was published in *The Astrophysical Journal Letters*.

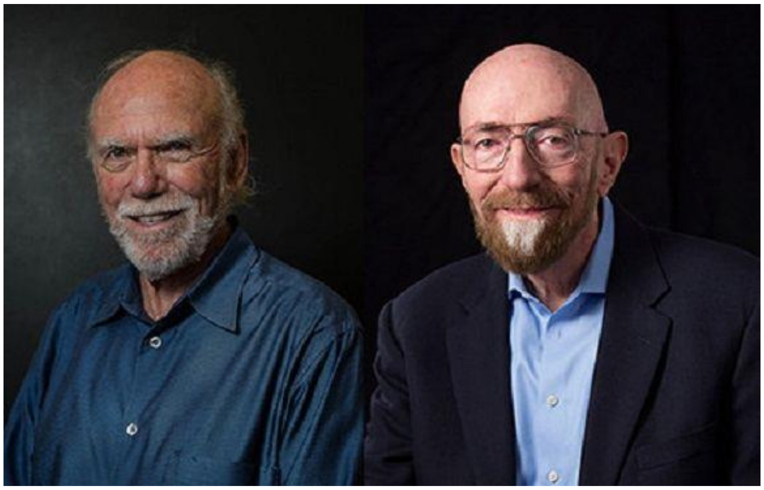




Comparison between the stellar (top) and molecular hydrogen (bottom) distribution in a very gas-rich galaxy (AGC191728) that is three billion years younger than the Milky Way.
Credit: ICRAR

Source: International Centre for Radio Astronomy Research Return to Contents

3. LIGO Scientists who Detected Gravitational Waves Awarded Nobel Prize in Physics



At left, Barry C. Barish and Kip S. Thorne, two of three recipients of the 2017 Nobel Prize in Physics. Credit: Caltech. At right, Rainer Weiss, famed MIT physicist and partial winner of the 2017 Nobel Prize in Physics. Credit: MIT/Bryce Vickmark

February of 2016, scientists working for the Laser Interferometer Gravitational-Wave Observatory (LIGO) made history when they announced the first-ever detection of gravitational waves. Since that time, multiple detections have taken place and scientific collaborations between observatories – like Advanced LIGO and Advanced Virgo – is are allowing for unprecedented levels of sensitivity and data sharing.

Not only was the first-time detection of gravity waves an historic accomplishment, it ushered in a new era of astrophysics. It is little wonder then why the three researchers who were central to the first detection have been awarded the 2017 Nobel Prize in Physics. The prize was awarded jointly to Caltech professors emeritus Kip S. Thorne and Barry C. Barish, along with MIT professor emeritus Rainer Weiss.

To put it simply, gravitational waves are ripples in space-time that are formed by major astronomical events – such as the merger of a binary black hole pair. They were first predicted over a century ago by Einstein's Theory of General Relativity, which indicated that massive perturbations would alter the structure of space-time. However, it was not until recent years that evidence of these waves was observed for the first time.

The first signal was detected by LIGO's twin observatories – in Hanford, Washington, and Livingston, Louisiana, respectively – and traced to a black mole merger 1.3 billion light-years away. To date, four detections have been, all of which were due to the mergers of black-hole pairs. These took place on December 26, 2015, January 4, 2017, and August 14, 2017, the last being detected by LIGO and the European Virgo gravitational-wave detector.

For the role they played in this accomplishment, one half of the prize was awarded jointly to Caltech's Barry C. Barish – the Ronald and Maxine Linde Professor of Physics, Emeritus – and Kip S. Thorne, the Richard P. Feynman Professor of Theoretical Physics, Emeritus. The other half was awarded to Rainer Weiss, Professor of Physics, Emeritus, at the Massachusetts Institute of Technology (MIT).

This accomplishment was all the more impressive considering that Albert Einstein, who first predicted their existence, believed gravitational waves would be too weak to study. However, by the 1960s, advances in laser technology and new insights into possible astrophysical sources led scientists to conclude that these waves might actually be detectable.

The first gravity wave detectors were built by Joseph Weber, an astrophysics from the University of Maryland. His detectors, which were built in the 1960s, consisted of large aluminum cylinders that would be driven to vibrate by passing gravitational waves. Other attempts followed, but all proved unsuccessful; prompting a shift towards a new type of detector involving interferometry.

One such instrument was developed by Weiss at MIT, which relied on the technique known as laser interferometry. In this kind of instrument, gravitational waves are measured using widely spaced and separated mirrors that reflect lasers over long distances. When gravitational waves cause space to stretch and squeeze by infinitesimal amounts, it causes the reflected light inside the detector to shift minutely.

At the same time, Thorne – along with his students and postdocs at Caltech – began working to improve the theory of gravitational waves. This included new estimates on the strength and frequency of waves produced by objects like black holes, neutron stars and supernovae. This culminated in a 1972 paper which Throne co-published with his student, Bill Press, which summarized their vision of how gravitational waves could be studied.

That same year, Weiss also published a detailed analysis of interferometers and their potential for astrophysical research. In this paper, he stated that larger-scale operations – measuring several km or more in size – might have a shot at detecting gravitational waves. He also identified the major challenges to detection (such as vibrations from the Earth) and proposed possible solutions for countering them.

In 1975, Weiss invited Thorne to speak at a NASA committee meeting in Washington, D.C., and the two spent an entire night talking about gravitational experiments. As a result of their conversation, Thorne went back to Calteh and proposed creating an experimental gravity group, which would work on interferometers in parallel with researchers at MIT, the University of Glasgow and the University of Garching (where similar experiments were being conducted).

Development on the first interferometer began shortly thereafter at Caltech, which led to the creation of a 40-meter (130-foot) prototype to test Weiss' theories about gravitational waves. In 1984, all of the work being conducted by these respective institutions came together. Caltech and MIT, with the support of the National Science Foundation (NSF) formed the LIGO collaboration and began work on its two interferometers in Hanford and Livingston.

The construction of LIGO was a major challenge, both logistically and technically. However, things were helped immensely when Barry Barish (then a Caltech particle physicist) became the Principal Investigator (PI) of LIGO in 1994. After a decade of stalled attempts, he was also made the director of LIGO and put its construction back on track. He also expanded the research team and developed a detailed work plan for the NSF.

By 1999, construction had wrapped up on the LIGO observatories and by 2002, LIGO began to obtain data. In 2008, work began on improving its original detectors, known as the Advanced LIGO Project. The process of converting the 40-m prototype to LIGO's current 4-km (2.5 mi) interferometers was a massive undertaking, and therefore needed to be broken down into steps.

The first step took place between 2002 and 2010, when the team built and tested the initial interferometers. While this did not result in any detections, it did demonstrate the observatory's basic concepts and solved many of the technical obstacles. The next phase – called Advanced LIGO, which took placed between 2010 and 2015 – allowed the detectors to achieve new levels of sensitivity.

Looking ahead, it is also pretty clear that Advanced LIGO, Advanced Virgo and other gravitational wave observatories around the world are just getting started. In addition to having detected four separate events, recent studies have indicated that gravitational wave detection could also open up new frontiers for astronomical and cosmological research.

Source: Universe Today

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The Night Sky

Tuesday, October 10

- Sometime around when nightfall is complete, you'll find zero-magnitude Arcturus low in the west-northwest at the same height as zero-magnitude Capella in the northeast. When this happens, turn to the south-southeast, and there will be 1st-magnitude Fomalhaut at the same height too — if you're at latitude 43° north. Seen from south of that latitude Fomalhaut will appear higher; from north of there it will be lower.

Wednesday, October 11

- The last-quarter Moon rises around 11 or midnight tonight, depending on your location. Once the Moon is well up you'll see that it's in Gemini, with Castor and Pollux shining to its left. Farther to its right you'll get an early look at Orion — your first of the season?

Thursday, October 12

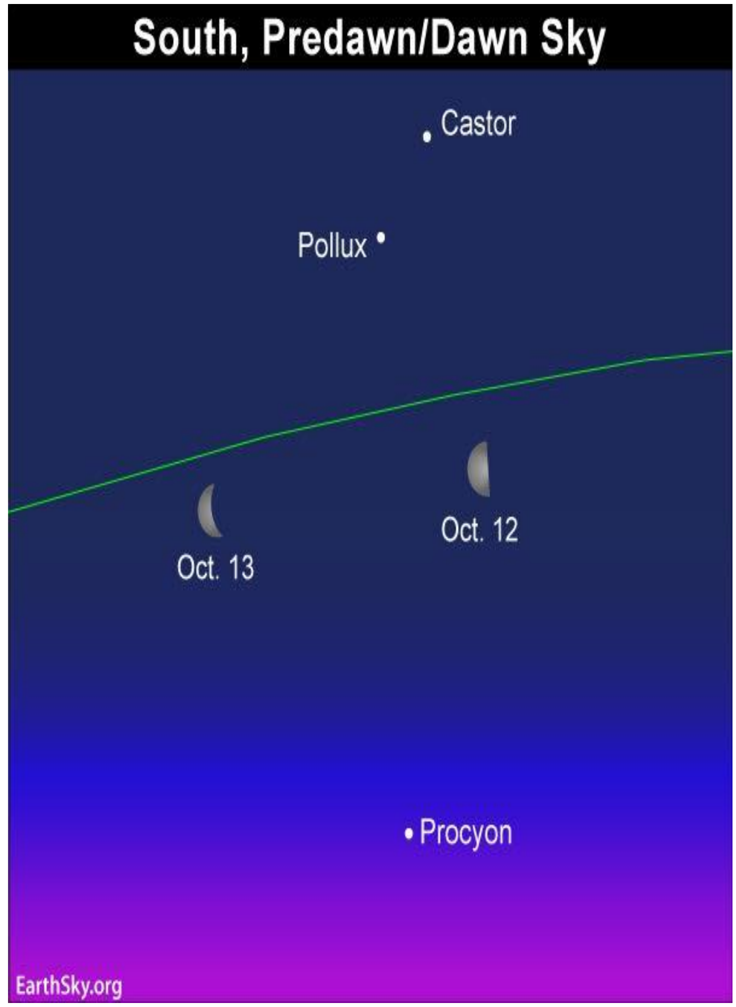
- After dark, spot the W of Cassiopeia high in the northeast, it's standing almost on end. The *third* segment of the W, counting from the top, points almost straight down. Extend it twice as far down as its own length, and you're at the Double Cluster in Perseus. This pair of star-swarms is dimly apparent to the unaided eye in a dark sky (use averted vision), and it's visible from almost anywhere in binoculars. It's lovely in telescopes.

Friday, October 13

- Now that we're in mid-October, Deneb has replaced Vega as the zenith star soon after nightfall (for skywatchers at mid-northern latitudes) — and, accordingly, Capricornus has replaced Sagittarius as the most notable constellation low in the south.

Saturday, October 14

- Vega is the brightest star in the west these evenings. Less high in the southwest is Altair, not quite as bright. Just upper right of Altair, by a finger-width at arm's length, is little orange Tarazed (Gamma Aquilae). Straight down from Tarazed runs the stick-figure backbone of Aquila, the Eagle.



Last quarter moon and Gemini stars
Credit: [Earth Sky.org]

Source: Sky and Telescope

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ISS Sighting Opportunities (from Denver)

Date	Visible	Max Height	Appears	Disappears
Tue Oct 10, 7:16 PM	4 min	16°	10° above NNW	13° above NE
Tue Oct 10, 8:52 PM	< 1 min	15°	12° above NW	15° above NW
Wed Oct 11, 8:00 PM	3 min	41°	10° above NW	41° above N
Thu Oct 12, 7:08 PM	5 min	27°	10° above NNW	16° above ENE
Thu Oct 12, 8:45 PM	< 1 min	17°	17° above WNW	17° above WNW
Fri Oct 13, 7:53 PM	3 min	75°	19° above WNW	59° above SSE

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

NASA-TV Highlights (all times Eastern Time Zone)

Tuesday, October 10

- 6:30 a.m. - Coverage of ISS Expedition 53 U.S. Spacewalk #45 (Spacewalk begins at 8:05 a.m. ET, expected to last 6 ½ hours; Bresnik and Vande Hei) (all channels)

Wednesday, October 11

- 5:30 a.m. - ISS Expedition 53 In-Flight Event for ESA with Flight Engineer Paolo Nespoli of the European Space Agency (Starts at 5:40 a.m.) (all channels)
- 2 p.m. - ISS Expedition 54-55 Crew News Conference (Tingle, Kanai, Shkaplerov) (all channels)
- 4 p.m. - Replay of the ISS Expedition 54-55 Crew News Conference (Tingle, Kanai, Shkaplerov) (all channels)

Thursday, October 12

- 5 a.m. - Coverage of the Launch of the ISS Progress 68 Cargo Ship to the ISS from the Baikonur Cosmodrome in Kazakhstan (Launch time is scheduled at 5:32 a.m. ET) (Starts at 5:15 a.m.) (all channels)
- 8 a.m. - Coverage of the Docking of the ISS Progress 68 Cargo Ship to the ISS from the Baikonur Cosmodrome in Kazakhstan (Docking is scheduled at 8:56 a.m. ET) (Starts at 8:15 a.m.) (all channels)

Friday, October 13

- 11 a.m. - SpaceCast Weekly (all channels)
- 1 p.m. - SS Expedition 53 In-Flight Event for a JSC Podcast with ISS Commander Randy Bresnik and Flight Engineers Mark Vande Hei and Joe Acaba of NASA and Flight Engineer Paolo Nespoli of the European Space Agency (Starts at 1:15 p.m.) (all channels)

Watch NASA TV online by going to the NASA website.

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Space Calendar

- **Oct 10 - Michibiki 4 (QZS-4) H-2A Launch**
- Oct 10 - Comet 73P-BK/Schwassmann-Wachmann Closest Approach To Earth (1.895 AU)
- Oct 10 - Comet 73P-J/Schwassmann-Wachmann Closest Approach To Earth (1.909 AU)
- Oct 10 - Comet 89P/Russell At Opposition (2.018 AU)
- Oct 10 - Asteroid 16897 (1998 DH10) Occults HIP 20804 (5.9 Magnitude Star)
- Oct 10 - Apollo Asteroid 2017 SN21 Near-Earth Flyby (0.023 AU)
- Oct 10 - Apollo Asteroid 2014 DQ Near-Earth Flyby (0.082 AU)
- Oct 10 - Asteroid 30857 Parsec Closest Approach To Earth (0.999 AU)
- Oct 10 - Asteroid 2001 Einstein Closest Approach To Earth (1.146 AU)
- Oct 10 - Asteroid 264020 Stuttgart Closest Approach To Earth (1.495 AU)
- Oct 10 - Asteroid 8623 Johnnygalecki Closest Approach To Earth (2.474 AU)
- Oct 10 - Colloquium: Venus' Well-kept Secrets - Lessons for Earth and Earth-like Planets, Tucson, Arizona
- Oct 10-12 - Annual Meeting of the Lunar Exploration Analysis Group (LEAG), Columbia, Maryland
- Oct 10-12 - GRACE Science Team Meeting, Austin, Texas
- **Oct 11 - Echostar 105/SES-11 Falcon 9 Launch**
- Oct 11 - Comet P/2010 P4 (WISE) At Opposition (0.942 AU)
- Oct 11 - Comet 47P/Ashbrook-Jackson Closest Approach To Earth (1.920 AU)
- Oct 11 - Comet 73P-AB/Schwassmann-Wachmann Closest Approach To Earth (1.945 AU)
- Oct 11 - Comet 237P/LINEAR At Opposition (2.247 AU)
- Oct 11 - Comet C/2017 S2 (PANSTARRS) At Opposition (2.646 AU)
- Oct 11 - Aten Asteroid 2017 SB20 Near-Earth Flyby (0.023 AU)
- Oct 11 - Apollo Asteroid 2007 DM41 Near-Earth Flyby (0.090 AU)
- Oct 11 - Asteroid 8208 Volta Closest Approach To Earth (1.274 AU)
- Oct 11 - Asteroid 432971 Loving Closest Approach To Earth (1.552 AU)
- Oct 11 - Kuiper Belt Object 303775 (2005 QU182) At Opposition (51.334 AU)
- Oct 11 - Colloquium: Dark Matter in the Genome - Transposable Elements and Human Disease, Greenbelt, Maryland
- Oct 11 - Colloquium: Order or disorder? What do the magnetic fields of supernova remnants look like?, Sydney, Australia
- Oct 11-12 - International Symposium for Personal and Commercial Spaceflight (ISPCS), Las Cruces, New Mexico
- **Oct 12 - Progress MS-7 Soyuz-2.1a Launch (International Space Station 68P)**
- Oct 12- Comet 73P-BJ/Schwassmann-Wachmann Closest Approach To Earth (1.959 AU)
- Oct 12 - Comet C/2015 T2 (PANSTARRS) Closest Approach To Earth (6.193 AU)
- Oct 12 - Apollo Asteroid 2012 TC4 Near-Earth Flyby (0.0003 AU)
- Oct 12 - Apollo Asteroid 2017 RV1 Near-Earth Flyby (0.046 AU)
- Oct 12-13 - Back to the Moon Workshop, Columbia, Maryland
- Oct 12-13 - Meeting: Committee on Radio Frequencies, Boulder, Colorado

Source: JPL Space Calendar

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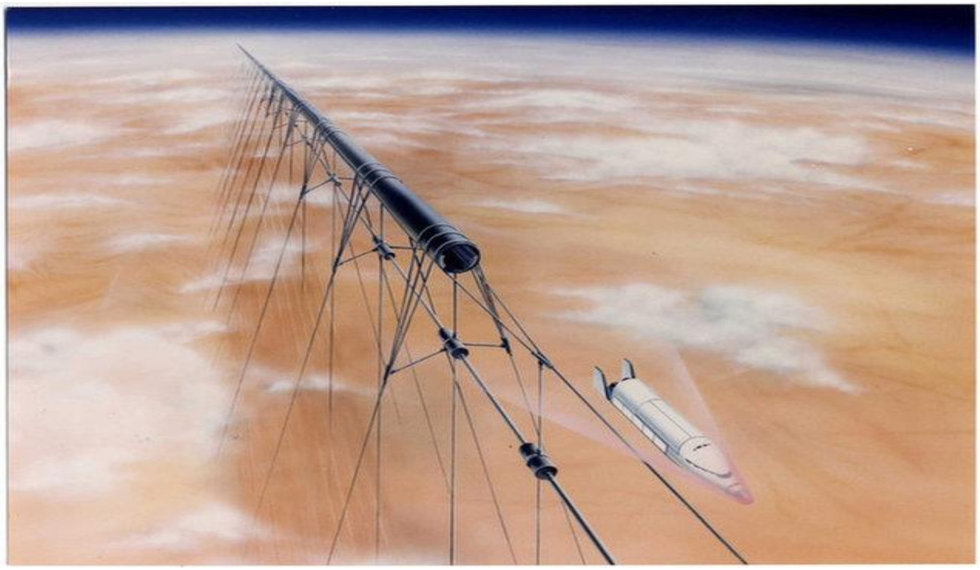
Food for Thought

You've Probably Heard of "Hyperloop" -- Could "StarTram" Revolutionize Space Travel?



While stuck in traffic in 1961, James Powell, a young researcher at Brookhaven National Laboratory came up with the idea of using powerful magnets to lift and propel massive passenger-carrying cars. Over the next seven years, he and his colleague Gordon Danby spent their spare time piecing together a concept. They obtained a patent for the breakthrough in 1968. Powell and Danby's magnetic levitation, or maglev, technology must have seemed like magic back then, but it is now being used to move large trains at speeds up to 375 miles per hour!

Not content to rest on this sole accomplishment, the 84-year-old Powell now has grander ambitions for his maglev breakthrough. In 2001, he teamed up with George Maise, an aeronautical engineer and 23-year veteran of Brookhaven National Laboratory, to put forth an idea to revolutionize space launches: StarTram.

StarTram is just as audacious as its name implies. It boils down to building a maglev train to outer space. Here's how it works: Magnetically-levitated spacecraft will be propelled inside a curved tube aimed skyward. All air will be evacuated from the tube in order to eliminate drag. Craft will exit the lengthy tube at a speed of 8.8 kilometers per second in order to escape Earth's atmosphere. A generation-1 StarTram design intended to launch cargo vessels will feature an 81-mile tube built up the side of a mountain to reach a launch altitude of 12,000 to 20,000 feet. The Andes Mountains of Chile or the White Sands Missile Range of southern New Mexico might be ideal locations. Powell estimates that spacecraft could be launched every hour, carrying upwards of seventy tons of cargo per launch at a cost of just $20 to $50 per kilogram. An even more ambitious generation-2 StarTram design capable of ferrying hundreds of thousands of space tourists each year will feature a tube track between 620 and 930 miles long (to give more time for acceleration to minimize g-forces), likely situated in remote regions of Canada or Antarctica, reaching heights of 70,000 feet – almost twice as high as the cruising altitude of most passenger planes – to avoid drag when vessels exit the tube. The final 150 or so miles of the track will be magnetically levitated using powerful superconducting cables. This awe-inspiring highwire act operates on the exact same physical principles used to levitate trains.

There are four key hurdles that need to be overcome for StarTram to work. First off, to propel spacecraft to necessary speeds, a massive amount of power will need to be stored and discharged over roughly thirty seconds, think between 50 and 100 gigawatts! That's equivalent to the power output of around 50,000 commercial wind turbines.

Second, levitating the generation-2 StarTram to the required 14-mile height would be a technical feat unlike any ever attempted. Powell says there are two ways to accomplish it. "The first is to construct the launch tube on the surface, together with its superconducting cables and restraining tethers, and then slowly energize the cable, levitating it over a period of days. The second option is to erect the cable and tether system, and then lift the launch tube into place using additional lifting tethers." He further notes that, "The real trick is not levitating the launch tube, but getting the cost of the superconducting cables down to an acceptable level." Energizing the cables will also require a significant amount of current, around 200 million amperes!

Third, maintaining a vacuum inside the open tube, which is needed for spacecraft to reach high speeds, would require a plasma pump device at the exit point to keep air out. Similar devices exist, but they have never been built for an application such as this.

The final hurdle is one that advocates of world-changing, futuristic projects are well aware of: cost. The generation-1 StarTram is projected to cost $20 billion. Generation-2 could cost upwards of $60 billion. Since these estimates are likely optimistic, we can probably add at least $10 to $30 billion to each.

But despite the drawbacks, there are plenty of reasons to think that we could actually build a functioning StarTram. First and foremost, none of the underlying principles are science fiction. The technologies for StarTram exist today; we just need to scale them up big time. Moreover, the costs are not insurmountable. The $20-40 billion required for a gen-1 design is far less than the $196 billion spent on the Space Shuttle program over its 30-year lifetime, and a pittance compared to the $600 billion the United States spent on defense in 2015 alone.

"The overall feasibility and cost of the StarTram approach was validated in 2005 by a thorough 'murder board' study conducted at Sandia National Laboratory," John Rather, a former Assistant Director for Space Technology at NASA, said of the project at the 2010 Space, Propulsion & Energy Sciences International Forum held at Johns Hopkins University Applied Physics Laboratory. Looking to the future, StarTram could open up a whole new world of possibilities in outer space. Carrying cargo into low-Earth orbit the old-fashioned way – with rockets – presently ranges in cost between $4,600 and $20,000 per kilogram, although SpaceX thinks they can get that down to $1,400. StarTram could take that down to just double digits. Moreover, it could achieve multiple launches in a single day. Powell pondered on what that would mean for nascent industries like space-based solar power and space tourism.

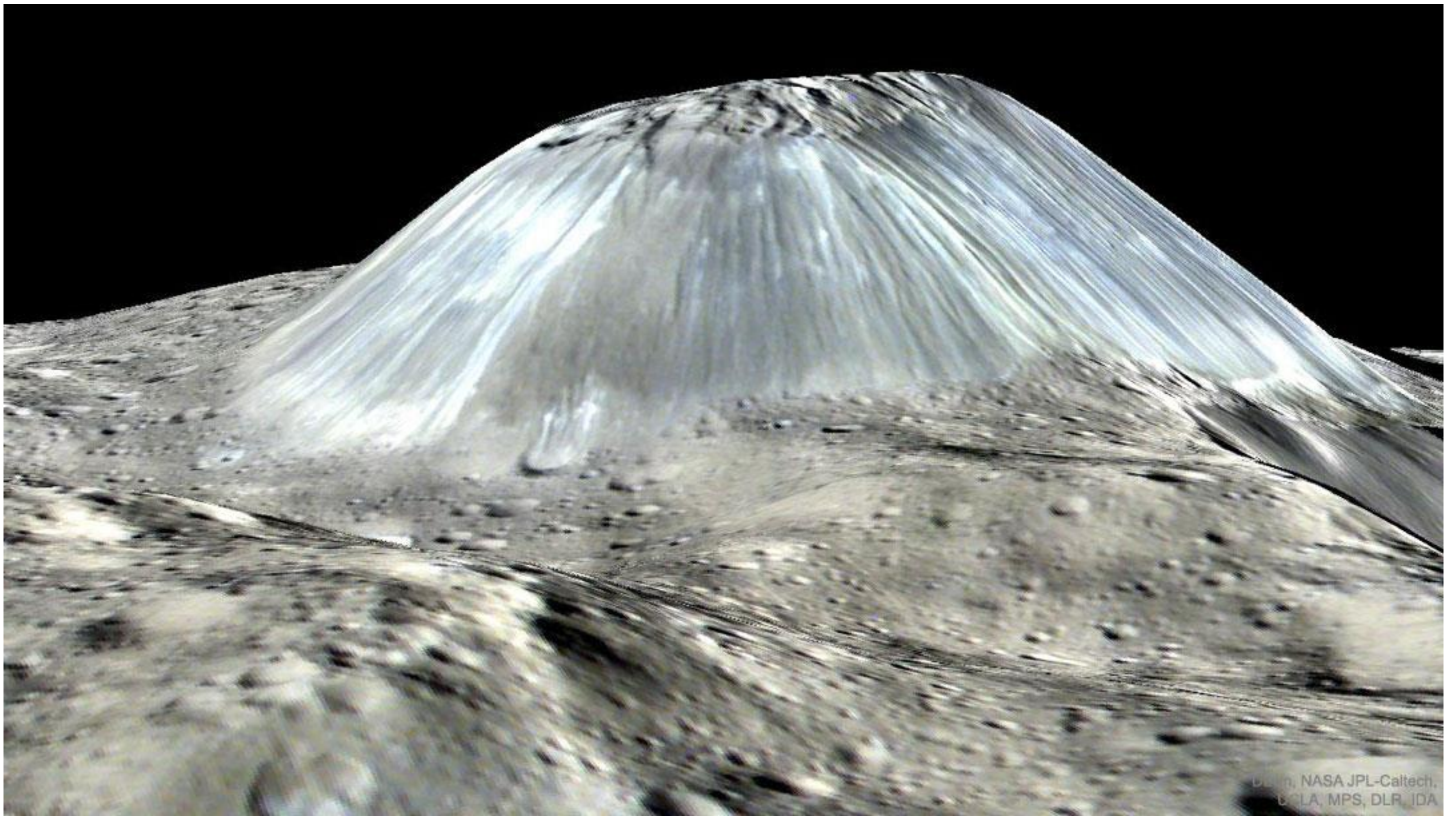
Launching just 100 Space Solar Power Satellites per year at a launch cost of $20 per pound would yield a revenue of 40 billion dollars per year, enough to pay off the StarTram facility in a couple of years. 1 million space tourists per year – 1/30th of the visitors to Disneyland – at $5,000 per passenger, would bring in 5 billion dollars annually. Other large markets appear possible.

Dr. John Rather went further, suggesting that StarTram could lead to "utilization of near-earth asteroids for habitats immune to ionizing radiation (together with protection of the Earth from impacts), safe space tourism, and development of the moon, Mars and the outer solar system. Synergistically, ground transportation on the Earth can be revolutionized, leading to enormous reduction in energy consumption and creation of millions of jobs."

Originally published on RealClearScience.

Source: Space.com Return to Contents

Space Image of the Week



Unusual Mountain Ahuna Mons on Asteroid Ceres
Image Credit: Dawn Mission, NASA, JPL-Caltech, UCLA, MPS/DLR/IDA

Explanation: What created this unusual mountain? Ahuna Mons is the largest mountain on the largest known asteroid in our Solar System, Ceres, which orbits our Sun in the main asteroid belt between Mars and Jupiter. Ahuna Mons, though, is like nothing that humanity has ever seen before. For one thing, its slopes are garnished not with old craters but young vertical streaks.

One hypothesis holds that Ahuna Mons is an ice volcano that formed shortly after a large impact on the opposite side of the dwarf planet loosened up the terrain through focused seismic waves. The bright streaks may be high in reflective salt, and therefore similar to other recently surfaced material such as visible in Ceres' famous bright spots. The featured double-height digital image was constructed from surface maps taken of Ceres last year by the robotic Dawn mission.

Source: NASA APOD

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