Space News Update

— March 6, 2020 —

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1. Curiosity's Latest Mars Panorama, Captured in 1.8 Billion Glorious Pixels

The Curiosity rover on Mars has captured the most detailed panoramic image ever taken of the Red Planet's surface. The image is made from over 1,000 images, containing 1.8 billion pixels of the Martian landscape, with 2.43 GB of high-resolution planetary goodness.

"This is the first time during the mission we've dedicated our operations to a stereo 360-degree panorama," said Curiosity Project Scientist Ashwin Vasavada.

The rover has been in Gale Crater on Mars since August of 2012.

NASA and JPL even put together a special feature where you can zoom in and out of the photo, plus a sweeping video of the scene, below.

The panorama was taken between November 24 and December 1, 2019 – over the week of the Thanksgiving holiday in the US. NASA said the rover was "sitting still with few tasks to do while awaiting the team to return and provide its next commands. The rover had a rare chance to image its surroundings from the same vantage point several days in a row."

"While many on our team were at home enjoying turkey, Curiosity produced this feast for the eyes," Vasavada said.

The image shows a panorama of Glen Torridon, a region on the side of Mount Sharp that Curiosity is exploring. The rover took more than 6 1/2 hours of exposures over four days with the rover's Mast Camera, or Mastcam, using its telephoto lens to produce the panorama.

The Mastcam operators had pre-programmed the complex task list, which included pointing the rover's mast and making sure the images were in focus. The photos were taken between noon and 2 p.m. local Mars time to ensure consistent lighting.

The Mastcam also used its medium-angle lens to produce a lower-resolution, nearly 650-million-pixel panorama that includes the rover's deck and robotic arm.

Over the following weeks, the images were painstakingly stitched together by the rover imaging team; they blend the edges of each photo to create a seamless look.

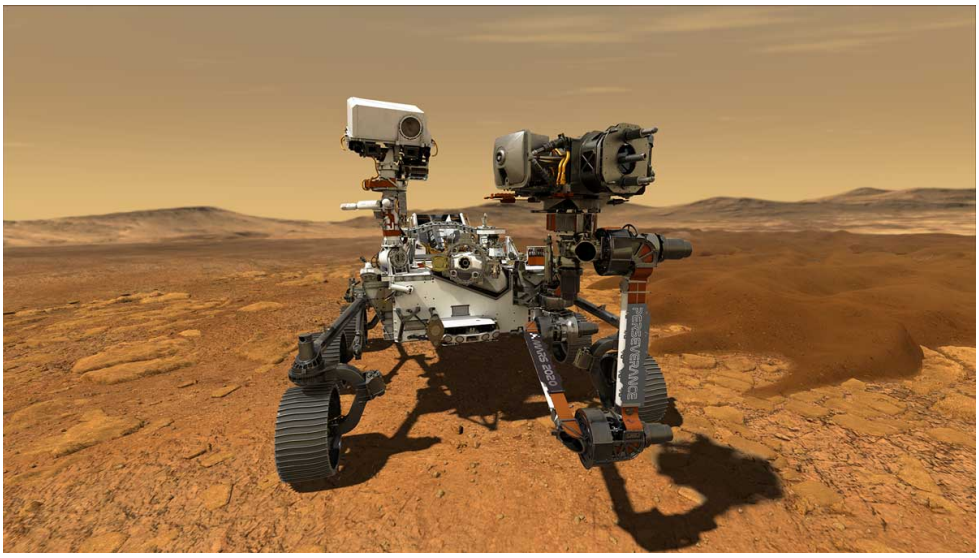
"What I love about this panorama is that we can zoom way in and see details far in the distance," said Vasavada in the video. "When you start to do that, you can see the rim of the crater we're inside of, all the way to the north."

He adds, "Here's an impressive sight: 20 miles away is Slangpos crater, just inside Gale crater's rim. End to end, Slangpos is three miles wide! Something huge must have struck here. Whenever I start to think that Mars looks familiar, sights like this dramatic impact crater remind me that we're looking at a different planet."

The next highest-res photo ever taken by Curiosity was in 2013 when it produced a 1.3-billion-pixel panorama.

Source: Universe Today Return to Contents

Virginia Middle School Student Earns Honor of Naming NASA's Next Mars Rover



NASA's next Mars rover has a new name – Perseverance.The name was announced Thursday by Thomas Zurbuchen, associate administrator of the Science Mission Directorate, during a celebration at Lake Braddock Secondary School in Burke, Virginia. Zurbuchen was at the school to congratulate seventh grader Alexander Mather, who submitted the winning entry to the agency's "Name the Rover" essay contest, which received 28,000 entries from K-12 students from every U.S. state and territory.

"Alex's entry captured the spirit of exploration," said Zurbuchen. "Like every exploration mission before, our rover is going to face challenges, and it's going to make amazing discoveries. It's already surmounted many obstacles to get us to the point where we are today – processing for launch. Alex and his classmates are the Artemis Generation, and they're going to be taking the next steps into space that lead to Mars. That inspiring work will always require perseverance. We can't wait to see that nameplate on Mars."

Perseverance is the latest in a long line of Red Planet rovers to be named by school-age children, from Sojourner in 1997 to the Spirit and Opportunity rovers, which landed on Mars in 2004, to Curiosity, which has been exploring Mars since 2012. In each case, the name was selected following a nationwide contest.

Source: NASA Return to Contents

2. NASA picks SpaceX Falcon Heavy to launch Psyche mission to metal asteroid in 2022

NASA has contracted SpaceX to launch the agency's Psyche mission to a unique metal asteroid.

The $117 million Psyche mission will use one of SpaceX's Falcon Heavy rockets, and it is scheduled to launch from Launch Complex 39A at Cape Canaveral Air Force Station in Florida in July 2022.

The spacecraft will travel to a unique metal-rich asteroid named Psyche, which orbits the sun between Mars and Jupiter. Astronomers believe that studying this new asteroid will offer new clues about how terrestrial planets like Earth form, according to a statement from NASA.

"The asteroid is considered unique, as it appears to largely be made of the exposed nickel-iron core of an early planet — one of the building blocks of our solar system," NASA officials said in the statement.

Rocky, terrestrial planets like Earth are believed to have a metallic core. However, it is difficult to observe or measure a planet's core directly because it lies far below a planet's mantle and crust.

By studying this unique asteroid up close, scientists hope to better understand the violent history of collisions and accretion that created terrestrial planets, according to the statement.

The Psyche orbiter — named for the asteroid that it will study — will have five solar array panels, as well as power and propulsion systems that will allow the spacecraft to navigate to and orbit the asteroid. The scientific experiments that the spacecraft will perform are in the design and fabrication phase. Final assembly and testing of the craft is expected to begin early next year, according to NASA.

With the launch of the Psyche orbiter, the Falcon Heavy rocket will also carry two secondary payloads, including the Escape and Plasma Acceleration and Dynamics Explorers (EscaPADE) and a small satellite called Janus.

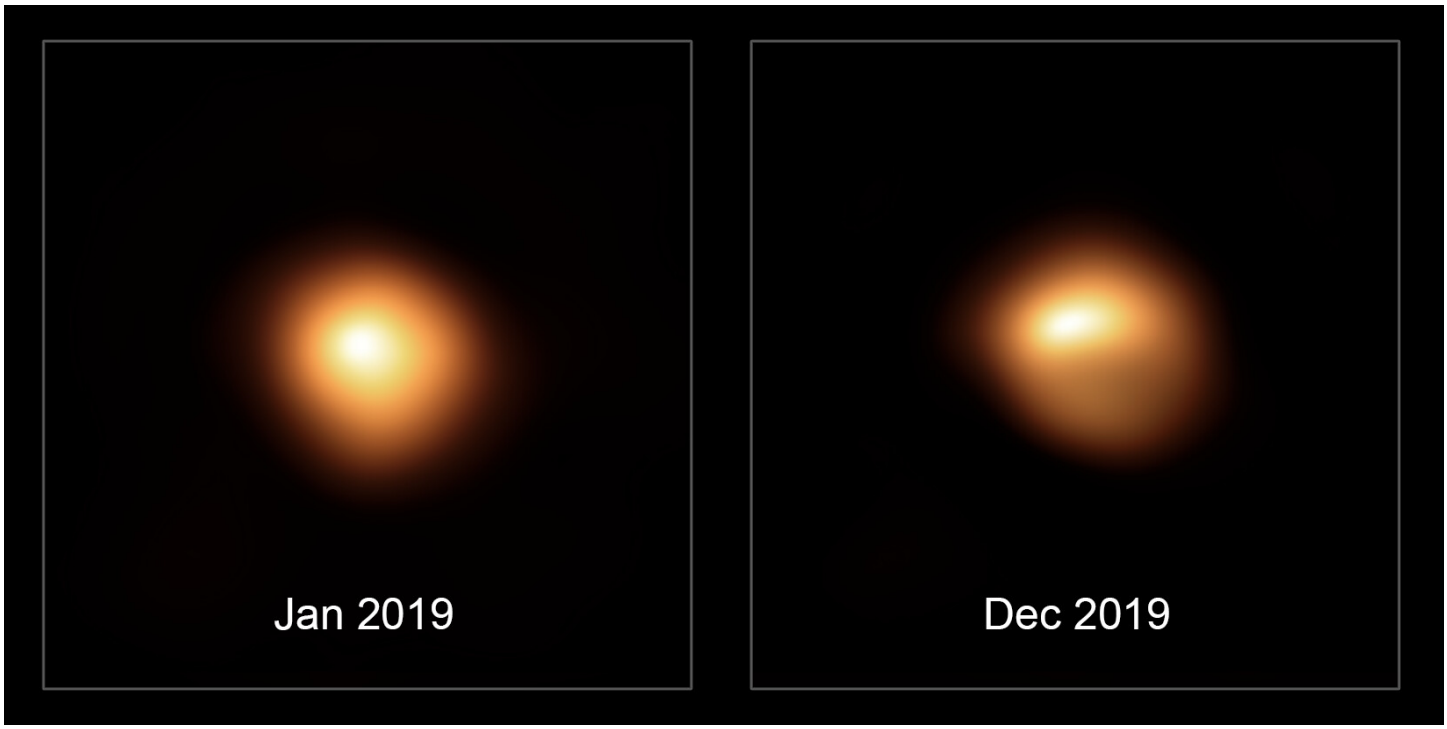
EscaPADE, a project led by the University of California, Berkeley, is designed to explore the atmosphere of Mars and the influence of solar wind. The Janus satellite, from the University of Colorado, will study binary

asteroids, which are pairs of asteroids that orbit around each other and are believed to be some of the earliest objects in the solar system. EscaPADE and Janus were two of the finalists that NASA selected in 2018 as part of the agency's Small Innovative Missions for Planetary Exploration (SIMPLEx).

After the Psyche mission's scheduled launch in 2022, it is expected to arrive at the asteroid Psyche, between the orbits of Mars and Jupiter, in 2026. The Psyche mission is led by Arizona State University. System engineering and testing for the Psyche mission will be performed at NASA's Jet Propulsion Laboratory.

Source: Space.com Return to Contents

3. **Dimming Betelgeuse likely isn't cold, just dusty, new study shows**



Late last year, news broke that the star Betelgeuse was fading significantly, ultimately dropping to around 40% of its usual brightness. The activity fueled popular speculation that the red supergiant would soon explode as a massive supernova.

But astronomers have more benign theories to explain the star's dimming behavior. And scientists at the University of Washington and Lowell Observatory believe they have support for one of them: Betelgeuse isn't dimming because it's about to explode -- it's just dusty.

In a paper accepted to *Astrophysical Journal Letters* and published on the preprint site arXiv, Emily Levesque, a UW associate professor of astronomy, and Philip Massey, an astronomer with Lowell Observatory, report that observations of Betelgeuse taken Feb. 14 at the Flagstaff, Arizona, observatory allowed them to calculate the average surface temperature of the star. They discovered that Betelgeuse is significantly warmer than expected if the recent dimming were caused by a cooling of the star's surface.

The new calculations lend support to the theory that Betelgeuse -- as many red supergiant stars are prone to do -- has likely sloughed off some material from its outer layers.

"We see this all the time in red supergiants, and it's a normal part of their life cycle," said Levesque. "Red supergiants will occasionally shed material from their surfaces, which will condense around the star as dust. As it cools and dissipates, the dust grains will absorb some of the light heading toward us and block our view."

It is still true: Astronomers expect Betelgeuse to explode as a supernova within the next 100,000 years when its core collapses. But the star's dimming, which began in October, wasn't necessarily a sign of an imminent supernova, according to Massey.

One theory was that newly formed dust was absorbing some of Betelgeuse's light. Another posited that huge convection cells within Betelgeuse had drawn hot material up to its surface, where it had cooled before falling back into the interior.

"A simple way to tell between these possibilities is to determine the effective surface temperature of Betelgeuse," said Massey.

Measuring a star's temperature is no straightforward task. Scientists can't just point a thermometer at a star and get a reading. But by looking at the spectrum of light emanating from a star, astronomers can calculate its temperature.

"Emily and I had been in contact about Betelgeuse, and we both agreed that the obvious thing to do was to get a spectrum," said Massey. "I already had observing time scheduled on the 4.3-meter Lowell Discovery Telescope, and I knew if I played around for a bit I would be able to get a good spectrum despite Betelgeuse still being one of the brightest stars in the sky."

The light from bright stars is often too strong for a detailed spectrum, but Massey employed a filter that effectively "dampened" the signal so they could mine the spectrum for a particular signature: the absorbance of light by molecules of titanium oxide.

Titanium oxide can form and accumulate in the upper layers of large, relatively cool stars like Betelgeuse, according to Levesque. It absorbs certain wavelengths of light, leaving telltale "scoops" in the spectrum of red supergiants that scientist can use to determine the star's surface temperature.

By their calculations, Betelgeuse's average surface temperature on Feb. 14 was about 3,325 degrees Celsius, or 6,017 F. That's only 50-100 degrees Celsius cooler than the temperature that a team -- including Massey and Levesque -- had calculated as Betelgeuse's surface temperature in 2004, years before its dramatic dimming began.

These findings cast doubt that Betelgeuse is dimming because one of the star's massive convection cells had brought hot gas from the interior to the surface, where it had cooled. Many stars have these convection cells, including our own sun. They resemble the surface of a pot of boiling water, said Levesque. But whereas the convection cells on our sun are numerous and relatively small -- roughly the size of Texas or Mexico -- red supergiants like Betelgeuse, which are larger, cooler and have weaker gravity, sport just three or four massive convection cells that stretch over much of their surfaces.

If one of these massive cells had risen to Betelgeuse's surface, Levesque and Massey would have registered a substantially greater decrease in temperature than what they see between 2004 and 2020.

"A comparison with our 2004 spectrum showed immediately that the temperature hadn't changed significantly," said Massey. "We knew the answer had to be dust."

Astronomers have observed clouds of dust around other red supergiants, and additional observations may reveal similar clutter around Betelgeuse.

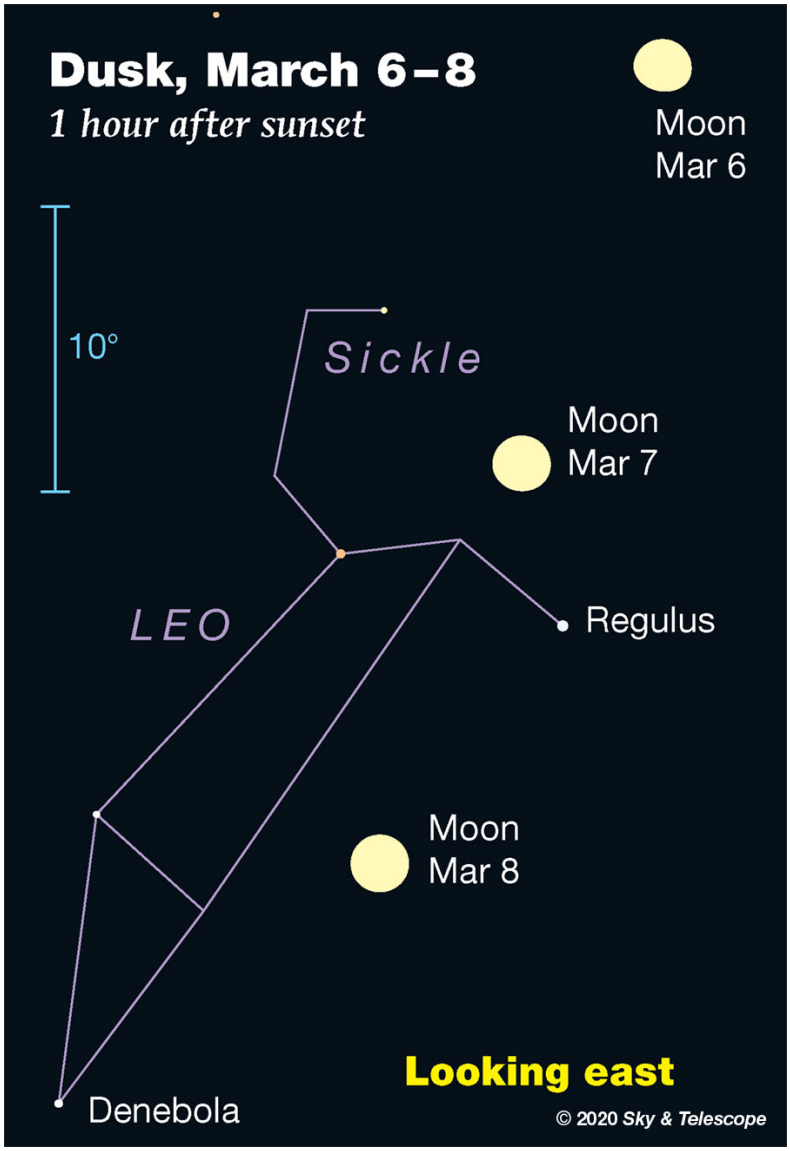
Over the past few weeks, Betelgeuse has actually started to brighten again, albeit slightly. Even if the recent dimming wasn't an indication that the star would soon explode, to Levesque and Massey, that's no reason to stop looking.

"Red supergiants are very dynamic stars," said Levesque. "The more we can learn about their normal behavior -- temperature fluctuations, dust, convection cells -- the better we can understand them and recognize when something truly unique, like a supernova, might happen."

Source: EurekAlert Return to Contents

The Night Sky

Friday, March 6



• It's not officially spring for another 13 days, but the Spring Star Arcturus seems eager to thrust itself into view. It rises above the east-northeast horizon fairly soon after dusk now, depending on your latitude.

Where should you watch for it to rise? Find the Big Dipper as soon as the stars come out, high in the northeast. Follow the curve of its handle down and around to the lower right by a little more than a Dipper-length. That's the spot on the horizon to watch.

Saturday, March 7

• Regulus shines below the nearly full Moon after dark, as shown below. Can you make out the rest of the Sickle of Leo, almost enclosing it, through the moonlight? Binoculars help.

As the gibbous Moon waxes toward full on the 9th, it crosses Leo. As always, the Moon at right is shown three times its actual apparent size.

Sunday, March 8

• Daylight-saving time began at 2 a.m. last night for most of North America.

• Venus continues to shine high in the west at nightfall for many weeks on end. But as the season advances, the starry background slides toward the lower right behind it. Not long ago the brightest stars of Aries were high over Venus. Now you'll find them closer to Venus's right or upper right.

And look high above the bright planet for the Pleiades cluster. Tonight they're 25° apart. But the Pleiades are heading toward Venus by 1° per day, and they will engulf it on the evening of April 3rd.

Monday, March 9

• Full Moon (exactly so at 12:48 p.m. EST). As the Moon climbs the eastern sky this evening, look about 8° or 9° to its upper left for Denebola, the tail star of Leo, magnitude 2.1. Is your sky clean and clear enough for you to see it through the moonlight without binoculars?

Tuesday, March 10

• Bright Sirius now stands due south on the meridian just as twilight fades away into night. Sirius is the bottom star of the equilateral Winter Triangle. The other two stars of the Triangle are orange Betelgeuse to Sirius's upper right (Orion's shoulder) and Procyon to Sirius's upper left.

Sirius is not only the brightest star on the entire celestial sphere (after the Sun), it's also the *nearest* star that's visible to the naked eye from mid-northern latitudes. (Alpha Centauri is nearer but too far south. A few dim red dwarfs in the northern sky are nearer, but they require optical aid.)

Source: Sky & Telescope Return to Contents

ISS Sighting Opportunities

For Denver:

Date	Visible	Max Height*	Appears	Disappears
Fri Mar 6, 4:16 AM	< 1 min	10°	10° above NNE	10° above NNE
Fri Mar 6, 5:51 AM	4 min	19°	10° above NNW	16° above NE
Sat Mar 7, 5:04 AM	3 min	15°	11° above NNW	12° above NE
Sun Mar 8, 5:17 AM	2 min	13°	12° above N	10° above NE
Sun Mar 8, 6:52 AM	4 min	39°	10° above NW	36° above ENE
Mon Mar 9, 6:05 AM	3 min	26°	11° above NNW	24° above NE
Tue Mar 10, 5:19 AM	2 min	19°	19° above NNE	16° above NE
Tue Mar 10, 6:53 AM	4 min	73°	10° above NW	50° above SSE

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

NASA-TV Highlights

(all times Eastern Daylight Time)

March 6, Friday
1:30 p.m. - 2:30 p.m. – NASA Podcast with astronaut Kayla Barron to discuss the new Astronaut Application Process (All Channels)
4 p.m. – SpaceX CRS 20 Prelaunch News Conference (All Channels)
11:30 p.m. – Coverage of the launch of the SpaceX/Dragon CRS-20 cargo flight to the International Space Station; launch scheduled at 11:50 p.m. EST (All Channels)

Editor's note: Daylight Savings Time resumes in most of the United States at 2 a.m. local time on March 8.

March 9, Monday
5:30 a.m. – Coverage of the rendezvous and capture of the SpaceX/Dragon cargo craft at the International Space Station. (Capture is scheduled at approximately 7 a.m. EDT) (All Channels)
8:30 a.m. – Coverage of the installation of the SpaceX/Dragon cargo craft to the International Space Station (All Channels)

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

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Space Calendar

- Mar 06 - [Mar 03] CRS-20/ Bartolomeo/ SPOC/ TechEdSat 10 (TES 10)/ GEROS Falcon 9 Launch (International Space Station)
- Mar 06 - Falcon Eye 2 Soyuz ST-A/Fregat-M Launch
- Mar 06 - Comet P/2019 A2 (ATLAS) Closest Approach To Earth (3.380 AU)
- Mar 06 - Comet 21P/Giacobini-Zinner At Opposition (3.723 AU)
- Mar 06 - Comet 370P/NEAT At Opposition (4.272 AU)
- Mar 06 - Comet C/2010 U3 (Boattini) At Opposition (8.144 AU)
- Mar 06 - [Mar 05] Amor Asteroid 2020 EA Near-Earth Flyby (0.046 AU)
- Mar 06 - Atira Asteroid 2015 DR215 Closest Approach To Earth (0.840 AU)
- Mar 06 - Asteroid 1279 Uganda Closest Approach To Earth (1.492 AU)
- Mar 06 - Asteroid 9305 Hazard Closest Approach To Earth (1.514 AU)
- Mar 06 - Asteroid 51827 Laurelclark Closest Approach To Earth (1.809 AU)
- Mar 06 - Kuiper Belt Object 88611 Teharonhiawako At Opposition (46.180)
- Mar 06 - Kuiper Belt Object 2017 FO161 At Opposition (77.336 AU)
- Mar 06 - 5th Anniversary (2015), Dawn, Ceres Arrival
- Mar 06 - Michelangelo's 545th Birthday (1475)
- Mar 07 - [Feb 29] International Day of Planetariums
- Mar 07 - Comet C/2020 B2 (Lemmon) At Opposition (1.903 AU)
- Mar 07 - Asteroid 2925 Beatty Closest Approach To Earth (0.999 AU)
- Mar 07 - Apollo Asteroid 2011 MD Closest Approach To Earth (1.669 AU)
- Mar 07 - Kuiper Belt Object 532037 (2013 FY27) At Opposition (78.901 AU)
- Mar 07 - [Mar 02] UK in Space Festival, Leicester, United Kingdom
- Mar 07 - Viktor Savinykh's 80th Birthday (1940)
- Mar 07 - Stanley Miller's 90th Birthday (1930)
- Mar 08 - [Mar 01] Daylight Saving - Set Clock Ahead 1 Hour (United States)
- Mar 08 - Comet 69P/Taylor Closest Approach To Earth (2.407 AU)
- Mar 08 - Asteroid 78577 JPL Closest Approach To Earth (1.942 AU)
- Mar 08 - Asteroid 128 Nemesis Closest Approach To Earth (2.052 AU)
- Mar 08 - Asteroid 15371 Steward Closest Approach To Earth (2.205 AU)
- Mar 08 - 110th Anniversary (1910), Raymonde de Laroche Becomes 1st Woman in World to Receive Pilot's License
- Mar 09 - [Mar 02] Super Worm Moon
- Mar 09 - Venus Passes 2.4 Degrees From Uranus
- Mar 09 - Comet 358P/PANSTARRS At Opposition (2.692 AU)
- Mar 09 - Comet C/2019 J3 (ATLAS) Closest Approach To Earth (2.858 AU)
- Mar 09 - Comet P/2007 T2 (Kowalski) At Opposition (3.862 AU)
- Mar 09 - Comet C/2018 X3 (PANSTARRS At Opposition (3.932 AU)
- Mar 09 - Apollo Asteroid 11066 Sigurd Closest Approach To Earth (0.876 AU)
- Mar 09 - Asteroid 78905 Seanokeefe Closest Approach To Earth (0.910 AU)
- Mar 09 - Asteroid 165347 Philplait Closest Approach To Earth (1.070 AU)
- Mar 09 - Asteroid 293 Brasilia Closest Approach To Earth (1.633 AU)
- Mar 09 - Asteroid 4587 Rees Closest Approach To Earth (1.646 AU)
- Mar 09 - Asteroid 1756 Giacobini Closest Approach To Earth (1.954 AU)
- Mar 09 - Asteroid 2742 Gibson Closest Approach To Earth (2.004 AU)
- Mar 09 - Asteroid 8423 Macao Closest Approach To Earth (2.713 AU)
- Mar 09 - Centaur Object 346889 Rhiphonos At Opposition (12.413 AU)
- Mar 10 - Comet 6P/d'Arrest At Opposition (3.450 AU)
- Mar 10 - Comet 361P/Spacewatch At Opposition (3.586 AU)

- Mar 10 - Apollo Asteroid 2018 RF6 Near-Earth Flyby (0.029 AU)
- Mar 10 - Apollo Asteroid 2020 CA3 Near-Earth Flyby (0.035 AU)
- Mar 10 - Apollo Asteroid 535844 (2015 BY310) Near-Earth Flyby (0.036 AU)
- Mar 10 - Asteroid 9622 Terryjones Closest Approach To Earth (1.134 AU)
- Mar 10 - Aerospace Day at the Colorado State Capitol 2020, Denver, Colorado

Source: JPL Space Calendar Return to Contents

Food for Thought

New ESO study evaluates impact of satellite constellations on astronomical observations

Astronomers have recently raised concerns about the impact of satellite mega-constellations on scientific research. To better understand the effect these constellations could have on astronomical observations, ESO commissioned a scientific study of their impact, focusing on observations with ESO telescopes in the visible and infrared but also considering other observatories. The study, which considers a total of 18 representative satellite constellations under development by SpaceX, Amazon, OneWeb and others, together amounting to over 26 thousand satellites, has now been accepted for publication in *Astronomy & Astrophysics*.

The study finds that large telescopes like ESO's Very Large Telescope (VLT) and ESO's upcoming Extremely Large Telescope (ELT) will be "moderately affected" by the constellations under development. The effect is more pronounced for long exposures (of about 1000 s), up to 3% of which could be ruined during twilight, the time between dawn and sunrise and between sunset and dusk. Shorter exposures would be less impacted, with fewer than 0.5% of observations of this type affected. Observations conducted at other times during the night would also be less affected, as the satellites would be in the shadow of the Earth and therefore not illuminated. Depending on the science case, the impacts could be lessened by making changes to the operating schedules of ESO telescopes, though these changes come at a cost. On the industry side, an effective step to mitigate impacts would be to darken the satellites.

The study also finds that the greatest impact could be on wide-field surveys, in particular those done with large telescopes. For example, up to 30% to 50% of exposures with the US National Science Foundation's Vera C. Rubin Observatory (not an ESO facility) would be "severely affected," depending on the time of year, the time of night, and the simplifying assumptions of the study. Mitigation techniques that could be applied on ESO telescopes would not work for this observatory although other strategies are being actively explored. Further studies are required to fully understand the scientific implications of this loss of observational data and complexities in their analysis. Wide-field survey telescopes like the Rubin Observatory can scan large parts of the sky quickly, making them crucial to spot short-lived phenomena like supernovae or potentially dangerous asteroids. Because of their unique capability to generate very large data sets and to find observation targets for many other observatories, astronomy communities and funding agencies in Europe and elsewhere have ranked wide-field survey telescopes as a top priority for future developments in astronomy.

Professional and amateur astronomers alike have also raised concerns about how satellite mega-constellations could impact the pristine views of the night sky. The study shows that about 1600 satellites from the constellations will be above the horizon of an observatory at mid-latitude, most of which will be low in the sky—within 30 degrees of the horizon. Above this—the part of the sky where most astronomical observations take place—there will be about 250 constellation satellites at any given time. While they are all illuminated by the Sun at sunset and sunrise, more and more get into the shadow of the Earth toward the middle of the night. The ESO study assumes a brightness for all of these satellites. With this assumption, up to about 100 satellites could be bright enough to be visible with the naked eye during twilight hours, about 10 of which would be higher than 30 degrees of elevation. All these numbers plummet as the night gets darker and the satellites fall into the shadow of the Earth. Overall, these new satellite constellations would about double the number of satellites visible in the night sky to the naked eye above 30 degrees.

These numbers do not include the trains of satellites visible immediately after launch. Whilst spectacular and bright, they are short lived and visible only briefly after sunset or before sunrise, and—at any given time—only from a very limited area on Earth.

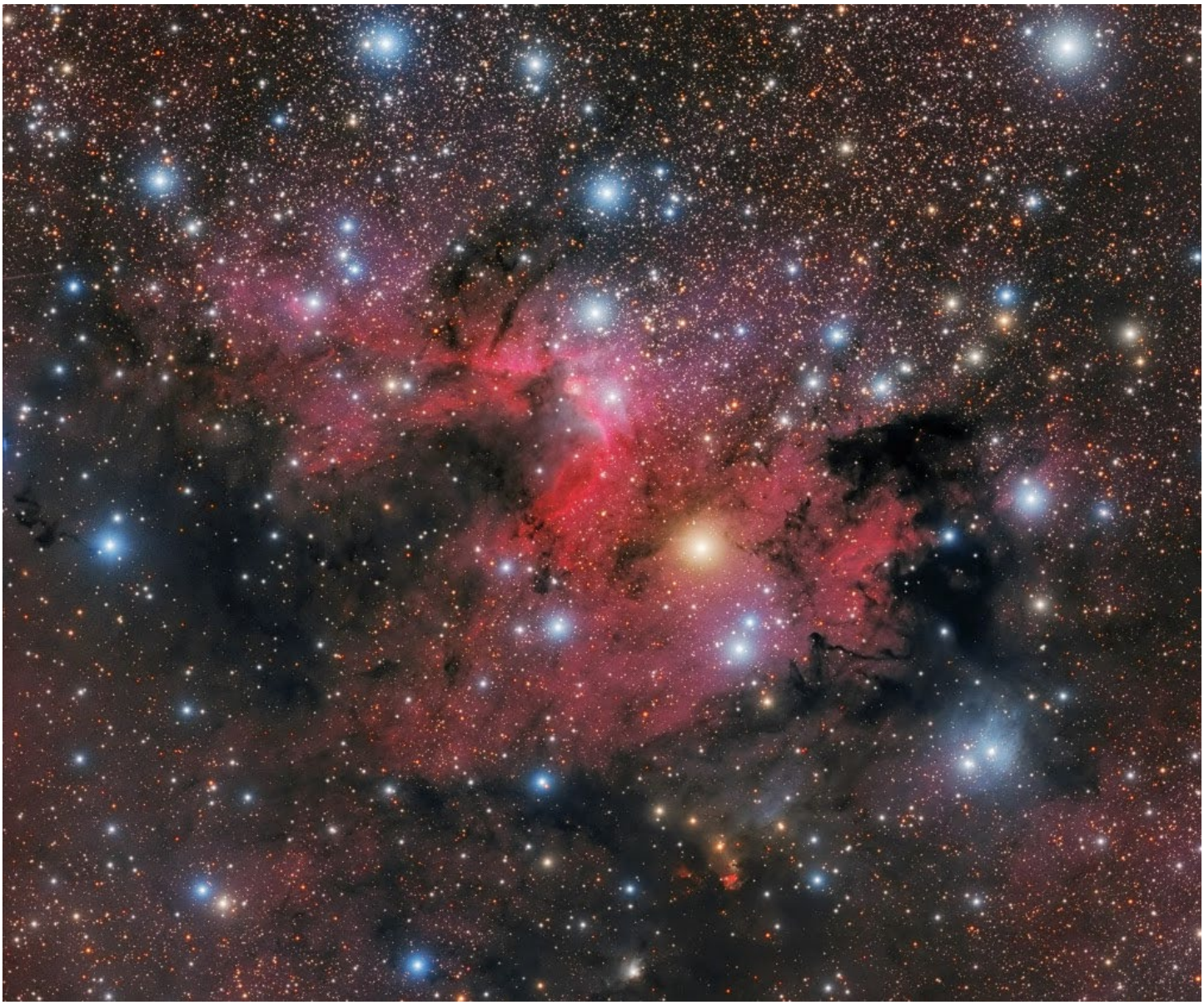
The ESO study uses simplifications and assumptions to obtain conservative estimates of the effects, which may be smaller in reality than calculated in the paper. More sophisticated modelling will be necessary to more precisely quantify the actual impacts. While the focus is on ESO telescopes, the results apply to similar non-ESO telescopes that also operate in the visible and infrared, with similar instrumentation and science cases.

Satellite constellations will also have an impact on radio, millimetre and submillimetre observatories, including the Atacama Large Millimeter/submillimeter Array (ALMA) and the Atacama Pathfinder Experiment (APEX). This impact will be considered in further studies.

ESO, together with other observatories, the International Astronomical Union (IAU), the American Astronomical Society (AAS), the UK Royal Astronomical Society (RAS), and other societies, is taking measures to raise the awareness of this issue in global fora such as the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) and the European Committee on Radio Astronomy Frequencies (CRAF). This is being done while exploring with the space companies practical solutions that can safeguard the large-scale investments made in cutting-edge ground-based astronomy facilities. ESO supports the development of regulatory frameworks that will ultimately ensure the harmonious coexistence of highly promising technological advancements in low Earth orbit with the conditions that enable humankind to continue its observation and understanding of the Universe.

Source: Phys.org Return to Contents

Space Image of the Week



The Light, the Dark, and the Dusty
Image Credit & Copyright: Casey Good

Explanation: This colorful skyscape spans about four full moons across nebula rich starfields along the plane of our Milky Way Galaxy in the royal northern constellation Cepheus. Near the edge of the region's massive molecular cloud some 2,400 light-years away, bright reddish emission region Sharpless (Sh) 155 is left of center, also known as the Cave Nebula. About 10 light-years across the cosmic cave's bright walls of gas are ionized by ultraviolet light from the hot young stars around it. Dusty blue reflection nebulae, like vdB 155 at lower right, and dense obscuring clouds of dust also abound on the interstellar canvas.
Astronomical explorations have revealed other dramatic signs of star formation, including the bright red fleck of Herbig-Haro (HH) 168. Below center in the frame, the Herbig-Haro object emission is generated by energetic jets from a newborn star.

Source: APOD

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