Space News Update

— February 1, 2019 —

Contents

In the News

Story 1:

Mars Rover Curiosity Makes First Gravity-Measuring Traverse on the Red Planet

Story 2:

NASA's NICER Mission Maps 'Light Echoes' of New Black Hole

Story 3:

Huge Cavity in Antarctic Glacier Signals Rapid Decay

Departments

The Night Sky

ISS Sighting Opportunities

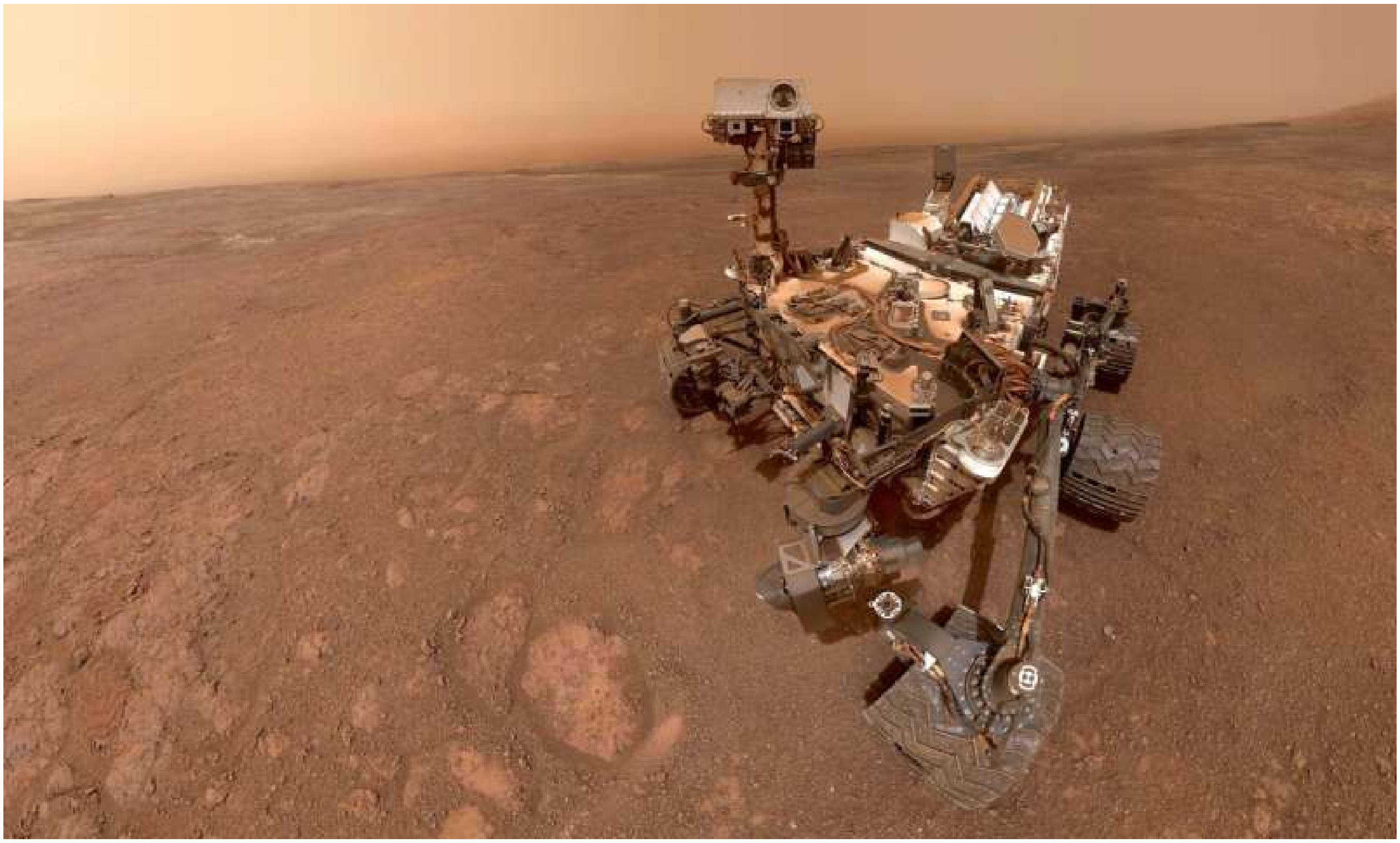
Space Calendar

NASA-TV Highlights

Food for Thought

Space Image of the Week

1. Mars Rover Curiosity Makes First Gravity-Measuring Traverse on the Red Planet



A clever use of non-science engineering data from NASA's Mars rover Curiosity has let a team of researchers, including an Arizona State University graduate student, measure the density of rock layers in 96-mile-wide Gale Crater.

The findings, to be published February 1, 2019, in the journal *Science*, show that the layers are more porous than scientists had suspected. The discovery also gives scientists a novel technique to use in the future as the rover continues its trek across the crater and up Mount Sharp, a three-mile-high mountain in its center.

"What we were able to do is measure the bulk density of the material in Gale Crater," says Travis Gabriel, a graduate student in ASU's School of Earth and Space Exploration. He worked on computing what the grain density should be for the rocks and ancient lakebed sediments the rover has been driving over.

"Working from the rocks' mineral abundances as determined by the Chemistry and Mineralogy instrument, we estimated a grain density of 2810 kilograms per cubic meter," he says. "However the bulk density that came out of our study is a lot less—1680 kilograms per cubic meter."

The much lower figure shows that the rocks have a reduced density most likely resulting from the rocks being more porous. This means the rocks have been compressed less than scientists have thought.

Like a Smartphone, but better

The engineering sensors used in the study were accelerometers and gyroscopes, much like those found in every smartphone. In a phone, these determine its orientation and motion. Curiosity's sensors do the same, but with much greater precision, helping engineers and mission controllers navigate the rover across the Martian surface.

But while the rover is standing still, the accelerometers also measure the local force of gravity at that spot on Mars.

The team took the engineering data from the first five years of the mission—Curiosity landed in 2012—and used it to measure the gravitational tug of Mars at more than 700 points along the rover's track. As Curiosity has been ascending Mount Sharp, the mountain began to tug on it, as well—but not as much as scientists expected.

"The lower levels of Mount Sharp are surprisingly porous," says lead author Kevin Lewis of Johns Hopkins University. "We know the bottom layers of the mountain were buried over time. That compacts them, making them denser. But this finding suggests they weren't buried by as much material as we thought."

Making Mount Sharp

Planetary scientists have long debated the origin of Mount Sharp. Mars craters the size of Gale have central peaks raised by the shock of the impact that made the crater. This would account for part of the mound's height. But the upper layers of the mound appear to be made of wind-scoured sediments more easily eroded than rock.

Did these sediments once fill the entire bowl of Gale Crater? If so, they might have weighed heavily on the materials at the base, compacting them.

But the new findings suggest Mount Sharp's lower layers have been compacted by only a half-mile to a mile (1 to 2 kilometers) of material—much less than if the crater had been completely filled.

"There are still many questions about how Mount Sharp developed, but this paper adds an important piece to the puzzle," said Ashwin Vasavada, Curiosity's project scientist at NASA's Jet Propulsion Laboratory in Pasadena, California, which manages the mission. "I'm thrilled that creative scientists and engineers are still finding innovative ways to make new scientific discoveries with the rover."

Gabriel adds, "This is a testament to the utility of having a diverse set of techniques with the Curiosity rover, and we're excited to see what the upper layers of Mount Sharp have in store."

Explore further: Image: Mount Sharp 'photobombs' Mars Curiosity rover

More information: K.W. Lewis at Johns Hopkins University in Baltimore, MD el al., "A surface gravity traverse on Mars indicates low bedrock density at Gale crater," *Science* (2019). science.sciencemag.org/lookup/ … 1126/science.aat0738

Journal reference: Science

Source: Phys.org Return to Contents

2. NASA's NICER Mission Maps 'Light Echoes' of New Black Hole

Scientists have charted the environment surrounding a stellar-mass black hole that is 10 times the mass of the Sun using NASA's Neutron star Interior Composition Explorer (NICER) payload aboard the International Space Station. NICER detected X-ray light from the recently discovered black hole, called MAXI J1820+070 (J1820 for short), as it consumed material from a companion star. Waves of X-rays formed "light echoes" that reflected off the swirling gas near the black hole and revealed changes in the environment's size and shape.

"NICER has allowed us to measure light echoes closer to a stellar-mass black hole than ever before," said Erin Kara, an astrophysicist at the University of Maryland, College Park and NASA's Goddard Space Flight Center in Greenbelt, Maryland, who presented the findings at the 233rd American Astronomical Society meeting in Seattle. "Previously, these light echoes off the inner accretion disk were only seen in supermassive black holes, which are millions to billions of solar masses and undergo changes slowly. Stellar black holes like J1820 have much lower masses and evolve much faster, so we can see changes play out on human time scales."

A paper describing the findings, led by Kara, appeared in the Jan. 10 issue of Nature and is available online.

J1820 is located about 10,000 light-years away toward the constellation Leo. The companion star in the system was identified in a survey by ESA's (European Space Agency) Gaia mission, which allowed researchers to estimate its distance. Astronomers were unaware of the black hole's presence until March 11, 2018, when an outburst was spotted by the Japan Aerospace Exploration Agency's Monitor of All-sky X-ray Image (MAXI), also aboard the space station. J1820 went from a totally unknown black hole to one of the brightest sources in the X-ray sky over a few days. NICER moved quickly to capture this dramatic transition and continues to follow the fading tail of the eruption.

"NICER was designed to be sensitive enough to study faint, incredibly dense objects called neutron stars," said Zaven Arzoumanian, the NICER science lead at Goddard and a co-author of the paper. "We're pleased at how useful it's also proven in studying these very X-ray-bright stellar-mass black holes."

A black hole can siphon gas from a nearby companion star into a ring of material called an accretion disk. Gravitational and magnetic forces heat the disk to millions of degrees, making it hot enough to produce X-rays at the inner parts of the disk, near the black hole. Outbursts occur when an instability in the disk causes a flood of gas to move inward, toward the black hole, like an avalanche. The causes of disk instabilities are poorly understood.

Above the disk is the corona, a region of subatomic particles around 1 billion degrees Celsius (1.8 billion degrees Fahrenheit) that glows in higher-energy X-rays. Many mysteries remain about the origin and evolution of the corona. Some theories suggest the structure could represent an early form of the high-speed particle jets these types of systems often emit.

Astrophysicists want to better understand how the inner edge of the accretion disk and the corona above it change in size and shape as a black hole accretes material from its companion star. If they can understand how and why these changes occur in stellar-mass black holes over a period of weeks, scientists could shed light on how supermassive black holes evolve over millions of years and how they affect the galaxies in which they reside.

One method used to chart those changes is called X-ray reverberation mapping, which uses X-ray reflections in much the same way sonar uses sound waves to map undersea terrain. Some X-rays from the corona travel straight toward us, while others light up the disk and reflect back at different energies and angles.

X-ray reverberation mapping of supermassive black holes has shown that the inner edge of the accretion disk is very close to the event horizon, the point of no return. The corona is also compact, lying closer to the black hole rather than over much of the accretion disk. Previous observations of X-ray echoes from stellar black holes, however, suggested the inner edge of the accretion disk could be quite distant, up to hundreds of times the size of the event horizon. The stellar-mass J1820, however, behaved more like its supermassive cousins.

As they examined NICER's observations of J1820, Kara's team saw a decrease in the delay, or lag time, between the initial flare of X-rays coming directly from the corona and the flare's echo off the disk, indicating that the X-rays traveled shorter and shorter distances before they were reflected. From 10,000 light-years away, they estimated that the corona contracted vertically from roughly 100 to 10 miles — that's like seeing something the size of a blueberry shrink to something the size of a poppy seed at the distance of Pluto.

"This is the first time that we've seen this kind of evidence that it's the corona shrinking during this particular phase of outburst evolution," said co-author Jack Steiner, an astrophysicist at the Massachusetts Institute of Technology's Kavli Institute for Astrophysics and Space Research in Cambridge. "The corona is still pretty mysterious, and we still have a loose understanding of what it is. But we now have evidence that the thing that's evolving in the system is the structure of the corona itself."

To confirm the decreased lag time was due to a change in the corona and not the disk, the researchers used a signal called the iron K line created when X-rays from the corona collide with iron atoms in the disk, causing them to fluoresce. Time runs slower in stronger gravitational fields and at higher velocities, as stated in Einstein's theory of relativity. When the iron atoms closest to the black hole are bombarded by light from the core of the corona, the X-ray wavelengths they emit get stretched because time is moving slower for them than for the observer (in this case, NICER).

Kara's team discovered that J1820's stretched iron K line remained constant, which means the inner edge of the disk remained close to the black hole — similar to a supermassive black hole. If the decreased lag time was caused by the inner edge of the disk moving even further inward, then the iron K line would have stretched even more.

These observations give scientists new insights into how material funnels in to the black hole and how energy is released in this process.

“NICER’s observations of J1820 have taught us something new about stellar-mass black holes and about how we might use them as analogs for studying supermassive black holes and their effects on galaxy formation,” said co-author Philip Uttley, an astrophysicist at the University of Amsterdam. “We’ve seen four similar events in NICER’s first year, and it’s remarkable. It feels like we’re on the edge of a huge breakthrough in X-ray astronomy.”

NICER is an Astrophysics Mission of Opportunity within NASA's Explorer program, which provides frequent flight opportunities for world-class scientific investigations from space utilizing innovative, streamlined and efficient management approaches within the heliophysics and astrophysics science areas. NASA's Space Technology Mission Directorate supports the SEXTANT component of the mission, demonstrating pulsar-based spacecraft navigation.

Source: NASA Return to Contents

3. Huge Cavity in Antarctic Glacier Signals Rapid Decay

A gigantic cavity — two-thirds the area of Manhattan and almost 1,000 feet (300 meters) tall — growing at the bottom of Thwaites Glacier in West Antarctica is one of several disturbing discoveries reported in a new NASA-led study of the disintegrating glacier. The findings highlight the need for detailed observations of Antarctic glaciers' undersides in calculating how fast global sea levels will rise in response to climate change.

Researchers expected to find some gaps between ice and bedrock at Thwaites' bottom where ocean water could flow in and melt the glacier from below. The size and explosive growth rate of the newfound hole, however, surprised them. It's big enough to have contained 14 billion tons of ice, and most of that ice melted over the last three years.

"We have suspected for years that Thwaites was not tightly attached to the bedrock beneath it," said Eric Rignot of the University of California, Irvine, and NASA's Jet Propulsion Laboratory in Pasadena, California. Rignot is a co-author of the new study, which was published today in Science Advances. "Thanks to a new generation of satellites, we can finally see the detail," he said.

The cavity was revealed by ice-penetrating radar in NASA's Operation IceBridge, an airborne campaign beginning in 2010 that studies connections between the polar regions and the global climate. The researchers also used data from a constellation of Italian and German spaceborne synthetic aperture radars. These very high-resolution data can be processed by a technique called radar interferometry to reveal how the ground surface below has moved between images.

"[The size of] a cavity under a glacier plays an important role in melting," said the study's lead author, Pietro Milillo of JPL. "As more heat and water get under the glacier, it melts faster."

Numerical models of ice sheets use a fixed shape to represent a cavity under the ice, rather than allowing the cavity to change and grow. The new discovery implies that this limitation most likely causes those models to underestimate how fast Thwaites is losing ice.

About the size of Florida, Thwaites Glacier is currently responsible for approximately 4 percent of global sea level rise. It holds enough ice to raise the world ocean a little over 2 feet (65 centimeters) and backstops neighboring glaciers that would raise sea levels an additional 8 feet (2.4 meters) if all the ice were lost.

Thwaites is one of the hardest places to reach on Earth, but it is about to become better known than ever before. The U.S. National Science Foundation and British National Environmental Research Council are mounting a five-year field project to answer the most critical questions about its processes and features. The International Thwaites Glacier Collaboration will begin its field experiments in the Southern Hemisphere summer of 2019-20.

How Scientists Measure Ice Loss

There's no way to monitor Antarctic glaciers from ground level over the long term. Instead, scientists use satellite or airborne instrument data to observe features that change as a glacier melts, such as its flow speed and surface height.

Another changing feature is a glacier's grounding line — the place near the edge of the continent where it lifts off its bed and starts to float on seawater. Many Antarctic glaciers extend for miles beyond their grounding lines, floating out over the open ocean.

Just as a grounded boat can float again when the weight of its cargo is removed, a glacier that loses ice weight can float over land where it used to stick. When this happens, the grounding line retreats inland. That exposes more of a glacier's underside to sea water, increasing the likelihood its melt rate will accelerate.

An Irregular Retreat

For Thwaites, "We are discovering different mechanisms of retreat," Millilo said. Different processes at various parts of the 100-mile-long (160-kilometer-long) front of the glacier are putting the rates of grounding-line retreat and of ice loss out of sync.

The huge cavity is under the main trunk of the glacier on its western side — the side farther from the West Antarctic Peninsula. In this region, as the tide rises and falls, the grounding line retreats and advances across a zone of about 2 to 3 miles (3 to 5 kilometers). The glacier has been coming unstuck from a ridge in the bedrock at a steady rate of about 0.4 to 0.5 miles (0.6 to 0.8 kilometers) a year since 1992. Despite this stable rate of grounding-line retreat, the melt rate on this side of the glacier is extremely high.

"On the eastern side of the glacier, the grounding-line retreat proceeds through small channels, maybe a kilometer wide, like fingers reaching beneath the glacier to melt it from below," Milillo said. In that region, the rate of grounding-line retreat doubled from about 0.4 miles (0.6 kilometers) a year from 1992 to 2011 to 0.8 miles (1.2 kilometers) a year from 2011 to 2017. Even with this accelerating retreat, however, melt rates on this side of the glacier are lower than on the western side.

These results highlight that ice-ocean interactions are more complex than previously understood.

Milillo hopes the new results will be useful for the International Thwaites Glacier Collaboration researchers as they prepare for their fieldwork. "Such data is essential for field parties to focus on areas where the action is, because the grounding line is retreating rapidly with complex spatial patterns," he said.

"Understanding the details of how the ocean melts away this glacier is essential to project its impact on sea level rise in the coming decades," Rignot said.

The paper by Milillo and his co-authors in the journal Science Advances is titled "Heterogeneous retreat and ice melt of Thwaites Glacier, West Antarctica." Co-authors were from the University of California, Irvine; the German Aerospace Center in Munich, Germany; and the University Grenoble Alpes in Grenoble, France.

Source: NASA

Return to Contents

The Night Sky

Friday, February 1

• As soon as it's fully dark, spot the Winter Triangle, bright and equilateral, in the southeast. Sirius is its brightest and lowest star. Betelgeuse, Orion's shoulder, stands above Sirius by about two fists at arm's length. Left of their midpoint is Procyon.

And, glimmering 4° above Procyon is 3rd-magnitude Gomeisa, Beta Canis Minoris, the only other easy naked-eye star of Canis Minor.

Saturday, February 2

• The sky's biggest asterism — at least the biggest that's widely recognized — is the Winter Hexagon. It fills the sky toward the east and south these evenings.

Start with brilliant Sirius at its bottom. Going clockwise from there, march up through Procyon, Pollux and Castor, Menkalinan and Capella on high, down to Aldebaran, then to Rigel in Orion's foot, and back to Sirius.

Betelgeuse shines inside the Hexagon, off center.

Sunday, February 3

• New Moon (exact at 4:04 p.m. EST).

• In this dark-of-the-Moon time, use binoculars to get acquainted with the double stars and asterisms in and around the familiar Hyades.

A few degrees north of Aldebaran and the main Hyades V pattern (mapped at right) are two asterisms I call the Jumping Minnow and Dragonfly, imagining warm summer afternoons by a riverbank far from these icy winter nights. But Matt Wedel has a different take on them in his Binocular Highlight column in the February *Sky & Telescope*, page 43.

The Hyades V, like the Minnow and Dragonfly, has noteworthy star pairs for your binocs that help define its unique look. Click over to Bob King's Happy Nights with the Hyades for details and more maps.

• Algol is at minimum brightness for a couple hours centered on 11:55 p.m. EST (8:55 p.m. PST). It takes several additional hours to fade and to rebrighten.

Monday, February 4

• Have you ever closely compared the colors of Aldebaran and Betelgeuse? Can you detect any difference in their colors at all? I can't, really. Yet Aldebaran, spectral type *K* III, is often called an "orange" giant, while

Betelgeuse, spectral type *M*1-*M*2 Ia, is usually called a "red" supergiant. Their temperatures are indeed a bit different: 3,910 kelvin and 3,590 kelvin, respectively.

A complication: Betelgeuse is brighter, and to the human eye, the colors of brighter objects appear, falsely, to be *desaturated:* tending paler (whiter) than they really are.

Mars, off in the southwest, looks to me slightly redder than either of them.

Source: Sky & Telescope Return to Contents

ISS Sighting Opportunities

For Denver:

Date	Visible	Max Height	Appears	Disappears
Fri Feb 1, 6:44 PM	1 min	11°	10° above NNW	11° above N
Sat Feb 2, 5:53 PM	1 min	10°	10° above N	10° above NNE
Sat Feb 2, 7:28 PM	< 1 min	11°	11° above NNW	11° above NNW
Sun Feb 3, 6:37 PM	2 min	15°	11° above NNW	15° above NNE
Mon Feb 4, 5:46 PM	3 min	12°	10° above N	10° above NE
Mon Feb 4, 7:22 PM	1 min	17°	10° above NW	17° above NNW

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

NASA-TV Highlights

(all times Eastern Daylight Time)

Tuesday, February 5

1:35 p.m., ISS Expedition 58 In-Flight Educational Event with the William Brooks Elementary and Buckeye Elementary Schools in El Dorado Hills, California and NASA Flight Engineer Anne McClain (all channels)

Thursday, February 7

11:35 a.m., ISS Expedition 58 In-Flight Event for the Canadian Space Agency with CSA Flight Engineer David Saint-Jacques (NTV- 1 with interpretation, NTV-3 in native language) (all channels)

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

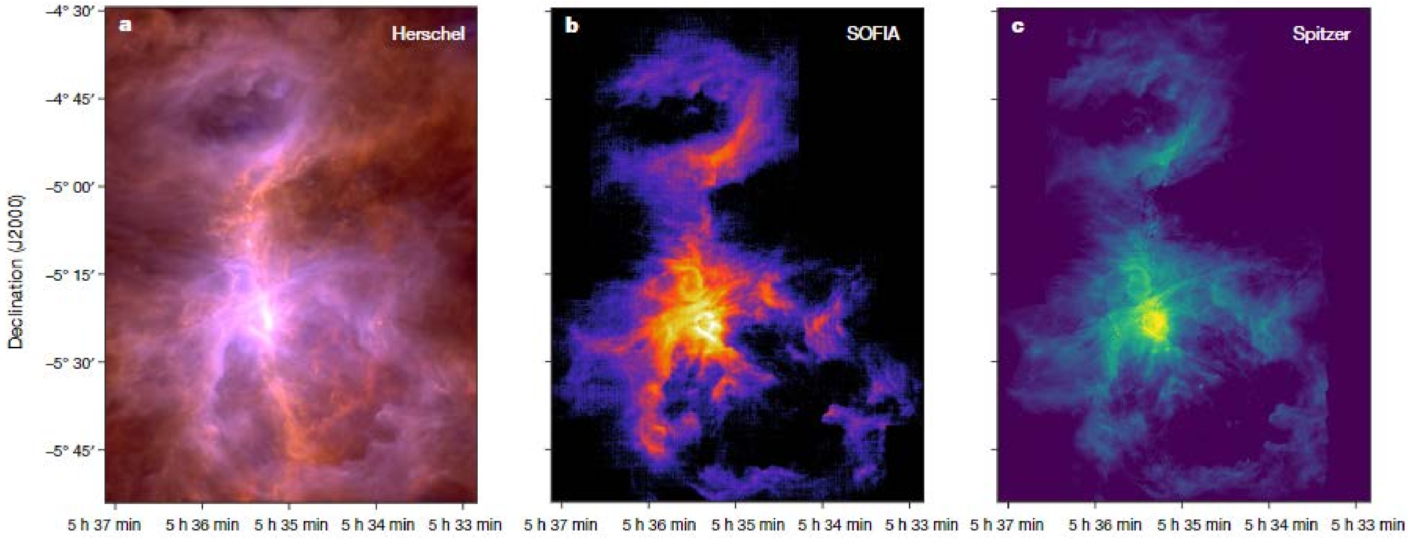
Return to Contents

Space Calendar

- Feb 01 - Comet 164P/Christensen Closest Approach To Earth (1.850 AU)
- Feb 01 - Comet 240P/NEAT Closest Approach To Earth (2.033 AU)
- Feb 01 - NEW [Jan 29] Apollo Asteroid 2019 BD3 Near-Earth Flyby (0.031 AU)
- Feb 01 - Apollo Asteroid 2019 AV2 Near-Earth Flyby (0.045 AU)
- Feb 01 - NEW [Jan 30] Amor Asteroid 2019 BX3 Near-Earth Flyby (0.045 AU)
- Feb 01 - Asteroid 7958 Leakey Closest Approach To Earth (1.109 AU)
- Feb 01 - Asteroid 207563 Toscana Closest Approach To Earth (2.082 AU)
- Feb 01 - Amor Asteroid 5370 Taranis Closest Approach To Earth (3.918 AU)
- Feb 01 - Centaur Object 32532 Thereus At Opposition (11.652 AU)
- Feb 01 - 20th Anniversary (1999), Galileo, Europa 19 Flyby
- Feb 02 - Moon Occults Saturn
- Feb 02 - Moon Occults Dwarf Planet Pluto
- Feb 02 - Moon Occults Asteroid 16 Psyche
- Feb 02 - Comet P/2019 A6 (Lemmon-PANSTARRS) At Opposition (1.557 AU)
- Feb 02 - Comet P/2016 G1 (PANSTARRS) Closest Approach To Earth (2.164 AU)
- Feb 02 - Comet P/2016 G1 (PANSTARRS) At Opposition (2.164 AU)
- Feb 02 - Comet P/2003 F2 (NEAT) At Opposition (2.615 AU)
- Feb 02 - Comet C/2017 B3 (LINEAR) Perihelion (3.924 AU)
- Feb 02 - Comet 208P/McMillan At Opposition (4.049 AU)
- Feb 02 - Asteroid 433 Eros Occults UCAC4 569-15669 (11.0 Magnitude Star)
- Feb 02 - NEW [Jan 30] Apollo Asteroid 2019 BR3 Near-Earth Flyby (0.004 AU)
- Feb 02 - NEW [Jan 28] Apollo Asteroid 2019 BW1 Near-Earth Flyby (0.033 AU)
- Feb 02 - Asteroid 37582 Faraday Closest Approach To Earth (1.548 AU)
- Feb 02 - Asteroid 19383 Rolling Stones Closest Approach To Earth (1.657 AU)
- Feb 02 - Asteroid 12490 Leiden Closest Approach To Earth (2.138 AU)
- Feb 03 - Comet P/2019 A1 (PANSTARRS) Closest Approach To Earth (1.463 AU)
- Feb 03 - Comet 54P/de Vico-Swift-NEAT At Opposition (3.380 AU)
- Feb 03 - NEW [Jan 26] Apollo Asteroid 2019 BH1 Near-Earth Flyby (0.028 AU)
- Feb 03 - NEW [Jan 29] Apollo Asteroid 2019 BE3 Near-Earth Flyby (0.043 AU)
- Feb 03 - Aten Asteroid 99942 Apophis Closest Approach To Earth (1.084 AU)
- Feb 03 - Asteroid 3763 Quianxuesen Closest Approach To Earth (1.155 AU)
- Feb 03 - Asteroid 3430 Bradfield Closest Approach To Earth (2.045 AU)
- Feb 03 - 25th Anniversary (1994), Maiden Flight of the H-2 Launch Vehicle (Japan)
- Feb 03 - 25th Anniversary (1994), STS-60 Launch (Space Shuttle Discovery, SPACEHAB)
- Feb 03 - 35th Anniversary (1984), STS-41-B Launch (Space Shuttle Challenger)
- Feb 03 - Jan Schilt's 125th Birthday (1894)
- Feb 04 - Comet P/2017 TW13 (Lemmon) Closest Approach To Earth (2.116 AU)
- Feb 04 - Comet 57P/du Toit-Neujmin-Delporte At Opposition (4.097 AU)
- Feb 04 - Comet 57P-A/du Toit-Neujmin-Delporte At Opposition (4.097 AU)
- Feb 04 - Asteroid 433 Eros Occults UCAC4 559-14990 (11.3 Magnitude Star)
- Feb 04 - NEW [Jan 29] Apollo Asteroid 2019 BH3 Near-Earth Flyby (0.036 AU)
- Feb 04 - Asteroid 6135 Billowen Closest Approach To Earth (1.319 AU)
- Feb 04 - Asteroid 17627 Humptydumpty Closest Approach To Earth (1.822 AU)
- Feb 04 - Asteroid 4511 Rembrandt Closest Approach To Earth (2.077 AU)
- Feb 04 - Thomas Earnshaw's 270th Birthday (1749)

Food for Thought

Newborn Stars in the Orion Nebula Prevent Other Stars from Forming



The Orion Nebula is one of the most observed and photographed objects in the night sky. At a distance of 1350 light years away, it's the closest active star-forming region to Earth.

This diffuse nebula is also known as M42, and has been studied intensely by astronomers for many years. From it, astronomers have learned a lot about star formation, planetary system formation, and other bedrock topics in astronomy and astrophysics. Now a new discovery has been made which goes against the grain of established theory: stellar winds from newly-formed massive stars may prevent other stars from forming in their vicinity. They also play a much larger role in star formation, and in galaxy evolution, than previously thought.

The Orion Nebula is pretty easy to see. If you can see the Orion constellation, then you're looking at the nebula without really trying. Depending on where you live, you can use binoculars or a small telescope to see it. Through a telescope, it looks like a grey, wispy, cloud.

But more powerful instruments reveal all the complexity inside the nebula. It's a great example of a stellar nursery, a place where young stars are born in a cloud of gas called a molecular cloud. Around these young stars are young protoplanetary disks, places where planets like ours may be forming right now.

As these young stars are born, and burst into fusion, they expel a stellar wind. This new study shows that this stellar wind plays a larger role than previously thought.

The study is published in the journal Nature, and is led by Cornelia Pabst, a Ph.D. student at the University of Leiden in the Netherlands and the lead author on the paper. In the paper, the authors describe how newly-formed stars inhibit the formation of other stars in a process called "stellar feedback."

Current thinking says that supernovae can dominate the star-forming process. Massive supernova explosions send powerful shock waves through molecular clouds, and this creates dense concentrations of gas which then go on to form stars. While that remains true, it looks like stellar feedback from new stars may shape the process, too.

The research is based on the work of NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA.) SOFIA is a flying observatory in a customized Boeing 747. SOFIA has a German instrument onboard called GREAT, or German Receiver for Astronomy at Terahertz Frequencies.

The Orion Nebula is an object of great astronomical beauty, but that beauty is what makes it hard to see into. Those clouds of gas that look so ephemeral and beautiful do weird things to light. GREAT allowed astronomers to look inside the Orion Nebula with increased clarity and to observe in detail the newly-formed star Theta1 Orionis C (01 Ori C).

What they found is that the stellar wind from 01 Ori C is carving a bubble around itself, essentially blowing all the gas away from itself, preventing any new stars from forming.

"The wind is responsible for blowing an enormous bubble around the central stars," explained Pabst. "It disrupts the natal cloud and prevents the birth of new stars."

Because SOFIA does its science from altitude, it flies above 99% of the water vapour in Earth's atmosphere. That, combined with the sensitivity of the GREAT instrument, makes it a powerful fool for peering at 01 Ori C. The team behind the paper combined GREAT data with data from the Herschel and Spitzer space observatories to get their results.

They were able to determine the velocity of the gas creating the bubble and to track its growth and origin. "Astronomers use GREAT like a police officer uses a radar gun," explained Alexander Tielens, an astronomer at Leiden Observatory and a senior scientist on the paper. "The radar bounces off your car, and the signal tells the officer if you're speeding."

The process is called "stellar feedback" because of the way the bubble interacts with the gas around it. As the image above shows, the wind (black arrows) leaves the star in all directions. But when it hits the dense OMC-1 region, on the right of the image, there is pushback from other young stars, labelled BN/KL in the graphic. This creates the vertical column of red-grey arrows, which represents the combined bubbles from 01 Ori C's and the BN/KL bubbles.

As these stellar winds feed back on each other, they shape the interstellar medium (ISM) and any molecular clouds in the vicinity. This creates localized areas that either encourage or discourage more star formation.

The bubble itself is huge. It's a 4 parsec diameter half shell. Inside that area, no star formation is possible because all the gas has been forced out. But on the edge of that bubble, gas is more dense. In those denser regions, star formation is more likely. It's similar to the way that shockwaves from a supernova create areas of dense gas, which leads to increased star formation.

01 Orionis C's bubble is inside a much larger bubble called the Orion-Eridanus Superbubble, made of overlapping supernova remnants. Eventually, the small bubble will erupt and vent its gas into the superbubble. In some millions of years, another supernova will explode and carry the material from 01 Orionis C's bubble into the wall of the superbubble. That wall of gas that makes up the edges of the superbubble will be come more dense, and likely lead to more star formation. So while it may look like the supernova played a more direct role in star formation, the bubble from the young star will already have played its role.

As the conclusion of the paper says, "Stellar winds from O-type massive stars are very effective at disrupting molecular cores and star formation. Because energy input from stellar wind is dominated by the most massive stars in a cluster whereas that from supernovae is dominated by the more numerous B-type stars, the predominance of the disruption caused by stellar winds has a direct effect on cosmological simulations."

This is only one example of the stellar feedback process. As the paper says, “Here we have analysed one specific case of the interaction of a wind from a massive star with its environment; whether our conclusions apply more generally still needs to be assessed.”

Sources:

- NASA Press Release: Lifting the Veil on Star Formation in the Orion Nebula
- Research Paper: Disruption of the Orion molecular core 1 by wind from the massive star ?[1] Orionis C
- SOFIA

Source: Universe Today Return to Contents

Space Image of the Week

Wide Field View of Great American Eclipse

Explanation Only in the fleeting darkness of a total solar eclipse is the light of the solar corona easily visible. Normally overwhelmed by the bright solar disk, the expansive corona, the sun's outer atmosphere, is an alluring sight. But the subtle details and extreme ranges in the corona's brightness, although discernible to the eye, are notoriously difficult to photograph. Pictured here, however, using over 120 images and meticulous digital processing, is a detailed wide-angle image of the Sun's corona taken during the Great American Eclipse in 2017 August. Clearly visible are intricate layers and glowing caustics of an ever changing mixture of hot gas and magnetic fields. Hundreds of stars as faint as 11th magnitude are visible behind the Moon and Sun, with Mars appearing in red on the far right. The next total eclipse of the Sun will occur on July 2 and be visible during sunset from a thin swath across Chile and Argentina.

Image Credit & Copyright: Nicolas Lefaudeux

Source: APOD

Return to Contents