Space News Update

— May 15, 2018 —

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In the News

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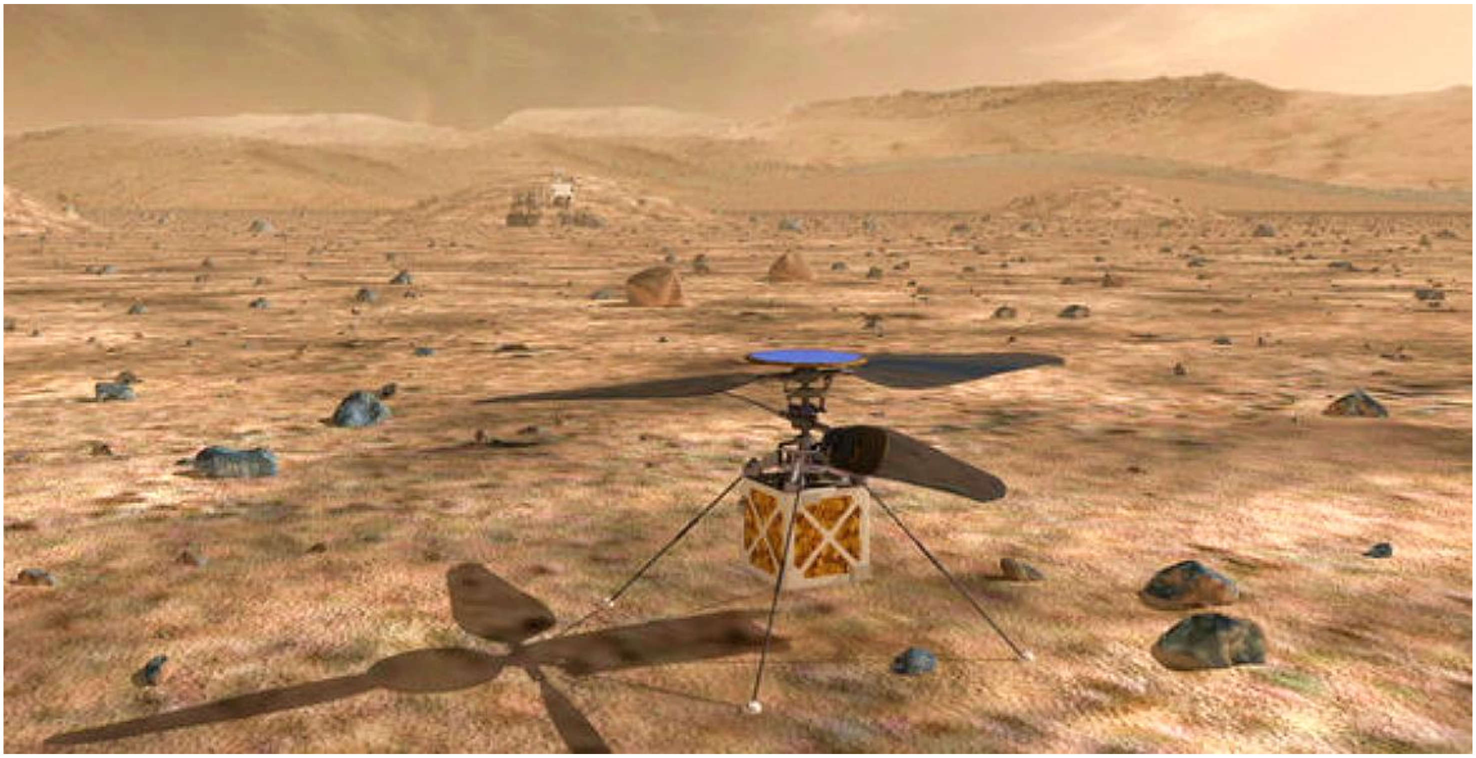
1. Mars Helicopter to Fly on NASA's Next Red Planet Rover Mission



NASA's Mars Helicopter, a small, autonomous rotorcraft, will travel with the agency's Mars 2020 rover, currently scheduled to launch in July 2020, to demonstrate the viability and potential of heavier-than-air vehicles on the Red Planet. Credits: NASA/JPL-Caltech

NASA is sending a helicopter to Mars.

The Mars Helicopter, a small, autonomous rotorcraft, will travel with the agency's Mars 2020 rover mission, currently scheduled to launch in July 2020, to demonstrate the viability and potential of heavier-than-air vehicles on the Red Planet.

"NASA has a proud history of firsts," said NASA Administrator Jim Bridenstine. "The idea of a helicopter flying the skies of another planet is thrilling. The Mars Helicopter holds much promise for our future science, discovery, and exploration missions to Mars."

U.S. Rep. John Culberson of Texas echoed Bridenstine's appreciation of the impact of American firsts on the future of exploration and discovery.

"It's fitting that the United States of America is the first nation in history to fly the first heavier-than-air craft on another world," Culberson said. "This exciting and visionary achievement will inspire young people all over the United States to become scientists and engineers, paving the way for even greater discoveries in the future."

Started in August 2013 as a technology development project at NASA's Jet Propulsion Laboratory (JPL), the Mars Helicopter had to prove that big things could come in small packages. The result of the team's four years of design, testing and redesign weighs in at little under four pounds (1.8 kilograms). Its fuselage is about the size of a softball, and its twin, counter-rotating blades will bite into the thin Martian atmosphere at almost 3,000 rpm – about 10 times the rate of a helicopter on Earth.

“Exploring the Red Planet with NASA’s Mars Helicopter exemplifies a successful marriage of science and technology innovation and is a unique opportunity to advance Mars exploration for the future,” said Thomas Zurbuchen, Associate Administrator for NASA's Science Mission Directorate at the agency headquarters in Washington. “After the Wright Brothers proved 117 years ago that powered, sustained, and controlled flight was possible here on Earth, another group of American pioneers may prove the same can be done on another world.”

The helicopter also contains built-in capabilities needed for operation at Mars, including solar cells to charge its lithium-ion batteries, and a heating mechanism to keep it warm through the cold Martian nights. But before the helicopter can fly at Mars it has to get there. It will do so attached to the belly pan of the Mars 2020 rover.

“The altitude record for a helicopter flying here on Earth is about 40,000 feet. The atmosphere of Mars is only one percent that of Earth, so when our helicopter is on the Martian surface, it’s already at the Earth equivalent of 100,000 feet up,” said Mimi Aung, Mars Helicopter project manager at JPL. “To make it fly at that low atmospheric density, we had to scrutinize everything, make it as light as possible while being as strong and as powerful as it can possibly be.”

Once the rover is on the planet’s surface, a suitable location will be found to deploy the helicopter down from the vehicle and place it onto the ground. The rover then will be driven away from the helicopter to a safe distance from which it will relay commands. After its batteries are charged and a myriad of tests are performed, controllers on Earth will command the Mars Helicopter to take its first autonomous flight into history.

“We don’t have a pilot and Earth will be several light minutes away, so there is no way to joystick this mission in real time,” said Aung. “Instead, we have an autonomous capability that will be able to receive and interpret commands from the ground, and then fly the mission on its own.”

The full 30-day flight test campaign will include up to five flights of incrementally farther flight distances, up to a few hundred meters, and longer durations as long as 90 seconds, over a period. On its first flight, the helicopter will make a short vertical climb to 10 feet (3 meters), where it will hover for about 30 seconds.

As a technology demonstration, the Mars Helicopter is considered a high-risk, high-reward project. If it does not work, the Mars 2020 mission will not be impacted. If it does work, helicopters may have a real future as low-flying scouts and aerial vehicles to access locations not reachable by ground travel.

“The ability to see clearly what lies beyond the next hill is crucial for future explorers,” said Zurbuchen. “We already have great views of Mars from the surface as well as from orbit. With the added dimension of a bird’s-eye view from a ‘marscopter,’ we can only imagine what future missions will achieve.”

Mars 2020 will launch on a United Launch Alliance (ULA) Atlas V rocket from Space Launch Complex 41 at Cape Canaveral Air Force Station in Florida, and is expected to reach Mars in February 2021.

The rover will conduct geological assessments of its landing site on Mars, determine the habitability of the environment, search for signs of ancient Martian life, and assess natural resources and hazards for future human explorers. Scientists will use the instruments aboard the rover to identify and collect samples of rock and soil, encase them in sealed tubes, and leave them on the planet’s surface for potential return to Earth on a future Mars mission.

Source: NASA

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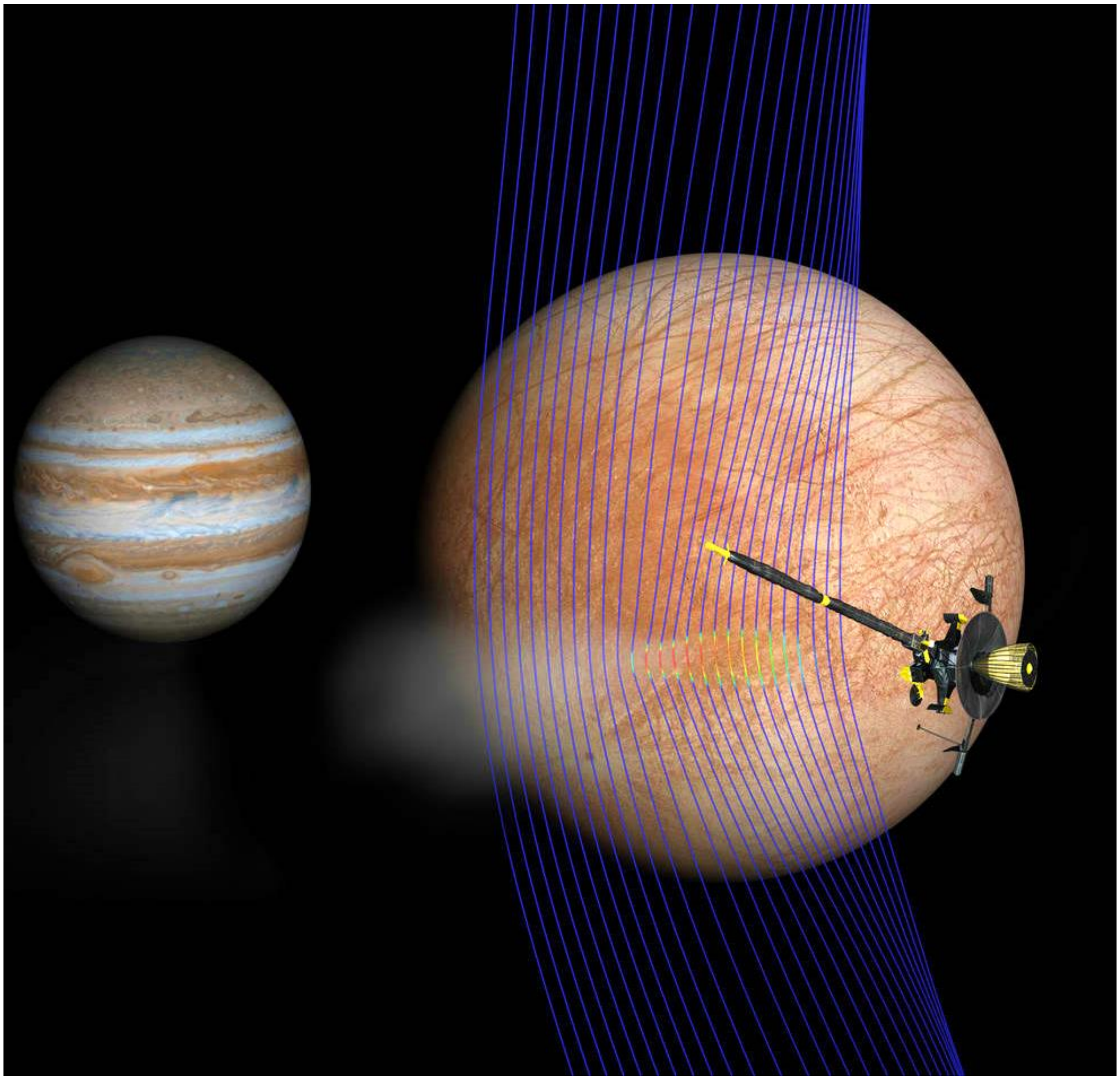
2. Old Data Reveal New Evidence of Europa Plumes



Artist's illustration of Jupiter and Europa (in the foreground) with the Galileo spacecraft after its pass through a plume erupting from Europa's surface. A new computer simulation gives us an idea of how the magnetic field interacted with a plume. The magnetic field lines (depicted in blue) show how the plume interacts with the ambient flow of Jovian plasma. The red colors on the lines show more dense areas of plasma. Credits: NASA/JPL-Caltech/Univ. of Michigan

Scientists re-examining data from an old mission bring new insights to the tantalizing question of whether Jupiter's moon Europa has the ingredients to support life. The data provide independent evidence that the moon's subsurface liquid water reservoir may be venting plumes of water vapor above its icy shell.

Data collected by NASA's Galileo spacecraft in 1997 were put through new and advanced computer models to untangle a mystery -- a brief, localized bend in the magnetic field -- that had gone unexplained until now. Previous ultraviolet images from NASA's Hubble Space Telescope in 2012 suggested the presence of plumes, but this new analysis used data collected much closer to the source and is considered strong, corroborating support for plumes. The findings appear in Monday's issue of the journal Nature Astronomy.

The research was led by Xianzhe Jia, a space physicist at the University of Michigan in Ann Arbor and lead author of the journal article. Jia also is co-investigator for two instruments that will travel aboard Europa

Clipper, NASA's upcoming mission to explore the moon's potential habitability. "The data were there, but we needed sophisticated modeling to make sense of the observation," Jia said.

Jia's team was inspired to dive back into the Galileo data by Melissa McGrath of the SETI Institute in Mountain View, California. A member of the Europa Clipper science team, McGrath delivered a presentation to fellow team scientists, highlighting other Hubble observations of Europa.

"One of the locations she mentioned rang a bell. Galileo actually did a flyby of that location, and it was the closest one we ever had. We realized we had to go back," Jia said. "We needed to see whether there was anything in the data that could tell us whether or not there was a plume."

At the time of the 1997 flyby, about 124 miles (200 kilometers) above Europa's surface, the Galileo team didn't suspect the spacecraft might be grazing a plume erupting from the icy moon. Now, Jia and his team believe, its path was fortuitous.

When they examined the information gathered during that flyby 21 years ago, sure enough, high-resolution magnetometer data showed something strange. Drawing on what scientists learned from exploring plumes on Saturn's moon Enceladus -- that material in plumes becomes ionized and leaves a characteristic blip in the magnetic field -- they knew what to look for. And there it was on Europa –- a brief, localized bend in the magnetic field that had never been explained.

Galileo carried a powerful Plasma Wave Spectrometer (PWS) to measure plasma waves caused by charged particles in gases around Europa's atmosphere. Jia's team pulled that data as well, and it also appeared to back the theory of a plume.

But numbers alone couldn't paint the whole picture. Jia layered the magnetometry and plasma wave signatures into new 3D modeling developed by his team at the University of Michigan, which simulated the interactions of plasma with solar system bodies. The final ingredient was the data from Hubble that suggested dimensions of potential plumes.

The result that emerged, with a simulated plume, was a match to the magnetic field and plasma signatures the team pulled from the Galileo data.

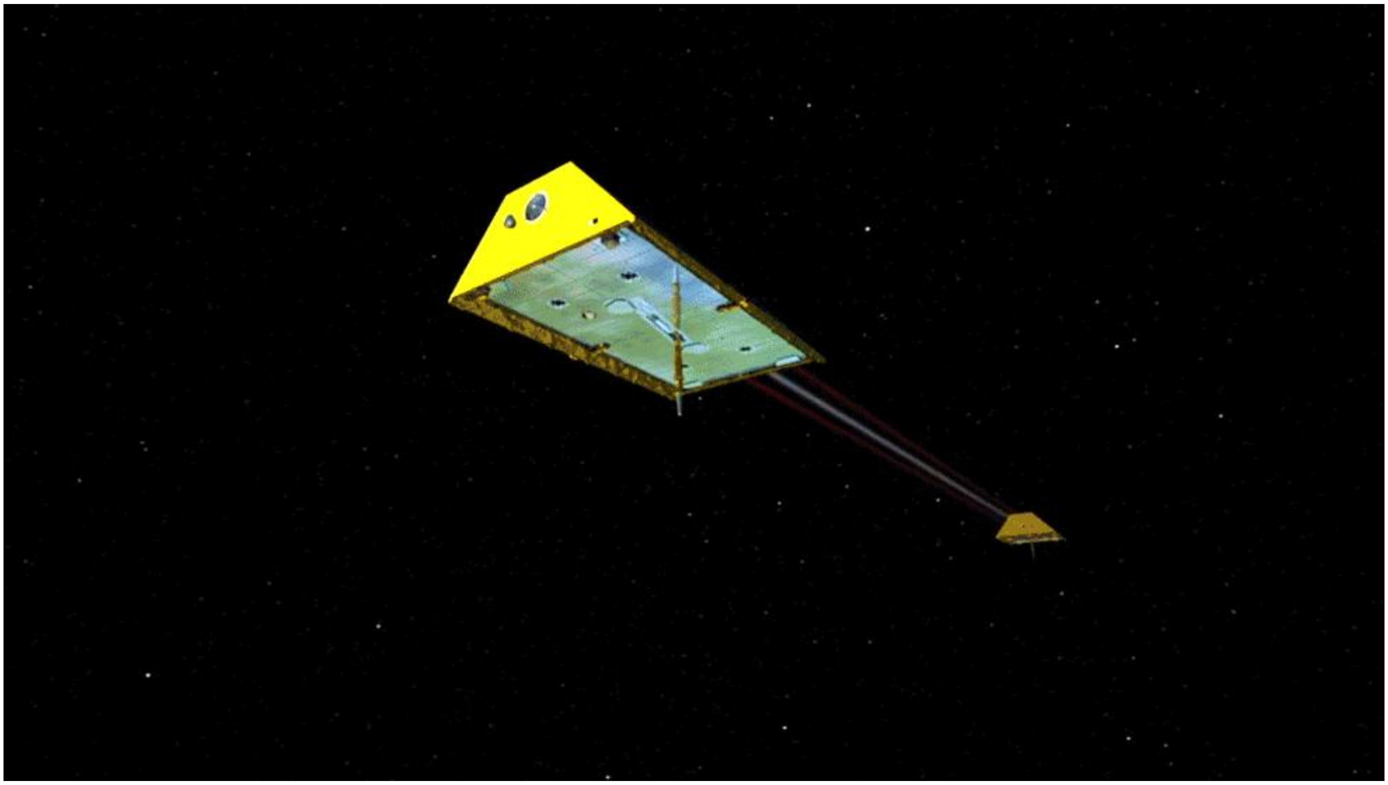
"There now seem to be too many lines of evidence to dismiss plumes at Europa," said Robert Pappalardo, Europa Clipper project scientist at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California. "This result makes the plumes seem to be much more real and, for me, is a tipping point. These are no longer uncertain blips on a faraway image."

The findings are good news for the Europa Clipper mission, which may launch as early as June 2022. From its orbit of Jupiter, Europa Clipper will sail close by the moon in rapid, low-altitude flybys. If plumes are indeed spewing vapor from Europa's ocean or subsurface lakes, Europa Clipper could sample the frozen liquid and dust particles. The mission team is gearing up now to look at potential orbital paths, and the new research will play into those discussions.

"If plumes exist, and we can directly sample what's coming from the interior of Europa, then we can more easily get at whether Europa has the ingredients for life," Pappalardo said. "That's what the mission is after. That's the big picture."

Source: NASA Return to Contents

3. Lasers in Space: Earth Mission Tests New Technology



GRACE-FO will demonstrate the effectiveness of using lasers instead of microwaves to more precisely measure fluctuations in the separation distance between the two spacecraft, potentially improving the precision of range fluctuation measurements by a factor of at least 10 on future GRACE-like missions. Credits: NASA/JPL-Caltech

Imagine standing on the roof of a building in Los Angeles and trying to point a laser so accurately that you could hit a particular building in San Diego, more than 100 miles (160 kilometers) away. This accuracy is required for the feat that a novel technology demonstration aboard the soon-to-launch Gravity Recovery and Climate Experiment Follow-On (GRACE-FO) mission will aim to achieve. For the first time, a promising technique called laser ranging interferometry will be tested between two satellites.

GRACE-FO, scheduled to launch no earlier than May 21st, carries on the rich legacy of the original GRACE mission, which launched in 2002 on a planned five-year mission and concluded operations in October 2017. Among its insights, GRACE transformed our understanding of the global water cycle by showing how masses of liquid water and ice are changing each month. The mission also added to our knowledge of large-scale changes in the solid Earth. GRACE-FO will provide continuity for GRACE's landmark measurements for at least another five years, further improving scientific understanding of Earth system processes and the accuracy of environmental monitoring and forecasts.

How Did GRACE Work? GRACE obtained its data on the movement of Earth's mass by precisely measuring slight changes in the distance between two spacecraft that flew one behind the other around Earth. When the satellites encountered a change in the distribution of Earth's mass -- such as a mountain range or mass of underground water -- Earth's gravitational pull on the spacecraft changed the distance between them. The Himalaya Mountains, for example, changed the separation distance by about three-hundredths of an inch (80 micrometers). By accurately calculating each month how the satellites' separation distance changed during each orbit and over time, it was possible to detect changes in Earth's mass distribution with high precision.

Measuring the change in the separation between the spacecraft was possible to a high degree of precision because each spacecraft was transmitting microwaves toward the other. The way the waves interacted with each other -- the way they interfered with each other -- created a microwave interferometer in space. This process essentially transformed the two spacecraft into a single instrument that could very precisely measure the distance change between them, which in turn can be related to changes in the mass distribution on Earth.

What's New About GRACE-FO? GRACE-FO works on these same principles. Each spacecraft again carries a microwave instrument to track changes in the separation distance. But GRACE-FO also carries something new: a technology demonstration of a laser ranging interferometer (LRI), jointly managed by NASA's Jet Propulsion Laboratory in Pasadena, California, and the Max Planck Institute for Gravitational Physics (Albert-Einstein Institut) in Hanover, Germany. In addition to transmitting microwaves between each other, the GRACE-FO satellites will shine lasers at each other.

Since the wavelengths in a laser beam are significantly shorter than microwave wavelengths, the laser ranging interferometer will improve the tracking precision of separation changes -- just as measuring in millimeters instead of centimeters would be more precise. GRACE-FO's interferometer will detect changes in distance more than 10 times smaller than what the microwave instrument detects -- changes on the order of 100 times narrower than a human hair.

"With GRACE-FO, we're taking something cutting-edge from the lab and making it ready for space flight," said Kirk McKenzie, the LRI instrument manager at JPL. "The reason we spend decades working in the lab is to see our technology enable a new type of measurement and result in scientific discoveries."

Each GRACE-FO satellite will be able to detect the laser signal of the other. But this is no easy feat. Each laser has the power of about four laser pointers and must be detected by a spacecraft an average of 137 miles (220 kilometers) away. Even the ultra- precise assembly of the satellites isn't enough to guarantee the laser transmitted from each spacecraft will be aligned well enough to hit the other spacecraft.

As a result, McKenzie explains, the first time the laser ranging interferometer is turned on, the components of the LRI on each spacecraft need to perform a scan to send out the instrument's signals and try to "catch" the other's signals in all possible configurations. The spacecraft have so many possible configurations, it takes nine hours. For one millisecond out of those nine hours, there will be a flash on both spacecraft to show that they're talking to each other. After this signal acquisition occurs once, the interferometer's optical link will be formed and then the instrument is designed to operate continuously and autonomously.

"We're trying something that is very hard -- the first-ever demonstration of laser interferometry in space between satellites," said Gerhard Heinzel, the instrument manager at the Max Planck Institute. "But it's very satisfying to puzzle over a problem and find something that works."

The difficulty of the task required tapping different areas of expertise. JPL oversaw the laser on the interferometer, measurement electronics and optical cavity. The Max Planck Institute was responsible for the optics, detectors, mirrors and beam splitters. The GRACE-FO laser ranging interferometer also took advantage of the two groups' 15-year-long history of collaborating on the technology behind the ESA/NASA Laser Interferometer in Space Antenna (LISA) mission, which will launch in the early 2030s.

Source: NASA

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The Night Sky

Tuesday, May 15

• For the rest of this spring and summer, Jupiter stays within less than 2° or 3° of 3rd-magnitude Alpha Librae (Zubenelgenubi): a fine, wide double star for binoculars. Its two components, magnitudes 2.8 and 5.1, are a generous 231 arcseconds apart. Nevertheless they form a real, gravitationally bound pair; they're both measured to be 77 light-years away.

• New Moon (exact at 7:48 a.m. Eastern Daylight Time).

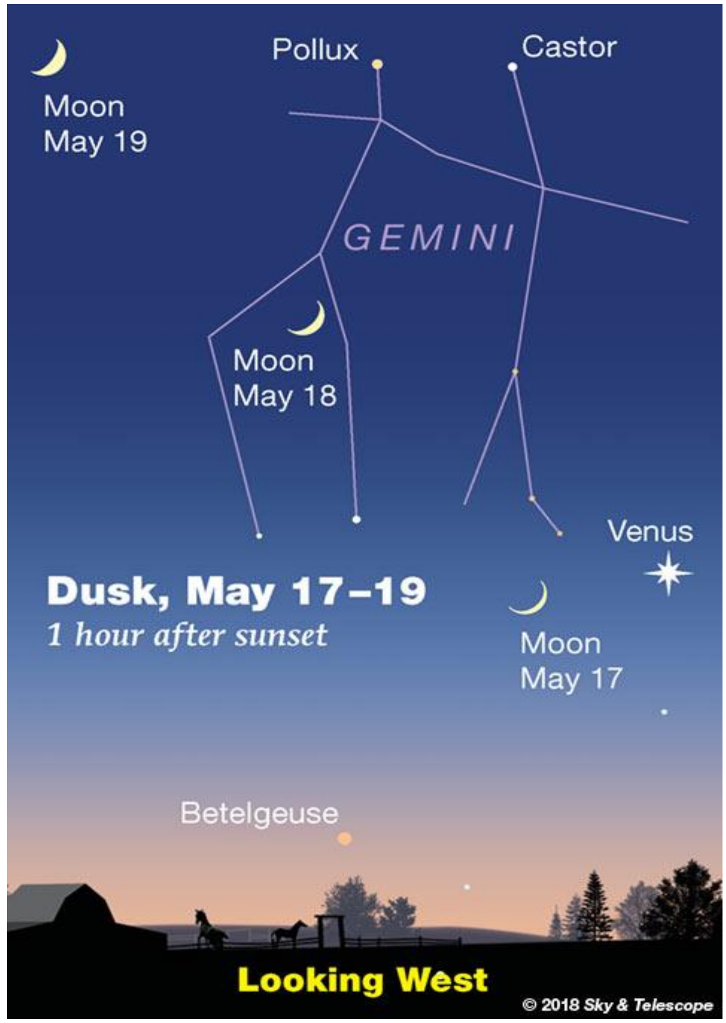
Wednesday, May 16

• Vega is the brightest star in the east-northeast after dark. Look 14° (about a fist and a half at arm's length) to Vega's upper left for Eltanin, the nose of Draco the Dragon. Closer above and upper left of Eltanin are the three fainter stars of Draco's stick-figure head, also called the Lozenge. Draco always points his nose to Vega. He seems curious about it.

Thursday, May 17

• Look for the thin waxing Moon left of Venus in twilight, as shown at lower right. They're about 6° apart at the times of twilight in the Americas.

And can you say a final goodbye to setting Betelgeuse? Binoculars help.



Watch the waxing crescent Moon climb past Venus through Gemini as it orbits eastward around Earth away from our line of sight to the Sun.

Friday, May 18

• A binocular challenge: *Just* as nightfall becomes complete, spot Venus still a little above the west-northwest horizon. Get it in binoculars or a low-power, wide-field scope. Look upper left of it by about 1.6°. Can you make out the dim glow of the star cluster M35? Have you *ever* seen an M object so near the horizon? It'll slide closer by Venus on Saturday and Sunday nights.

Source: Sky and Telescope

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ISS Sighting Opportunities (from Denver)

Date	Visible	Max Height	Appears	Disappears
Wed May 16, 3:16 AM	< 1 min	10°	10° above N	10° above N
Wed May 16, 4:51 AM	2 min	18°	10° above NNW	18° above NNE
Thu May 17, 2:23 AM	< 1 min	10°	10° above NNW	10° above N
Thu May 17, 3:59 AM	1 min	13°	10° above NNW	13° above N
Fri May 18, 1:31 AM	< 1 min	12°	12° above N	12° above N
Fri May 18, 3:07 AM	< 1 min	11°	10° above N	11° above N
Fri May 18, 4:43 AM	3 min	29°	10° above NW	29° above NNE

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

NASA-TV Highlights (all times Eastern Time Zone)

Tuesday, May 15

- 2 p.m. and 8 p.m.- Replay of the NASA Science Chat: Exploring Europa's Plumes (all channels)

Wednesday, May 16

- 6:30 a.m. - U.S. Spacewalk # 50 Coverage (Feustel and Arnold; spacewalk begins at 8:10 a.m. EDT, scheduled to last appx. 6 ½ hours) (all channels)

Thursday, May 17

- 9:30 a.m. - ISS Expedition 55 In-Flight Event with the USA Today Network and the "Off Track with Hinch and Rossi Podcast" with NASA Flight Engineers Drew Feustel and Scott Tingle (Starts at 9:35 a.m.) (all channels)

Friday, May 18

- 10 a.m., - ISS Expedition 55 In-Flight Educational Event with the Edwardsville Community Unity School District in Edwardsville, Illinois and Flight Engineers Drew Feustel and Ricky Arnold of NASA (Starts at 10:10 a.m.) (all channels)

Watch NASA TV online by going to the NASA website.

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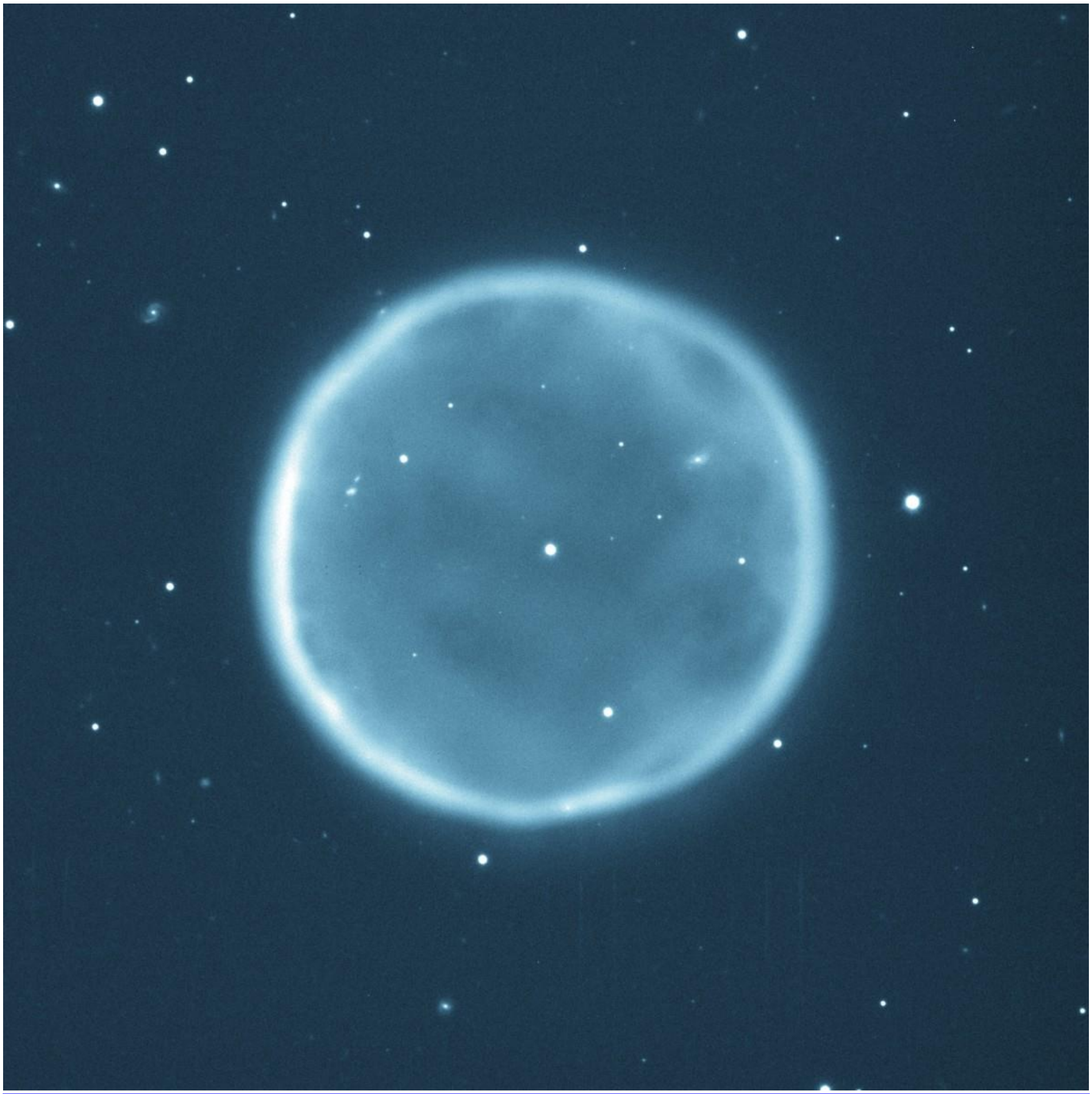
Space Calendar

- May 15 - Comet P/2012 O1 (McNaught) Closest Approach To Earth (2.111 AU)
- May 15 - Comet C/2013 C2 (Tenagra) Closest Approach To Earth (8.818 AU)
- **May 15 - Apollo Asteroid 2010 WC9 Near-Earth Flyby (0.001 AU)**
- May 15 - Amor Asteroid 2018 JX1 Near-Earth Flyby (0.024 AU)
- May 15 - Aten Asteroid 1999 LK1 Near-Earth Flyby (0.034 AU)
- May 15 - Apollo Asteroid 101955 Bennu Closest Approach To Earth (0.352 AU)
- May 15 - Asteroid 42998 Malinafrank Closest Approach To Earth (1.226 AU)
- May 15 - Asteroid 2045 Peking Closest Approach To Earth (1.255 AU)
- May 15 - Asteroid 4017 Disneya Closest Approach To Earth (1.665 AU)
- May 15 - Asteroid 90388 Philchristensen Closest Approach To Earth (1.719 AU)
- May 15 - Asteroid 203 Pompeja Closest Approach To Earth (1.888 AU)
- May 15 - Asteroid 5281 Lindstrom Closest Approach To Earth (2.322 AU)
- May 15-16 - 2nd COSPAR Workshop: Closing Planetary Protection Knowledge Gaps for Future Human Missions, Houston, Texas
- May 15-17 - ASTRO 2018 Biennial Conference, Quebec City, Canada
- May 15-18 - Workshop: Technology Requirements to Operate at and Utilize the Solar Gravity Lens for Exoplanet Imaging, Pasadena, California
- May 16 - Moon Occults Aldebaran
- May 16 - Comet C/2017 T1 (Heinze) Closest Approach To Earth (1.302 AU)
- May 16 - Comet 240P/NEAT Perihelion (2.134 AU)
- May 16 - Apollo Asteroid 2018 JX Near-Earth Flyby (0.010 AU)
- May 16 - Apollo Asteroid 2015 KJ19 Near-Earth Flyby (0.061 AU)
- May 16 - Apollo Asteroid 2012 WS3 Near-Earth Flyby (0.095 AU)
- May 16 - Atira Asteroid 2013 JX28 Closest Approach To Earth (0.870 AU)
- May 16 - Asteroid 5535 Annefrank Closest Approach To Earth (1.237 AU)
- May 16 - Teleconference: Exoplanet Science Strategy
- May 16 - Lecture: Magnifying Light by 100 Billion Times with the Solar Gravity Lens to Image an Exoplanet, Pasadena, California
- May 16-18 - Workshop: Advances in Space Mass Spectrometry for the Search of Extraterrestrial Signs of Life, Orleans, France
- May 16-18 - Summer School: Neutron Star Mergers for Non-experts - GW170817 in the Multi-Messenger Astronomy and FRIB Eras, East Lansing, Michigan
- May 17 - Comet 263P/Gibbs Closest Approach To Earth (1.658 AU)
- May 17 - Comet 331P/Gibbs Closest Approach To Earth (2.113 AU)
- May 17 - Amor Asteroid 2018 GL1 Near-Earth Flyby (0.036 AU)
- May 17 - Apollo Asteroid 2018 JC Near-Earth Flyby (0.046 AU)
- May 17 - Asteroid 70713 Sethmacfarlane Closest Approach To Earth (1.655 AU)
- May 17 - Asteroid 78453 Bullock Closest Approach To Earth (2.052 AU)
- May 17 - Asteroid 439 Ohio Closest Approach To Earth (2.329 AU)
- May 17 - Lecture: Juno and The New Jupiter - What Have We Learned So Far?, Pasadena, California
- May 17 - Lecture: Exoplanets - The Search for Life Beyond Our Solar System, Tucson, Arizona
- May 17 - Lecture: Orbital Access to Space from the UK?, London, United Kingdom

Source: JPL Space Calendar Return to Contents

Food for Thought

What Will Happen When Our Sun Dies?



This is an example of a planetary nebula. This one is called Abell 39. The nebula has a diameter of about five light-years, and the thickness of the spherical shell is about a third of a light-year. The nebula itself is roughly 7,000 light-years from Earth in the constellation Hercules. Credit: National Optical Astronomy Observatory

Scientists agree the sun will die in approximately five billion years, but they weren't sure what would happen next…until now.

A team of international astronomers, including Professor Albert Zijlstra from the School of Physics & Astronomy, predict it will turn into a massive ring of luminous, interstellar gas and dust, known as a planetary nebula.

A planetary nebula marks the end of 90% of all stars active lives and traces the star's transition from a red giant to a degenerate white dwarf. But, for years, scientists weren't sure if the sun in our galaxy would follow the same fate: it was thought to have too low mass to create a visible planetary nebula.

To find out the team developed a new stellar, data-model that predicts the lifecycle of stars. The model was used to predict the brightness (or luminosity) of the ejected envelope, for stars of different masses and ages. The research is being published in *Nature Astronomy*.

Prof Zijlstra explains: "When a star dies it ejects a mass of gas and dust – known as its envelope – into space. The envelope can be as much as half the star's mass. This reveals the star's core, which by this point in the star's life is running out of fuel, eventually turning off and before finally dying.

"It is only then the hot core makes the ejected envelope shine brightly for around 10,000 years – a brief period in astronomy. This is what makes the planetary nebula visible. Some are so bright that they can be seen from extremely large distances measuring tens of millions of light years, where the star itself would have been much too faint to see."

The model also solves another problem that has been perplexing astronomers for a quarter of a century.

Approximately 25 years ago astronomers discovered that if you look at planetary nebulae in another galaxy, the brightest ones always have the same brightness. It was found that it was possible to see how far away a galaxy was just from the appearance of its brightest planetary nebulae. In theory it worked in any of type galaxy.

But whilst the data suggested this was correct, the scientific models claimed otherwise. Prof Zijlstra adds: "Old, low mass stars should make much fainter planetary nebulae than young, more massive stars. This has become a source of conflict for the past for 25 years.

"The data said you could get bright planetary nebulae from low mass stars like the sun, the models said that was not possible, anything less than about twice the mass of the sun would give a planetary nebula too faint to see."

The new models show that after the ejection of the envelope, the stars heat up three times faster than found in older models. This makes it much easier for a low mass star, such as the sun, to form a bright planetary nebula. The team found that in the new models, the sun is almost exactly the lowest mass star that still produces a visible, though faint, planetary nebula. Stars even a few per cent smaller do not.

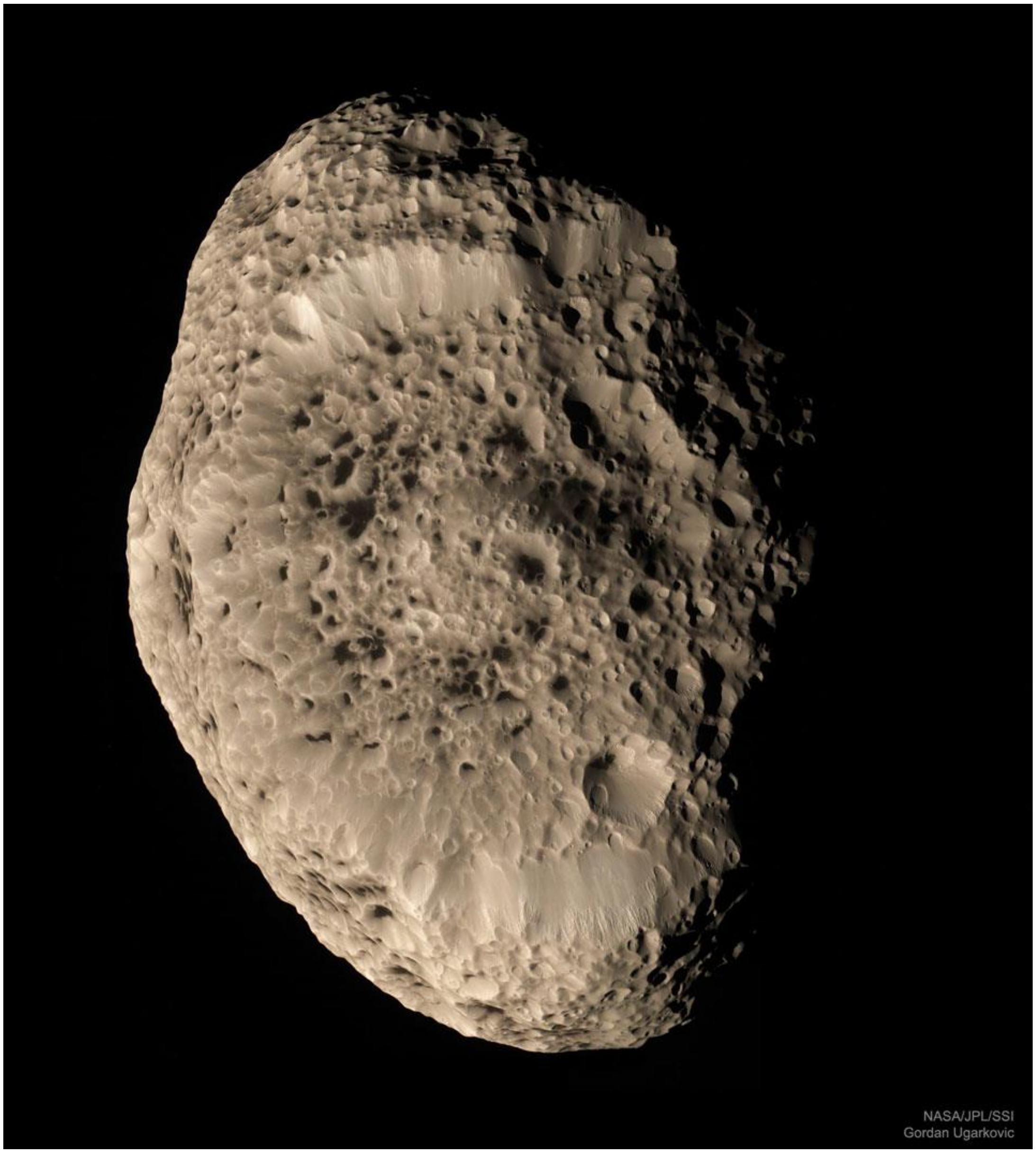
Professor Zijlstra added: "We found that stars with mass less than 1.1 times the mass of the sun produce fainter nebula, and stars more massive than 3 solar masses brighter nebulae, but for the rest the predicted brightness is very close to what had been observed. Problem solved, after 25 years!

"This is a nice result. Not only do we now have a way to measure the presence of stars of ages a few billion years in distant galaxies, which is a range that is remarkably difficult to measure, we even have found out what the sun will do when it dies!"

Reference: *The paper "The mysterious age invariance of the cut-off the Planetary Nebula Luminosity Function" has been scheduled for Advance Online Publication (AOP) on Nature Astronomy - K. Gesicki , A. A. Zijlstra, and 3 M. M. Miller Bertolami DOI will be DOI:10.1038/S41550-018-0453-9.*

Source: University of Manchester/EurekAlert Return to Contents

Space Image of the Week



Saturn's Hyperion in Natural Color
Image Credit & License: NASA/JPL/SSI; Composition: Gordan Ugarkovic

Explanation: What lies at the bottom of Hyperion's strange craters? To help find out, the robot Cassini spacecraft orbited past the sponge-textured moon in 2005 and 2010 and took images of unprecedented detail. A six-image mosaic from the 2005 pass, featured here in natural color, shows a remarkable world strewn with strange craters and an odd sponge-like surface.

At the bottom of most craters lies some type of unknown dark reddish material. This material appears similar to that covering part of another of Saturn's moons, Iapetus, and might sink into the ice moon as it better absorbs warming sunlight. Hyperion is about 250 kilometers across, rotates chaotically, and has a density so low that it likely houses a vast system of caverns inside.

Source: NASA APOD Return to Contents