Space News Update

— March 17, 2017 —

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1. Hubble Discovery of Runaway Star Yields Clues to Breakup of Multiple-Star System

As British royal families fought the War of the Roses in the 1400s for control of England's throne, a grouping of stars was waging its own contentious skirmish — a star war far away in the Orion Nebula.

The stars were battling each other in a gravitational tussle, which ended with the system breaking apart and at least three stars being ejected in different directions. The speedy, wayward stars went unnoticed for hundreds of years until, over the past few decades, two of them were spotted in infrared and radio observations, which could penetrate the thick dust in the Orion Nebula.

The observations showed that the two stars were traveling at high speeds in opposite directions from each other. The stars' origin, however, was a mystery. Astronomers traced both stars back 540 years to the same location and suggested they were part of a now-defunct multiple-star system. But the duo's combined energy, which is propelling them outward, didn't add up. The researchers reasoned there must be at least one other culprit that robbed energy from the stellar toss-up.

Now NASA's Hubble Space Telescope has helped astronomers find the final piece of the puzzle by nabbing a third runaway star. The astronomers followed the path of the newly found star back to the same location where the two previously known stars were located 540 years ago. The trio reside in a small region of young stars called the Kleinmann-Low Nebula, near the center of the vast Orion Nebula complex, located 1,300 light-years away.

"The new Hubble observations provide very strong evidence that the three stars were ejected from a multiple-star system," said lead researcher Kevin Luhman of Penn State University in University Park, Pennsylvania. "Astronomers had previously found a few other examples of fast-moving stars that trace back to multiple-star systems, and therefore were likely ejected. But these three stars are the youngest examples of such ejected stars. They're probably only a few hundred thousand years old. In fact, based on infrared images, the stars are still young enough to have disks of material leftover from their formation."

All three stars are moving extremely fast on their way out of the Kleinmann-Low Nebula, up to almost 30 times the speed of most of the nebula's stellar inhabitants. Based on computer simulations, astronomers predicted

that these gravitational tugs-of-war should occur in young clusters, where newborn stars are crowded together. "But we haven't observed many examples, especially in very young clusters," Luhman said. "The Orion Nebula could be surrounded by additional fledging stars that were ejected from it in the past and are now streaming away into space."

The team's results will appear in the March 20, 2017 issue of The Astrophysical Journal Letters.

Luhman stumbled across the third speedy star, called "source x," while he was hunting for free-floating planets in the Orion Nebula as a member of an international team led by Massimo Robberto of the Space Telescope Science Institute in Baltimore, Maryland. The team used the near-infrared vision of Hubble's Wide Field Camera 3 to conduct the survey. During the analysis, Luhman was comparing the new infrared images taken in 2015 with infrared observations taken in 1998 by the Near Infrared Camera and Multi-Object Spectrometer (NICMOS). He noticed that source x had changed its position considerably, relative to nearby stars over the 17 years between Hubble images, indicating the star was moving fast, about 130,000 miles per hour.

The astronomer then looked at the star's previous locations, projecting its path back in time. He realized that in the 1470s source x had been near the same initial location in the Kleinmann-Low Nebula as two other runaway stars, Becklin-Neugebauer (BN) and "source I."

BN was discovered in infrared images in 1967, but its rapid motion wasn't detected until 1995, when radio observations measured the star's speed at 60,000 miles per hour. Source I is traveling roughly 22,000 miles per hour. The star had only been detected in radio observations; because it is so heavily enshrouded in dust, its visible and infrared light is largely blocked.

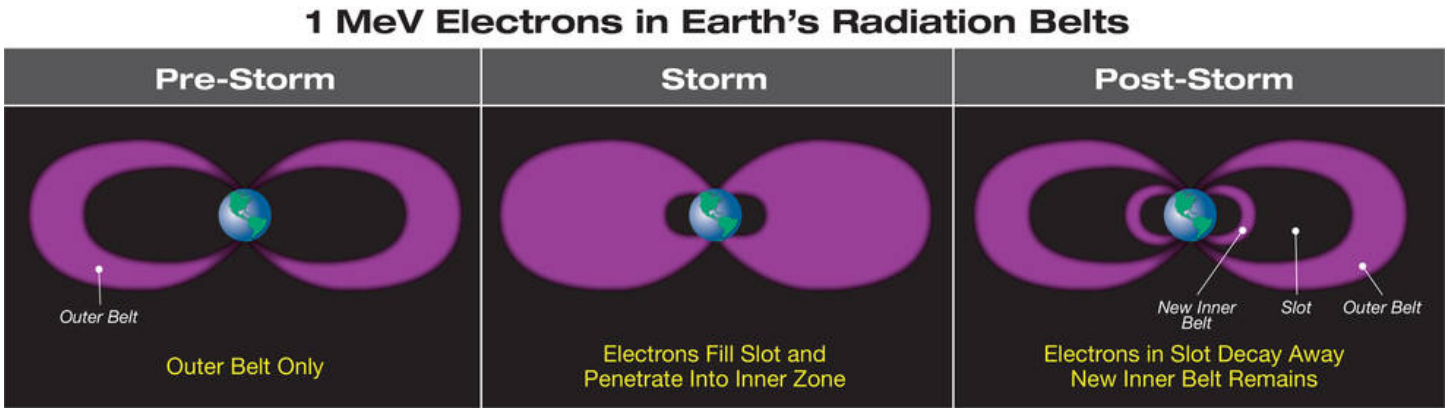
The three stars were most likely kicked out of their home when they engaged in a game of gravitational billiards, Luhman said. What often happens when a multiple system falls apart is that two of the member stars move close enough to each other that they merge or form a very tight binary. In either case, the event releases enough gravitational energy to propel all of the stars in the system outward. The energetic episode also produces a massive outflow of material, which is seen in the NICMOS images as fingers of matter streaming away from the location of the embedded source I star.

Future telescopes, such as the James Webb Space Telescope, will be able to observe a large swath of the Orion Nebula. By comparing images of the nebula taken by the Webb telescope with those made by Hubble years earlier, astronomers hope to identify more runaway stars from other multiple-star systems that broke apart.

The Hubble Space Telescope is a project of international cooperation between NASA and ESA (European Space Agency). NASA's Goddard Space Flight Center in Greenbelt, Maryland, manages the telescope. The Space Telescope Science Institute in Baltimore conducts Hubble science operations. STScI is operated for NASA by the Association of Universities for Research in Astronomy, Inc., in Washington, D.C.

Source: NASA Return to Contents

2. Relativistic Electrons Uncovered with NASA's Van Allen Probes



Earth's radiation belts, two doughnut-shaped regions of charged particles encircling our planet, were discovered more than 50 years ago, but their behavior is still not completely understood. Now, new observations from NASA's Van Allen Probes mission show that the fastest, most energetic electrons in the inner radiation belt are not present as much of the time as previously thought. The results are presented in a paper in the Journal of Geophysical Research and show that there typically isn't as much radiation in the inner belt as previously assumed — good news for spacecraft flying in the region.

Past space missions have not been able to distinguish electrons from high-energy protons in the inner radiation belt. But by using a special instrument, the Magnetic Electron and Ion Spectrometer — MagEIS — on the Van Allen Probes, the scientists could look at the particles separately for the first time. What they found was surprising —there are usually none of these super-fast electrons, known as relativistic electrons, in the inner belt, contrary to what scientists expected.

"We've known for a long time that there are these really energetic protons in there, which can contaminate the measurements, but we've never had a good way to remove them from the measurements until now," said Seth Claudepierre, lead author and Van Allen Probes scientist at the Aerospace Corporation in El Segundo, California.

Of the two radiation belts, scientists have long understood the outer belt to be the rowdy one. During intense geomagnetic storms, when charged particles from the sun hurtle across the solar system, the outer radiation belt pulsates dramatically, growing and shrinking in response to the pressure of the solar particles and magnetic field. Meanwhile, the inner belt maintains a steady position above Earth's surface. The new results, however, show the composition of the inner belt isn't as constant as scientists had assumed.

Ordinarily, the inner belt is composed of high-energy protons and low-energy electrons. However, after a very strong geomagnetic storm in June 2015, relativistic electrons were pushed deep into the inner belt.

The findings were visible because of the way MagEIS was designed. The instrument creates its own internal magnetic field, which allows it to sort particles based on their charge and energy. By separating the electrons from the protons, the scientists could understand which particles were contributing to the population of particles in the inner belt.

"When we carefully process the data and remove the contamination, we can see things that we've never been able to see before," said Claudepierre. "These results are totally changing the way we think about the radiation belt at these energies."

Given the rarity of the storms, which can inject relativistic electrons into the inner belt, the scientists now understand there to typically be lower levels of radiation there — a result that has implications for spacecraft flying in the region. Knowing exactly how much radiation is present may enable scientists and engineers to design lighter and cheaper satellites tailored to withstand the less intense radiation levels they'll encounter.

In addition to providing a new outlook on spacecraft design, the findings open a new realm for scientists to study next.

"This opens up the possibility of doing science that previously was not possible," said Shri Kanekal, Van Allen Probes deputy mission scientist at NASA's Goddard Space Flight Center in Greenbelt, Maryland, not involved with the study. "For example, we can now investigate under what circumstances these electrons penetrate the inner region and see if more intense geomagnetic storms give electrons that are more intense or more energetic."

The Van Allen Probes is the second mission in NASA's Living with a Star Program and one of many NASA heliophysics missions studying our near-Earth environment. The spacecraft plunge through the radiation belts five to six times a day on a highly elliptical orbit, in order to understand the physical processes that add and remove electrons from the region.

Related

- NASA's Van Allen Probes website

Source: NASA Return to Contents

3. NASA Study Confirms Biofuels Reduce Jet Engine Pollution

Using biofuels to help power jet engines reduces particle emissions in their exhaust by as much as 50 to 70 percent, in a new study conclusion that bodes well for airline economics and Earth's environment.

The findings are the result of a cooperative international research program led by NASA and involving agencies from Germany and Canada, and are detailed in a study published in the journal Nature.

During flight tests in 2013 and 2014 near NASA's Armstrong Flight Research Center in Edwards, California, data was collected on the effects of alternative fuels on engine performance, emissions and aircraft-generated contrails at altitudes flown by commercial airliners. The test series were part of the Alternative Fuel Effects on Contrails and Cruise Emissions Study, or ACCESS.

Contrails are produced by hot aircraft engine exhaust mixing with the cold air that is typical at cruise altitudes several miles above Earth's surface, and are composed primarily of water in the form of ice crystals.

Researchers are most interested in persistent contrails because they create long-lasting, and sometimes extensive, clouds that would not normally form in the atmosphere, and are believed to be a factor in influencing Earth's environment.

"Soot emissions also are a major driver of contrail properties and their formation," said Bruce Anderson, ACCESS project scientist at NASA's Langley Research Center in Hampton, Virginia. "As a result, the observed particle reductions we've measured during ACCESS should directly translate into reduced ice crystal concentrations in contrails, which in turn should help minimize their impact on Earth's environment."

That's important because contrails, and the cirrus clouds that evolve from them, have a larger impact on Earth's atmosphere than all the aviation-related carbon dioxide emissions since the first powered flight by the Wright brothers.

The tests involved flying NASA's workhorse DC-8 as high as 40,000 feet while its four engines burned a 50-50 blend of aviation fuel and a renewable alternative fuel of hydro processed esters and fatty acids produced from camelina plant oil. A trio of research aircraft took turns flying behind the DC-8 at distances ranging from 300 feet to more than 20 miles to take measurements on emissions and study contrail formation as the different fuels were burned.

"This was the first time we have quantified the amount of soot particles emitted by jet engines while burning a 50-50 blend of biofuel in flight," said Rich Moore, lead author of the Nature report.

The trailing aircraft included NASA's HU-25C Guardian jet based at Langley, a Falcon 20-E5 jet owned by the German Aerospace Center (DLR), and a CT-133 jet provided by the National Research Council of Canada.

“Measurements in the wake of aircraft require highly experienced crew members and proven measuring equipment, which DLR has built up over many years,” said report co-author Hans Schlager of the DLR Institute of Atmospheric Physics. “Since 2000, the DLR Falcon has been used in numerous measurement campaigns to investigate the emissions and contrails of commercial airliners.”

Researchers plan on continuing these studies to understand and demonstrate the potential benefits of replacing current fuels in aircraft with biofuels. It’s NASA’s goal to demonstrate biofuels on their proposed supersonic X-plane.

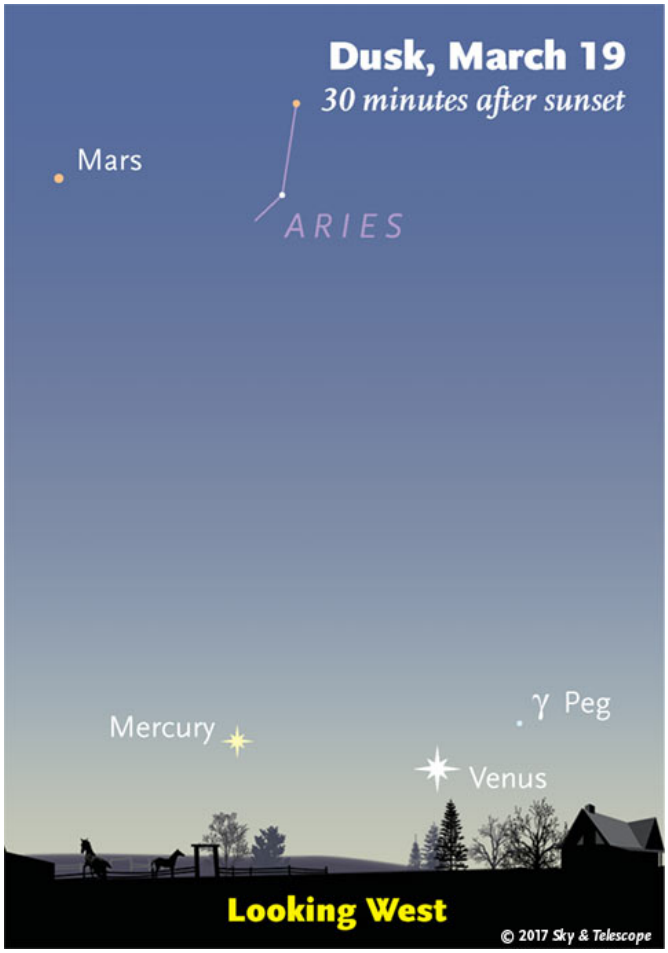
For more information about NASA’s aeronautics research, visit:

http://www.nasa.gov/aero

Source: NASA Return to Contents

The Night Sky

Friday, March 17



• On the traditional divide between the winter and spring sky is the dim constellation Cancer. It lies between Gemini to its west and Leo to its east. Dim it may be, but Cancer holds something unique: the Beehive Star Cluster, M44, in its middle. The Beehive shows dimly to the naked eye if you have little or no light pollution. With binoculars, it's a snap even from fairly polluted areas. Look for it a little less than halfway from Pollux in Gemini to Regulus in Leo.

• Algol is at minimum light for about two hours centered on 9:14 p.m. Eastern Daylight Time.

Saturday, March 18

• Jupiter's moon Io, barely off Jupiter's western limb, disappears into eclipse by Jupiter's shadow around 10:24 p.m. EDT. A small telescope will show it slowly fade away.

Sunday, March 19

• Comet 41P/Tuttle-Giacobini-Kresak ("T-G-K") is becoming nicely visible in amateur telescopes high in the northern evening sky. Currently magnitude 7 or 8, it should reach 6th magnitude at the end of March and stay about that bright through April. This comet has been known to flare in brightness. See our article Comet 41P/T-G-K Greens Up For St. Paddy's Day.

NOTE: Use the new finder chart for the comet that's in that article. The charts for it in the May *Sky & Telescope* are significantly off due to an error in the ephemeris.

• For early risers Monday morning, the nearly last-quarter Moon is only a few degrees from Saturn. Look for them together early in the dawn, high in the south.

Monday, March 20

• Last-quarter Moon (exact at 11:58 a.m. EDT). The Moon rises tonight as late as 2 or 3 a.m. daylight saving time Tuesday morning. As Tuesday's dawn begins, look for Saturn well to the Moon's right, and the Sagittarius Teapot down to the Moon's lower right.

Source: Sky & Telescope

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ISS Sighting Opportunities

For Denver:

Date	Visible	Max Height	Appears	Disappears
Sat Mar 18, 4:45 AM	< 1 min	11°	11° above NNE	10° above NNE
Sat Mar 18, 6:18 AM	4 min	32°	10° above NW	28° above NE
Sun Mar 19, 5:27 AM	3 min	21°	13° above NNW	18° above NE
Mon Mar 20, 4:37 AM	< 1 min	15°	15° above NNE	13° above NE
Mon Mar 20, 6:10 AM	6 min	70°	10° above NW	16° above ESE
Tue Mar 21, 5:20 AM	3 min	38°	24° above NNW	26° above E

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

NASA-TV Highlights

(all times Eastern Daylight Time)

Friday, March 17

8 p.m., Replay of SpaceCast Weekly (all channels)

Saturday, March 18

8 a.m., Replay of SpaceCast Weekly (all channels)

2 p.m., Replay of SpaceCast Weekly (all channels)

11 p.m., Replay of SpaceCast Weekly (NTV-1 (Public))

Sunday, March 19

5 a.m., Release of the SpaceX/Dragon CRS-10 Cargo Craft from the ISS (Release scheduled at 5:11 a.m. ET) (Starts at 4:45a.m.) (all channels)

6 a.m., Replay of SpaceCast Weekly (all channels)

10 a.m., Replay of SpaceCast Weekly (all channels)

4 p.m., Replay of SpaceCast Weekly (all channels)

Monday, March 20

9:30 a.m., ISS Expedition 50 In-Flight Event for ESA for World Water Day and Flight Engineer Thomas Pesquet (Starts at 9:15a.m.) (all channels)

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

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Space Calendar

- Mar 17 - UPDATED [Mar 15] IGS Radar 5 H-2A Launch
- Mar 17 - Comet 73P-C/Schwassmann-Wachmann Perihelion (0.972 AU)
- Mar 17 - Comet 73P-G/Schwassmann-Wachmann Perihelion (0.972 AU)
- Mar 17 - Comet 73P-X/Schwassmann-Wachmann Closest Approach To Earth (1.042 AU)
- Mar 17 - Comet C/2016 C1 (PANSTARRS) At Opposition (7.789 AU)
- Mar 17 - NEW [Mar 11] Apollo Asteroid 2017 EG3 Near-Earth Flyby (0.011 AU)
- Mar 17 - Amor Asteroid 3199 Nefertiti Closest Approach To Earth (1.027 AU)
- Mar 17 - Asteroid 19578 Kirkdouglas Closest Approach To Earth (1.347 AU)
- Mar 17 - Asteroid 37530 Dancingangel Closest Approach To Earth (2.067 AU)
- Mar 17 - Asteroid 589 Croatia Closest Approach To Earth (2.226 AU)
- Mar 17 - 15th Anniversary (2002), GRACE Launch
- Mar 17 - Kalpana Chawla's 55th Birthday (1962)
- Mar 17 - 165th Anniversary (1852), Annibale de Gasparis' Discovery of Asteroid 16 Psyche
- Mar 17 - Horace Tuttle's 180th Birthday (1837)
- Mar 18 - UPDATED [Mar 16] Wideband Gapfiller Satellite 9 (WGS-9) Delta 4 Launch
- Mar 18 - Comet 73P-B/Schwassmann-Wachmann Perihelion (0.972 AU)
- Mar 18 - Comet C/2017 E1 (Borisov) Closest Approach To Earth (1.322 AU)
- Mar 18 - Comet 133P/Elst-Pizarro At Opposition (2.303 AU)
- Mar 18 - Comet 222P/LINEAR At Opposition (3.938 AU)
- Mar 18 - UPDATED [Mar 16] Comet P/2000 R2 (LINEAR) At Opposition (3.955 AU)
- Mar 18 - Asteroid 4116 Elachi Closest Approach To Earth (0.747 AU)
- Mar 18 - Asteroid 3526 Jeffbell Closest Approach To Earth (1.887 AU)
- Mar 18 - Asteroid 5231 Verne Closest Approach To Earth (1.893 AU)
- Mar 18 - Astrofest, Perth, Australia
- Mar 19 - Comet 73P-K/Schwassmann-Wachmann Perihelion (0.972 AU)
- Mar 19 - Comet P/2013 T2 (Schwartz) At Opposition (4.132 AU)
- Mar 19 - Asteroid 2118 Flagstaff Closest Approach To Earth (1.649 AU)
- Mar 19 - Wilhelm von Biela's 235th Birthday (1782)
- Mar 20 - Vernal Equinox, 10:29 UT
- Mar 20 - Cassini, Distant Flyby of Titan, Janus & Pallene
- Mar 20 - Comet 73P-BS/Schwassmann-Wachmann At Opposition (0.605 AU)
- Mar 20 - Comet 73P-H/Schwassmann-Wachmann Perihelion (0.972 AU)
- Mar 20 - Comet 144P/Kushida Closest Approach To Earth (1.592 AU)
- Mar 20 - Comet 212P/NEAT Closest Approach To Earth (1.641 AU)
- Mar 20 - Comet 245P/WISE At Opposition (2.252 AU)
- Mar 20 - Asteroid 8275 Inca Closest Approach To Earth (0.956 AU)
- Mar 20 - Apollo Asteroid 65803 Didymos Closest Approach To Earth (1.144 AU)
- Mar 20 - Asteroid 5102 Benfranklin Closest Approach To Earth (2.349 AU)
- Mar 20 - NEW [Mar 17] Colloquium: SKA Computing and Software, Sydney, Australia
- Mar 20 - Tim Puckett's 55th Birthday (1962)

Source: JPL Space Calendar

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Food for Thought

NASA Says Goodbye to a Pathfinder Earth Satellite After 17 Years

The first to map active lava flows from space.

The first to measure a facility's methane leak from space.

The first to track re-growth in a partially logged Amazon forest from space.

After 17 years in orbit, one of NASA's pathfinder Earth satellites for testing new satellite technologies and concepts comes to an end on March 30, 2017. The Earth Observing-1 (EO-1) satellite will be powered off on that date but will not enter Earth's atmosphere until 2056.

Launched on Nov. 21, 2000, EO-1 was designed as a technology validation mission focused on testing cutting-edge satellite and instrument technologies that could be incorporated into future missions. Commissioned as part of NASA's New Millennium Program, the satellite was part of a series of missions that were developed at a cheaper price tag to test new technologies and concepts that had never been flown before.

"EO-1 has changed the way spectral Earth measurements are being made and used by the science community," said Betsy Middleton, EO-1's Project Scientist at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

EO-1 was launched with 13 new technologies, including three new instruments. EO-1's most important technology goal was to validate the Advanced Land Imager (ALI) for future Earth-observing satellites. The ALI provided a variety of Earth data including observations of forest cover, crops, coastal waters and aerosols. The ALI's instrument design and onboard technology directly shaped the design of the Operational Land Imager (OLI) on Landsat 8, currently in orbit.

EO-1's other key instrument is a hyperspectral instrument called Hyperion that allows scientists to see chemical constituents of Earth's surface in fine detail with hundreds of wavelengths. These data allow scientists to identify specific minerals, track vegetation type and vigor of forests and monitor volcanic activity. The knowledge acquired and technology developed from Hyperion is being incorporated into a NASA concept for a potential future hyperspectral satellite, the Hyperspectral Infrared Imager, that will study the world's ecosystems, such as identifying different types of plants and assessing wildfires and droughts.

With both of these instruments, the EO-1 team was able to acquire images with high spatial resolution of events and natural disasters around the world for anyone who requested it. The EO-1 team could point the instruments at any specific location and gather images every two to five days of a particular spot, which was very useful for scientists as well as disaster relief managers trying to stay informed of rapidly changing events. (Landsat typically looks at the same area once every 16 days.) EO-1 captured scenes such as the ash after the World Trade Center attacks, the flooding in New Orleans after Hurricane Katrina, volcanic eruptions and a large methane leak in southern California.

EO-1 also served as a valuable pathfinder for a variety of space technologies. Technologists installed and tested autonomy software on EO-1 that allowed the satellite to make its own decisions based on the content of the data it collected. For instance, if a scientist instructed EO-1 to take a picture of an area where a volcano was currently erupting, the software could decide to automatically take a follow-up image the next time it passed over the location.

The mission also validated software that allowed “formation flying” that kept EO-1 orbiting Earth exactly one minute behind the Landsat-7 satellite, already in orbit. The original purpose was to validate the new ALI technologies for use in Landsat 8, which was accomplished.

EO-1 was originally only supposed to last one year, but after that initial mission, the satellite had no major issues or breakdowns. On a shoestring budget contributed by NASA, the U.S. Geological Survey, the National Oceanic and Atmospheric Administration, National Reconnaissance Office and Naval Research Laboratory, the satellite continued to operate for sixteen more years, resulting in more than 1,500 papers published on EO-1 research.

On March 30, 2017, the satellite will be decommissioned, drained of its energy and become inert. Without enough fuel to keep EO-1 in its current orbit, the mission team will shut down the satellite and wait for it to return to Earth. When EO-1 does reenter the earth’s atmosphere in about 39 years, it is estimated that all the components will burn up in the atmosphere.

“We’ll probably just see EO-1 as a streak in the sky as it disintegrates,” said Middleton.

For more information about EO-1 visit:

https://eo1.gsfc.nasa.gov/ or https://eospso.nasa.gov/missions/earth-observing-1

Source: NASA

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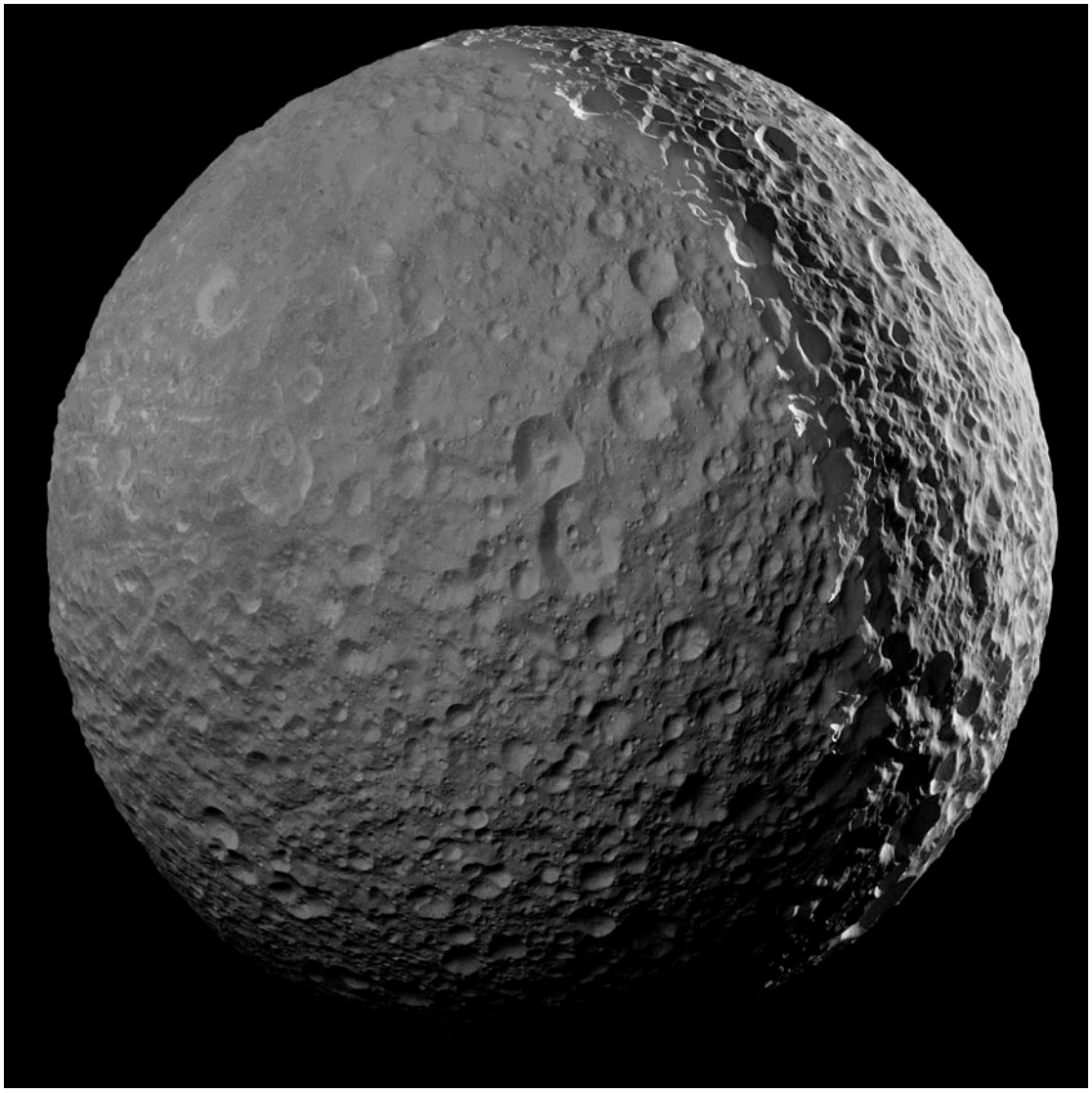
Space Image of the Week



Mimas in Saturnlight

Explanation: Peering from the shadows, the Saturn-facing hemisphere of Mimas lies in near darkness alongside a dramatic sunlit crescent. The mosaic was captured near the Cassini spacecraft's final close approach on January 30, 2017. Cassini's camera was pointed in a nearly sunward direction only 45,000 kilometers from Mimas. The result is one of the highest resolution views of the icy, crater-pocked, 400 kilometer diameter moon. An enhanced version better reveals the Saturn-facing hemisphere of the synchronously rotating moon lit by sunlight reflected from Saturn itself. To see it, slide your cursor over the image (or follow this link). Other Cassini images of Mimas include the small moon's large and ominous Herschel Crater.

Image Credit: Cassini Imaging Team, SSI, JPL, ESA, NASA

Source: Astronomy Picture of the Day

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