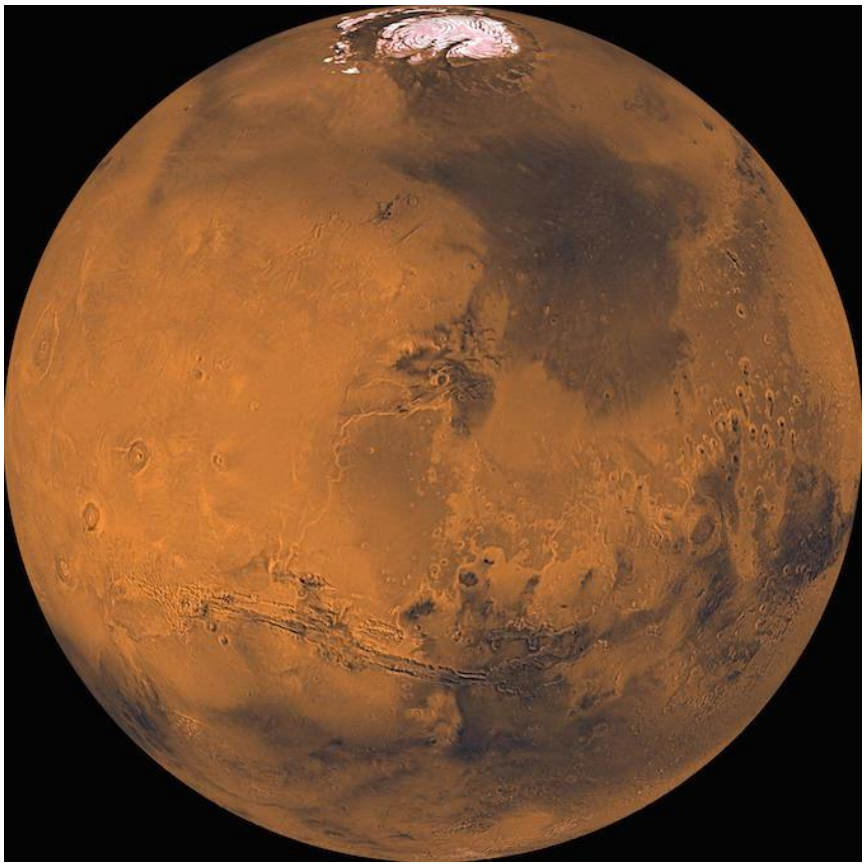
Space News Update

— January 2, 2018 —

Happy New Year !!

Contents

1. Mars And Earth May Not Have Always Been Neighbors



A global view of Mars. Credit: NASA

A study published in the journal Earth and Planetary Science Letters posits that Mars formed in what today is the Asteroid Belt, roughly one and a half times as far from the Sun as its current position, before migrating to its present location.

The assumption has generally been that Mars formed near Earth from the same building blocks, but that conjecture raises a big question: why are the two planets so different in composition? Mars contains different, lighter, silicates than Earth, more akin to those found in meteorites. In an attempt to explain why the elements and isotopes on Mars differ widely from those on Earth, researchers from Japan, the United States and the United Kingdom ran simulations to gain insights into the Red Planet's movement within the Solar System.

Even though the study's simulations suggested that the most probable explanation is that Mars formed near Earth, that model doesn't account for the compositional differences between the two planets. Thus, researchers paid particular attention to simulations consistent with the so-called Grand Tack model, which suggests that Jupiter played a major role in the formation and final orbital architecture of the inner planets. The theory holds that a newly-established Jupiter plowed a large concentration of mass towards the Sun, which contributed to the formation of Earth and Venus, while simultaneously pushing material away from Mars, accounting for the planet's small mass (roughly 11 percent that of Earth) and the difference between the two planets' compositions.

In Grand Tack simulations, the researchers gleaned additional insight into Mars' formation. A small percentage of the simulations suggested that Mars formed much farther from the Sun than it is now and that Jupiter's gravitational pull pushed Mars into its current position.

University of Colorado Geological Sciences professor Stephen Mojzsis, a co-author of the study, isn't concerned by the low probability of this scenario taking place.

"Low probability means one of two things: that we don't have a better physical mechanism to explain Mars' formation or in the enormous panoply of possibilities we ended up with one that is relatively rare," he says, noting that the latter seems to be the best conclusion.

Mojzsis also keeps such terms in perspective. "Keep in mind that rare is relative," when it comes to space, he says, and rare outcomes do happen. What are the chances that Earth would cross orbits with the asteroid that hit the Yucatan and rendered the dinosaurs extinct?

"Given enough time, we can expect these events," Mojzsis says. "For example, you'll eventually get double sixes if you roll the dice enough times. The probability is 1/36 or roughly the same as we get for our simulations of Mars' formation."

One implication of Mars forming farther away from the Sun is that the planet would have been colder than originally thought—perhaps too cold for liquid water or to sustain life. This theory would seem to challenge the idea that Mars was once far warmer and wetter than it is now. Mojzsis argues that there's plenty of time in Mars' early history for it to have been both colder and farther away and at times for it to have experienced warm, wet periods.

"Mars' formation in the Asteroid Belt took place very early in Mars' history, well before the crust stabilized and the atmosphere was established," he says. In a paper he co-authored last year, Mojzsis concludes that late in Mars' planetary formation it was bombarded by asteroids that formed the planet's countless craters. Such large impacts could "melt the cryosphere and Mars' crust to densify Mars' atmosphere and to restart the hydrologic cycle," Mojzsis says.

While many scientists are beginning to embrace the idea of planetary migration, studies such as this raise additional questions regarding the planets and their histories. What is Venus' composition and how does it compare to that of Earth? Confirmation of similarities between Venus and Earth would circumstantially support the idea that, in the Grand Tack theory, Jupiter pushed material in-system to form Earth and Venus. It would also support researchers' theories about the formation of planets in the inner Solar System, including Mars. However, the lack of any samples, even meteorites, from Venus makes it difficult to answer that question. NASA and the Russian space agency Roscosmos have proposed the joint Venera-D mission that would send an orbiter to Venus around 2025, which may yield some clues to the planet's composition.

Mojzsis also points out that one of the problems we face is trying to understand how the giant planets formed. Jupiter, Saturn, Uranus, and Neptune couldn't have formed where they now reside because the Outer Solar System didn't have enough mass early on to account for these giant worlds, he says.

It could be that the giant planets formed close together and then later moved away by the influence of their gravitational interactions. Such a theory isn't unique to our Solar System. "We understand from direct observations via the Kepler Space Telescope and earlier studies that giant planet migration is a normal feature of planetary systems," Mojzsis says. "Giant planet formation induces migration, and migration is all about gravity, and these worlds affected each other's orbits early on."

Mojzsis' recent work also focuses on how Jupiter ended up in its current position and how its formation corresponds with the dispersal of gas and dust from the Sun's planet-forming disc. Little by little, scientists are gaining a greater understanding of the Solar System's history—and of the nature of planetary formation in our galactic neighborhood.

Mojzsis' work was supported in part by NASA's Exobiology and Evolutionary Biology Program and by the John Templeton Foundation-FfAME origins project.

Source: AstronomyNow.com Return to Contents

2. A New Approach for Detecting Planets in the Alpha Centauri System

Illustration by Michael S. Helfenbein

Yale astronomers have taken a fresh look at the nearby Alpha Centauri star system and found new ways to narrow the search for habitable planets there.

According to a study led by Professor Debra Fischer and graduate student Lily Zhao, there may be small, Earth-like planets in Alpha Centauri that have been overlooked. Meanwhile, the study ruled out the existence of a number of larger planets in the system that had popped up in previous models.

"The universe has told us the most common types of planets are small planets, and our study shows these are exactly the ones that are most likely to be orbiting Alpha Centauri A and B," said Fischer, a leading expert on exoplanets who has devoted decades of research to the search for an Earth analog.

The new study appears in the Astronomical Journal. Co-authors are John Brewer and Matt Giguere of Yale and Bárbara Rojas-Ayala of Universidad Andrés Bello in Chile.

The Alpha Centauri system is located 1.3 parsecs (24.9 trillion miles) from Earth, making it our closest neighboring system. It has three stars: Centauri A, Centauri B, and Proxima Centauri. Last year, the discovery of an Earth-like planet orbiting Proxima Centauri set off a new wave of scientific and public interest in the system.

"Because Alpha Centauri is so close, it is our first stop outside our solar system," Fischer said. "There's almost certain to be small, rocky planets around Alpha Centauri A and B."

The findings are based on data coming in from a new wave of more advanced spectrographic instruments at observatories located in Chile: CHIRON, a spectrograph built by Fischer's team; HARPS, built by a team from Geneva; and UVES, part of the Very Large Telescope Array. "The precision of our instruments hasn't been good enough, until now," Fischer said.

The researchers set up a grid system for the Alpha Centauri system and asked, based on the spectrographic analysis, "If there was a small, rocky planet in the habitable zone, would we have been able to detect it?" Often, the answer came back: "No."

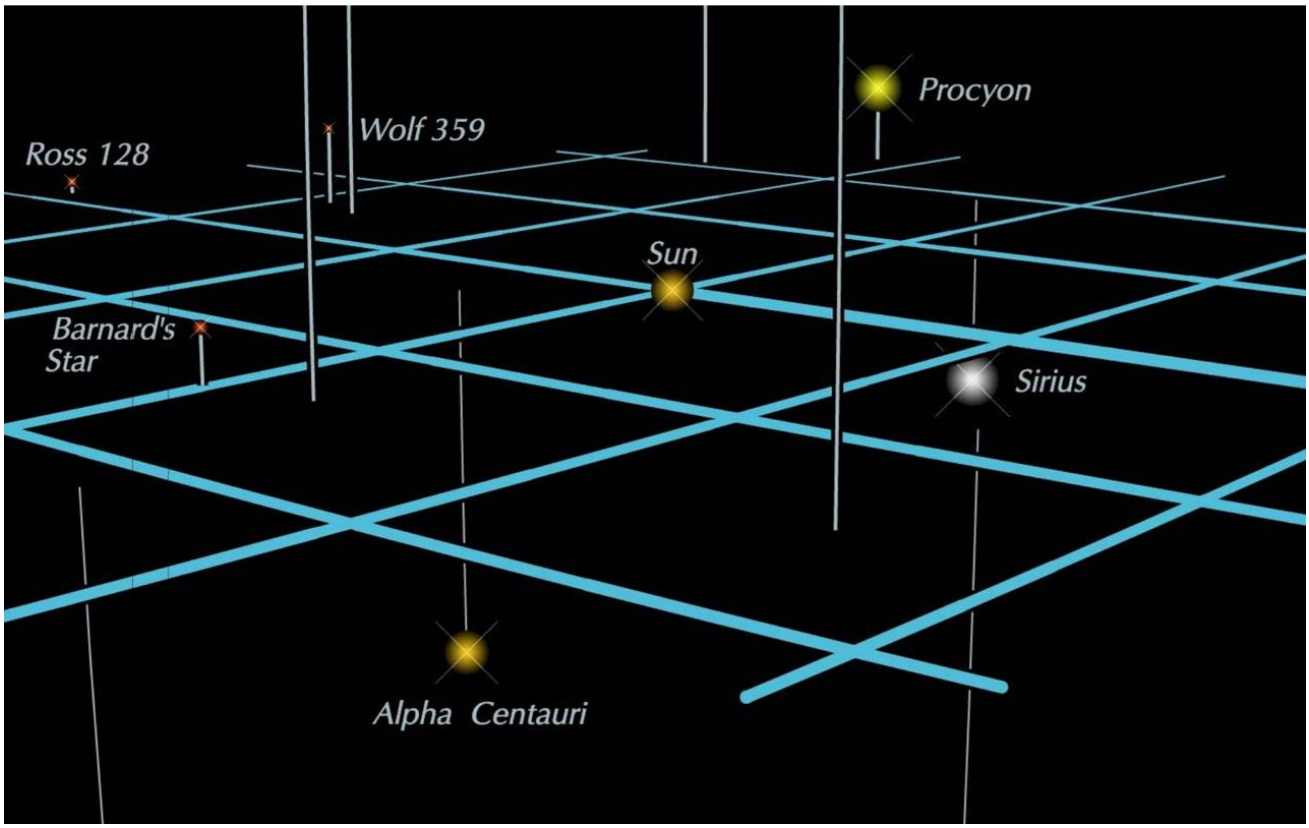
Zhao, the study's first author, determined that for Alpha Centauri A, there might still be orbiting planets that are smaller than 50 Earth masses. For Alpha Centauri B there might be orbiting planets than are smaller than 8 Earth masses; for Proxima Centauri, there might be orbiting planets that are less than one-half of Earth's mass.

In addition, the study eliminated the possibility of a number of larger planets. Zhao said this takes away the possibility of Jupiter-sized planets causing asteroids that might hit or change the orbits of smaller, Earth-like planets.

"This is a very green study in that it recycles existing data to draw new conclusions," said Zhao. "By using the data in a different way, we are able to rule out large planets that could endanger small, habitable worlds and narrow down the search area for future investigations."

This new information will help astronomers prioritize their efforts to detect additional planets in the system, the researchers said. Likewise, the continuing effort by Fischer and others to improve spectrographic technology will help identify and understand the composition of exoplanets.

The study was funded in part by NASA and the National Science Foundation.

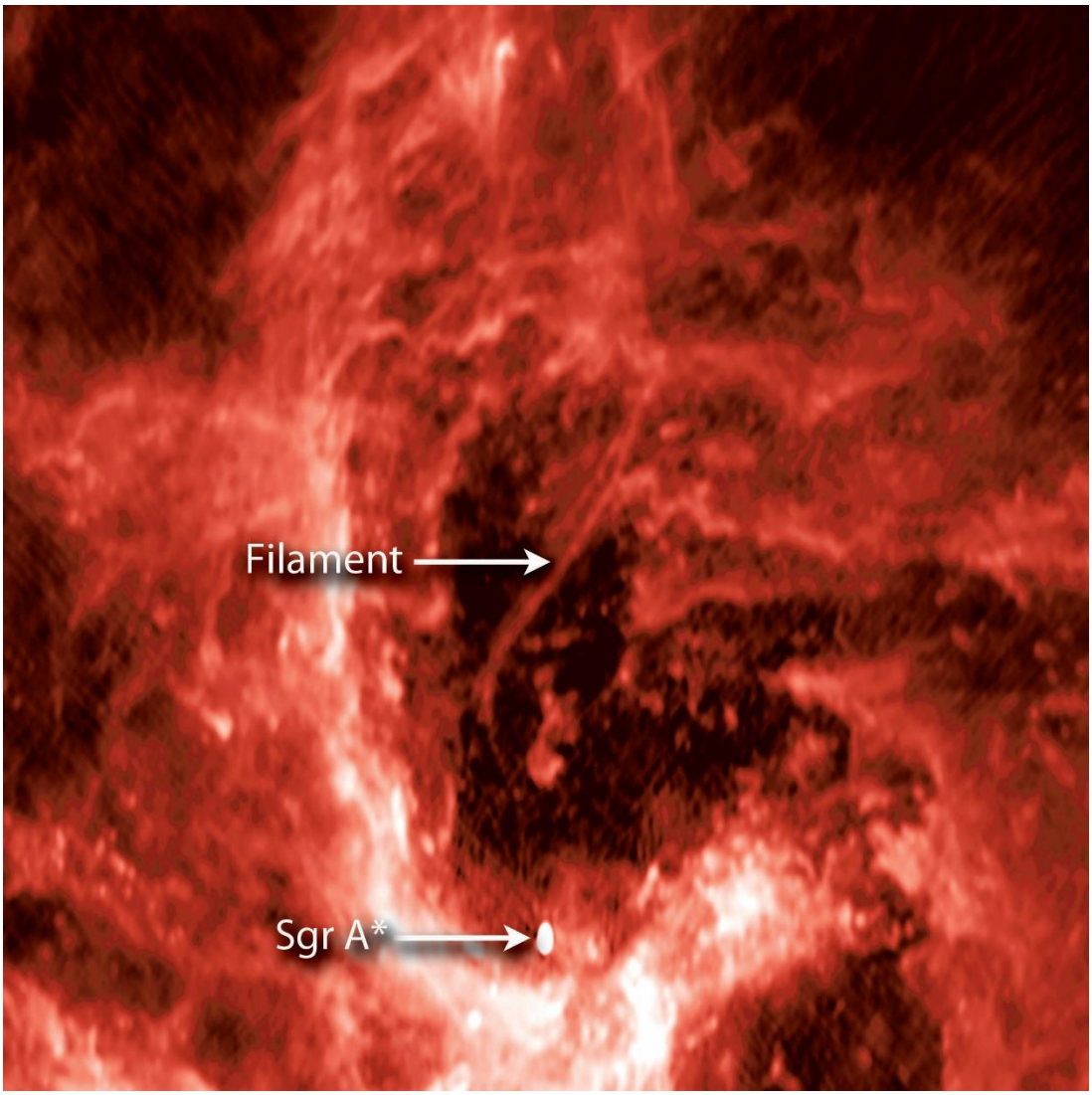


Stars within 12 light-years of the sun. The lines on the grid are 4 light-years apart. Diagram via Guy Ottewell's Astronomical Companion. Proxima Centauri is the nearest star, and on August 24, 2016 astronomers announced it likely has a planet. This star is the nearest of a triple star system, which we on Earth see with the eye alone as the single star Alpha Centauri, visible from Earth's Southern Hemisphere. They are about four light-years away. Source: EarthSky.org

Source: Yale University

Return to Contents

3. Cosmic Filament Probes Our Galaxy's Giant Black Hole



A radio image from the NSF's Karl G. Jansky Very Large Array showing the center of our galaxy. The mysterious radio filament is the curved line located near the center of the image, & the supermassive black hole Sagittarius A (Sgr A*), is shown by the bright source near the bottom of the image. Credit: NSF/VLA/UCLA/M. Morris et al.*

The center of our Galaxy has been intensely studied for many years, but it still harbors surprises for scientists. A snake-like structure lurking near our galaxy's supermassive black hole is the latest discovery to tantalize astronomers.

In 2016, Farhad Yusef-Zadeh of Northwestern University reported the discovery of an unusual filament near the center of the Milky Way Galaxy using the NSF's Karl G. Jansky Very Large Array (VLA). The filament is about 2.3 light years long and curves around to point at the supermassive black hole, called Sagittarius A* (Sgr A*), located in the Galactic center.

Now, another team of astronomers has employed a pioneering technique to produce the highest-quality image yet obtained of this curved object.

"With our improved image, we can now follow this filament much closer to the Galaxy's central black hole, and it is now close enough to indicate to us that it must originate there," said Mark Morris of the University of

California, Los Angeles, who led the study. "However, we still have more work to do to find out what the true nature of this filament is."

The researchers have considered three main explanations for the filament. The first is that it is caused by high-speed particles kicked away from the supermassive black hole. A spinning black hole coupled with gas spiraling inwards can produce a rotating, vertical tower of magnetic field that approaches or even threads the event horizon, the point of no return for infalling matter. Within this tower, particles would be sped up and produce radio emission as they spiral around magnetic field lines and stream away from the black hole.

The second, more fantastic, possibility is that the filament is a cosmic string, theoretical, as-yet undetected objects that are long, extremely thin objects that carry mass and electric currents. Previously, theorists had predicted that cosmic strings, if they exist, would migrate to the centers of galaxies. If the string moves close enough to the central black hole it might be captured once a portion of the string crosses the event horizon.

The final option is that the position and the direction of the filament aligning with the black hole are merely coincidental superpositions, and there is no real association between the two. This would imply it is like dozens of other known filaments found farther away from the center of the Galaxy. However, such a coincidence is quite unlikely to happen by chance.

"Part of the thrill of science is stumbling across a mystery that is not easy to solve," said co-author Jun-Hui Zhao of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass. "While we don't have the answer yet, the path to finding it is fascinating. This result is motivating astronomers to build next generation radio telescopes with cutting edge technology."

Each of the scenarios being investigated would provide intriguing insight if proven true. For example, if the filament is caused by particles being ejected by Sgr A*, this would reveal important information about the magnetic field in this special environment, showing that it is smooth and orderly rather than chaotic.

The second option, the cosmic string, would provide the first evidence for a highly speculative idea with profound implications for understanding gravity, space-time and the Universe itself.

Evidence for the idea that particles are being magnetically kicked away from the black hole would come from observing that particles further away from Sgr A* are less energetic than those close in. A test for the cosmic string idea will capitalize on the prediction by theorists that the string should move at a high fraction of the speed of light. Follow-up observations with the VLA should be able to detect the corresponding shift in position of the filament.

Even if the filament is not physically tied to Sgr A*, the bend in the shape of this filament is still unusual. The bend coincides with, and could be caused by, a shock wave, akin to a sonic boom, where the blast wave from an exploded star is colliding with the powerful winds blowing away from massive stars surrounding the central black hole.

"We will keep hunting until we have a solid explanation for this object," said co-author Miller Goss, from the National Radio Astronomy Observatory in Socorro, New Mexico. "And we are aiming to next produce even better, more revealing images."

A paper describing these results appeared in the December 1st, 2017 issue of *The Astrophysical Journal Letters*.

Headquartered in Cambridge, Mass., the Harvard-Smithsonian Center for Astrophysics (CfA) is a collaboration between the Smithsonian Astrophysical Observatory and the Harvard College Observatory. CfA scientists, organized into six research divisions, study the origin, evolution and ultimate fate of the universe.

Source: Harvard-Smithsonian Center for Astrophysics Return to Contents

The Night Sky

Tuesday, January 2

- The Moon, a day past full, forms a curving line this evening with Castor and Pollux to its upper left and Procyon to its lower right. Farther to the right is Orion.

Wednesday, January 3

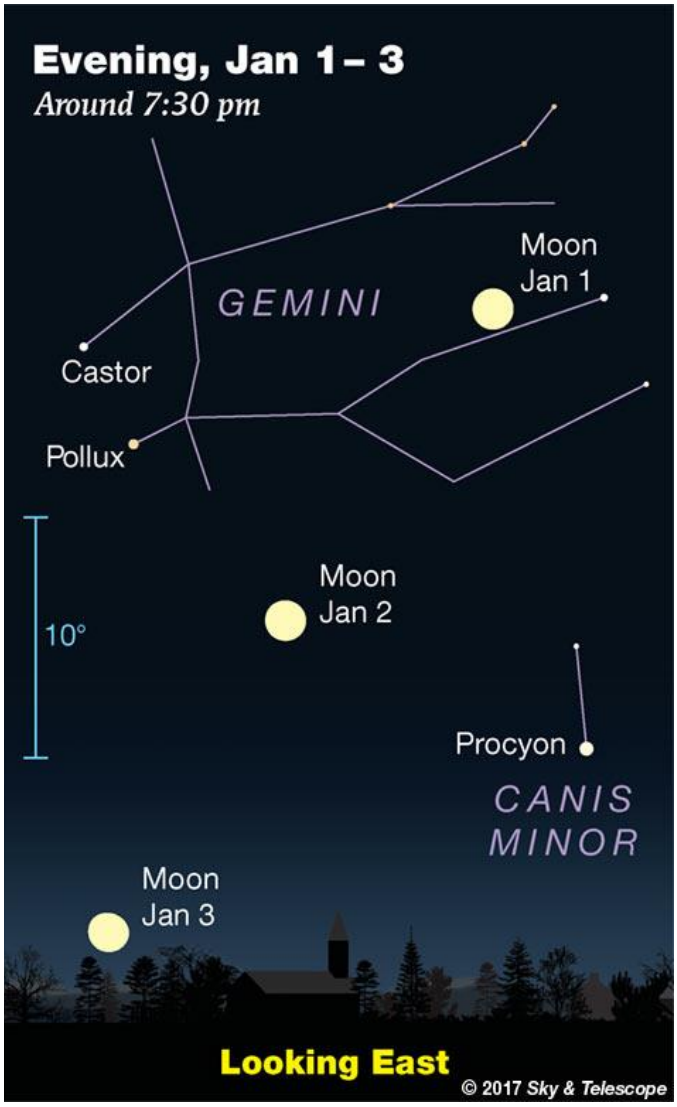
- Once the Moon rises in early evening, it forms a big, almost equilateral triangle with Pollux above it and Procyon to its upper right. A little above Pollux is Castor, slightly fainter.
- The Quadrantid meteor shower should reach its brief peak late tonight, well-timed for North America. But the floodlight of the waning gibbous Moon in the sky will hide all but the brightest of the Quads.

Thursday, January 4

- When the waning gibbous Moon rises late this evening, it's accompanied by Regulus in Leo (for North America). Watch the Moon slide past Regulus through the rest of the night. The Moon occults Regulus for parts of northern Canada and Alaska;

Friday, January 5

- Orion strides boldly up the southeastern sky after nightfall this month. Above it glitters orange Aldebaran, 65 light-years away. Above Aldebaran are the Pleiades, about 435 light-years away. Far left of Aldebaran and the Pleiades, brilliant Capella shines from a distance of 42 light-years.
- Just before or during early dawn on Saturday morning the 6th, spot bright Jupiter in the south-southeast. Fainter Mars is barely to its right, by just 1/3° — less than the width of a chopstick at arm's length. The two planets will fit in a medium-power eyepiece view, but both are near their maximum distances from Earth and about as small as they ever look. Mars is especially tiny.



On the evening of New Year's Day, the full supermoon shines in the feet of Gemini. (The blue 1° scale is about the width of your fist at arm's length.)

Source: Sky and Telescope

Return to Contents

ISS Sighting Opportunities (from Denver)

Sighting Information Not Available

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

NASA-TV Highlights (all times Eastern Time Zone)

Wednesday, January 3

- 1 p.m. - ISS Expedition 54 In-Flight Interviews with KMSP-TV, Minneapolis and the Voice of America with NASA Flight Engineers Scott Tingle and Mark Vande Hei and Flight Engineer Norishige Kanai of the Japan Aerospace Exploration Agency (JAXA) (Starts at 1 p.m.) (all channels)

Thursday, January 4

- 11:30 a.m. - ISS Expedition 54 In-Flight Interview with the Boston Globe and Flight Engineer Scott Tingle of NASA (all channels)

Friday, January 5

- 6 a.m. - ISS Expedition 54 In-Flight News Conference for Japanese Media with Flight Engineer Norishige Kanai of the Japan Aerospace Exploration Agency (JAXA) (Starts at 6:20 a.m.) (all channels)

Watch NASA TV online by going to the NASA website.

Return to Contents

Space Calendar

- **Jan 02 - Supermoon**
- Jan 02 - Comet 26P/Grigg-Skjellerup Closest Approach To Earth (2.103 AU)
- Jan 02 - Aten Asteroid 2015 RT1 Near-Earth Flyby (0.050 AU)
- Jan 02 - Asteroid 5053 Chladni Closest Approach To Earth (1.230 AU)
- Jan 02 - Asteroid 3263 Bligh Closest Approach To Earth (1.274 AU)
- Jan 02 - Asteroid 7707 Yes Closest Approach To Earth (1.799 AU)
- Jan 02 - Asteroid 904 Rockefellia Closest Approach To Earth (1.804 AU)
- Jan 02 - Asteroid 787 Moskva Closest Approach To Earth (1.888 AU)
- Jan 02 - Kuiper Belt Object 2014 WP509 At Opposition (41.569 AU)
- Jan 03 - **Earth At Perihelion (0.983 AU From Sun)**
- Jan 03 - **Quadrantids Meteor Shower Peak**
- Jan 03 - Comet C/2017 K6 (Jacques) Perihelion (2.003 AU)
- Jan 03 - Comet P/2002 EJ57 (LINEAR) Closest Approach To Earth (1.992 AU)
- Jan 03 - Comet 188P/LINEAR-Mueller At Opposition (2.340 AU)
- Jan 03 - Comet 347P/PANSTARRS Closest Approach To Earth (2.674 AU)
- Jan 03 - Comet C/2017 U4 (PANSTARRS) At Opposition (6.942 AU)
- Jan 03 - Apollo Asteroid 2017 YD7 Near-Earth Flyby (0.012 AU)
- Jan 03 - Apollo Asteroid 2017 YP5 Near-Earth Flyby (0.056 AU)
- Jan 03 - Apollo Asteroid 2017 UY4 Near-Earth Flyby (0.067 AU)
- Jan 03 - Apollo Asteroid 2017 XQ61 Near-Earth Flyby (0.089 AU)
- Jan 03 - Asteroid 1103 Sequoia Closest Approach To Earth (1.044 AU)
- Jan 03 - Asteroid 1031 Arctica Closest Approach To Earth (2.036 AU)
- **Jan 04 - "Zuma" Falcon 9 Launch**
- Jan 04 - Comet 338P/McNaught Closest Approach To Earth (2.648 AU)
- Jan 04 - Comet 136P/Mueller At Opposition (3.081 AU)
- Jan 04 - Asteroid 2062 Aten Closest Approach To Earth (0.979 AU)
- Jan 04 - Asteroid 19695 Billnye Closest Approach To Earth (1.358 AU)
- Jan 04 - Asteroid 9446 Cicero Closest Approach To Earth (2.551 AU)
- Jan 04 - Isaac Newton's 375th Birthday (1643)
- **Jan 04-07 - National Radio Science Meeting (NRSM), Boulder, Colorado**
- Jan 05 - Moon Occults Regulus
- Jan 05 - Comet C/2017 T1 (Heinze) Closest Approach To Earth (0.223 AU)
- Jan 05 - Comet C/2015 X5 (PANSTARRS) Closest Approach To Earth (5.909 AU)
- Jan 05 - Comet C/2015 X5 (PANSTARRS) At Opposition (5.909 AU)
- Jan 05 - Apollo Asteroid 12711 Tukmit Closest Approach To Earth (0.624 AU)
- Jan 05 - Asteroid 76272 De Jong Closest Approach To Earth (1.137 AU)
- Jan 05 - Asteroid 26715 South Dakota Closest Approach To Earth (1.514 AU)

Source: JPL Space Calendar

Return to Contents

Food for Thought

Ancient Fossil Microorganisms Indicate That Life in the Universe Is Common

A microorganism analyzed by the researchers. Credit: J. William Schopf/UCLA

A new analysis of the oldest known fossil microorganisms provides strong evidence to support an increasingly widespread understanding that life in the universe is common.

The microorganisms, from Western Australia, are 3.465 billion years old. Scientists from UCLA and the University of Wisconsin–Madison report today in the journal Proceedings of the National Academy of Sciences that two of the species they studied appear to have performed a primitive form of photosynthesis, another apparently produced methane gas, and two others appear to have consumed methane and used it to build their cell walls.

The evidence that a diverse group of organisms had already evolved extremely early in the Earth's history — combined with scientists' knowledge of the vast number of stars in the universe and the growing understanding that planets orbit so many of them — strengthens the case for life existing elsewhere in the universe because it would be extremely unlikely that life formed quickly on Earth but did not arise anywhere else.

"By 3.465 billion years ago, life was already diverse on Earth; that's clear — primitive photosynthesizers, methane producers, methane users," said J. William Schopf, a professor of paleobiology in the UCLA College, and the study's lead author. "These are the first data that show the very diverse organisms at that time in Earth's history, and our previous research has shown that there were sulfur users 3.4 billion years ago as well.

"This tells us life had to have begun substantially earlier and it confirms that it was not difficult for primitive life to form and to evolve into more advanced microorganisms."

Schopf said scientists still do not know how much earlier life might have begun.

"But, if the conditions are right, it looks like life in the universe should be widespread," he said.

The study is the most detailed ever conducted on microorganisms preserved in such ancient fossils. Researchers led by Schopf first described the fossils in the journal Science in 1993, and then substantiated their biological origin in the journal Nature in 2002. But the new study is the first to establish what kind of biological microbial organisms they are, and how advanced or primitive they are.

For the new research, Schopf and his colleagues analyzed the microorganisms with cutting-edge technology called secondary ion mass spectroscopy, or SIMS, which reveals the ratio of carbon-12 to carbon-13 isotopes — information scientists can use to determine how the microorganisms lived. (Photosynthetic bacteria have different carbon signatures from methane producers and consumers, for example.) In 2000, Schopf became the first scientist to use SIMS to analyze microscopic fossils preserved in rocks; he said the technology will likely be used to study samples brought back from Mars for signs of life.

The Wisconsin researchers, led by geoscience professor John Valley, used a secondary ion mass spectrometer — one of just a few in the world — to separate the carbon from each fossil into its constituent isotopes and determine their ratios.

"The differences in carbon isotope ratios correlate with their shapes," Valley said. "Their C-13-to-C-12 ratios are characteristic of biology and metabolic function."

The fossils were formed at a time when there was very little oxygen in the atmosphere, Schopf said. He thinks that advanced photosynthesis had not yet evolved, and that oxygen first appeared on Earth approximately half a billion years later before its concentration in our atmosphere increased rapidly starting about 2 billion years ago.

Oxygen would have been poisonous to these microorganisms, and would have killed them, he said.

Primitive photosynthesizers are fairly rare on Earth today because they exist only in places where there is light but no oxygen — normally there is abundant oxygen anywhere there is light. And the existence of the rocks the scientists analyzed is also rather remarkable: The average lifetime of a rock exposed on the surface of the Earth is about 200 million years, Schopf said, adding that when he began his career, there was no fossil evidence of life dating back farther than 500 million years ago.

"The rocks we studied are about as far back as rocks go."

While the study strongly suggests the presence of primitive life forms throughout the universe, Schopf said the presence of more advanced life is very possible but less certain.

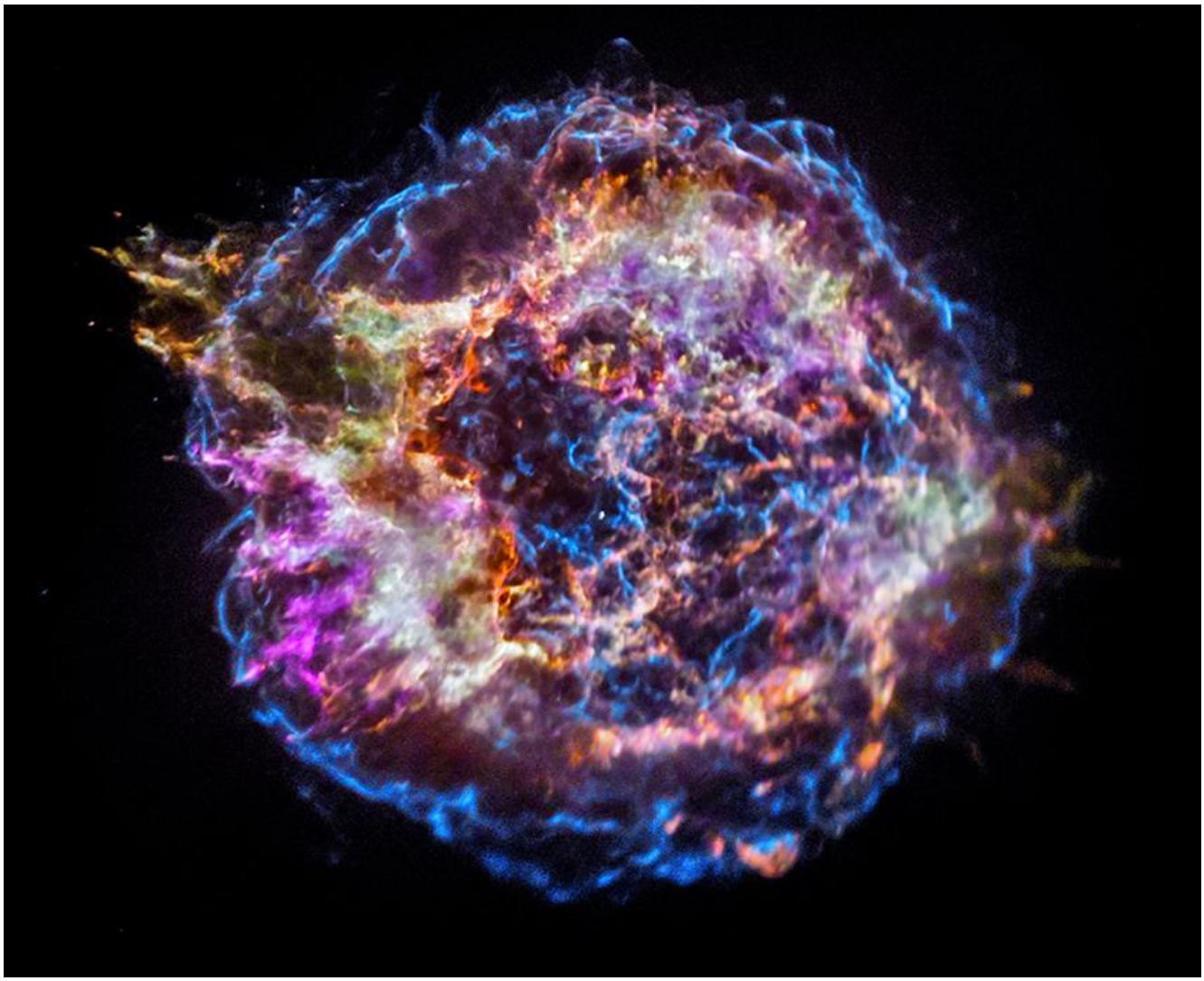
One of the paper's co-authors is Anatoliy Kudryavtsev, a senior scientist at UCLA's Center for the Study of Evolution and the Origin of Life, of which Schopf is director. The research was funded by the NASA Astrobiology Institute.

In May 2017, a paper in PNAS by Schopf, UCLA graduate student Amanda Garcia and colleagues in Japan showed the Earth's near-surface ocean temperature has dramatically decreased over the past 3.5 billion years. The work was based on their analysis of a type of ancient enzyme present in virtually all organisms.

In, 2015 Schopf was part of an international team of scientists that described in PNAS their discovery of the greatest absence of evolution ever reported — a type of deep-sea microorganism that appears not to have evolved over more than 2 billion years.

Source: UCLA Return to Contents

Space Image of the Week



Recycling Cassiopeia A
Image Credit: NASA, CXC, SAO

Explanation Massive stars in our Milky Way Galaxy live spectacular lives. Collapsing from vast cosmic clouds, their nuclear furnaces ignite and create heavy elements in their cores. After a few million years, the enriched material is blasted back into interstellar space where star formation can begin anew. The expanding debris cloud known as Cassiopeia A is an example of this final phase of the stellar life cycle. Light from the explosion which created this supernova remnant would have been first seen in planet Earth's sky about 350 years ago, although it took that light about 11,000 years to reach us.

This false-color Chandra X-ray Observatory image shows the still hot filaments and knots in the Cassiopeia A remnant. High-energy emission from specific elements has been color coded, silicon in red, sulfur in yellow, calcium in green and iron in purple, to help astronomers explore the recycling of our galaxy's star stuff - Still expanding, the blast wave is seen as the blue outer ring. The sharp X-ray image, spans about 30 light-years at the estimated distance of Cassiopeia A. The bright speck near the center is a neutron star, the incredibly dense, collapsed remains of the massive stellar core.

Source: NASA APOD

Return to Contents