Space News Update

— January 17, 2017 —

Contents

1. SpaceX Resumes Flights with On-Target Launch for Iridium

A Falcon 9 rocket lifted off from California's Central Coast at 9:54:39 a.m. PST (12:54:39 p.m. EST; 1754:39 GMT). Credit: SpaceX

SpaceX's Falcon 9 rocket climbed into orbit from California's Central Coast on Saturday, resuming service after an explosive setback last year and delivering much-needed reinforcements to Iridium's satellite constellation providing communications by land, sea and sky.

The comeback mission kicks off a busy launch manifest with more than 20 SpaceX rocket flights expected this year as the company prepares to start launching astronauts, vital national security payloads and a slate of valuable telecommunications satellites for global broadcasters and network clients.

The 229-foot-tall (70-meter) launcher fired away from Vandenberg Air Force Base, a military complex northwest Los Angeles, at 9:54:39 a.m. PST (12:54:39 p.m. EST; 1754:39 GMT) and soared into a brilliant blue sky, trailing a stream of orange-hot exhaust from nine kerosene-fueled Merlin 1D engines as the booster turned south over the Pacific Ocean.

Two-and-a-half minutes later, the first stage of the Falcon 9 rocket detached and flew back to the ground, steering through the rarefied upper atmosphere with aerodynamic grid fins and periodic bursts of rocket thrust, nailing a vertical propulsive landing on a barge — or "drone ship" — loitering in the Pacific Ocean west of Baja California.

The recovery attempts were billed as experiments when SpaceX first tried them, but Saturday's touchdown marked the seventh time one of the 15-story first stage boosters has landed intact. SpaceX intends to refurbish and refly the salvaged rockets, beginning as soon as late February with the launch of a communications craft for SES.

Meanwhile, the mission's primary purpose was the deployment of 10 new-generation voice and data relay spacecraft for Iridium, a provider of global satellite phone, aircraft and ship tracking, and messaging services.

"It's a clean sweep, 10 for 10," said John Insprucker, SpaceX's Falcon 9 product manager. "All the bridge wires show open, and that is a conclusion of the primary mission today, a great one (for the) first stage, second stage, and the customer's satellites deployed into a good orbit."

Engineers from Iridium and Thales Alenia Space, the satellites' prime contractor, verified all 10 relay stations were alive and functioning after their ride to orbit.

Saturday's flight was the first of at least seven Falcon 9 flights planned to populate the Iridium fleet with modernized satellites. Sixty-six are needed to fully replace Iridium's current constellation, and Iridium ordered 15 more as spares.

The Iridium network relies on satellites spread out in six orbital lanes, each home to 11 active spacecraft, to provide uninterrupted global coverage. The company's existing satellites were launched from 1997 through 2002 for missions originally scheduled to least eight years. Nevertheless, most of the satellites have outlived their design lives, and 64 of the 66 relay stations required for worldwide service remain operational.

The upgraded network will offer faster broadband connections, improved functionality and 3G-equivalent cellular phone services for Iridium's pool of nearly 850,000 subscribers, a client list that includes the U.S. military, oil and gas companies, aviation and maritime operators, and mining and construction contractors.

The upgraded satellites also carry piggyback payloads for Aireon, an affiliate of Iridium, to help air traffic controllers track airplane movements worldwide. Iridium Next satellites slated to fly on later launches will host an antenna to monitor maritime traffic for exactEarth, a Canadian company, and Harris Corp. of Melbourne, Florida.

The successful launch clears the way for the resumption of SpaceX missions after a rocket exploded on its launch pad at Cape Canaveral on Sept. 1, grounding the Falcon 9 four-and-a-half months.

SpaceX traced the probable cause of the accident to high-pressure helium tanks on the Falcon 9's upper stage, which are immersed inside super-cold liquid oxygen and wrapped in carbon shell.

Engineers found that voids could form between the aluminum lining of the tanks, which hold cryogenic helium to pressurize the rocket's propellant system for flight, and the carbon overwrap.

Liquid oxygen trapped in the buckles can ignite, investigators said, and most likely led to the sudden explosion Sept. 1 that destroyed a Falcon 9 rocket and a nearly $200 million satellite during a pre-flight test.

SpaceX said they would alter their countdown procedures on future launches, and no longer conduct such "static fire" tests with satellites on-board.

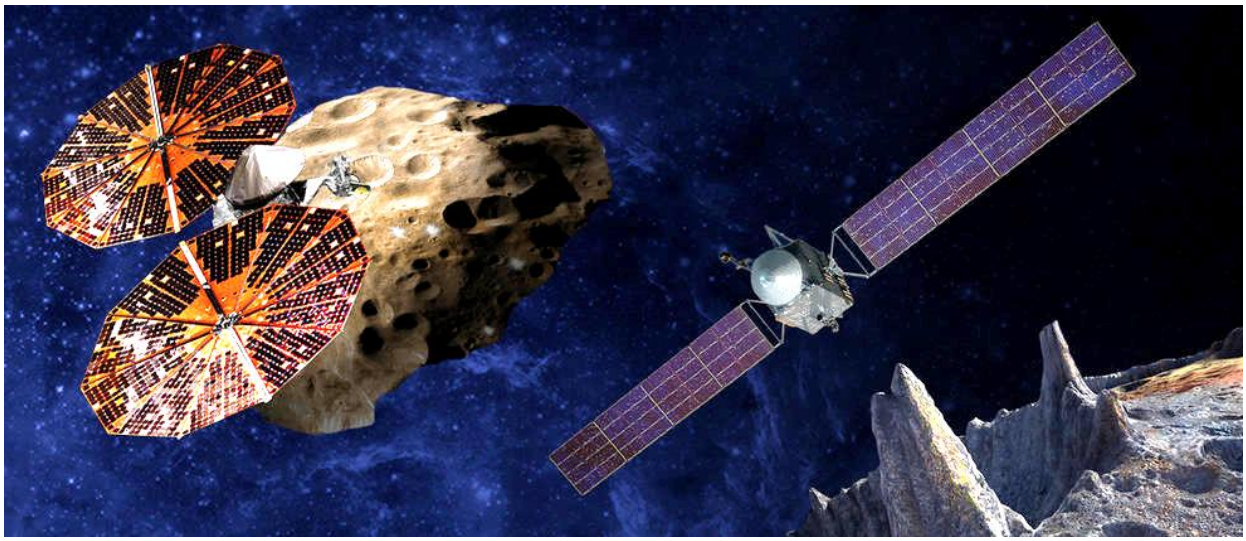
The launch company is shifting its Florida flights to Launch Pad 39A, a shuttle-era facility at NASA's Kennedy Space Center, after the Sept. 1 mishap damaged the Falcon 9's previous pad.

Construction crews are still finishing modifications to Pad 39A for Falcon 9 flights and eventual crewed launches, which are planned in partnership with NASA starting in 2018 to carry astronauts to the International Space Station.

The next Falcon 9 mission could take off as soon as Jan. 26 from Pad 39A with the EchoStar 23 communications satellite. SpaceX's next cargo delivery flight to the space station will follow around Feb. 8.

Source: SpaceflightNow.com Return to Contents

2. NASA Selects Two Missions to Explore the Early Solar System



(Left) An artist's conception of the Lucy spacecraft flying by the Trojan Eurybates – one of the six diverse and scientifically important Trojans to be studied. Trojans are fossils of planet formation and so will supply important clues to the earliest history of the solar system. (Right) Psyche, the first mission to the metal world 16 Psyche will map features, structure, composition, and magnetic field, and examine a landscape unlike anything explored before. Psyche will teach us about the hidden cores of the Earth, Mars, Mercury and Venus. Credits: SwRI and SSL/Peter Rubin

NASA has selected two missions that have the potential to open new windows on one of the earliest eras in the history of our solar system – a time less than 10 million years after the birth of our sun. The missions, known as Lucy and Psyche, were chosen from five finalists and will proceed to mission formulation, with the goal of launching in 2021 and 2023, respectively.

"Lucy will visit a target-rich environment of Jupiter's mysterious Trojan asteroids, while Psyche will study a unique metal asteroid that's never been visited before," said Thomas Zurbuchen, associate administrator for NASA's Science Mission Directorate in Washington. "This is what Discovery Program missions are all about – boldly going to places we've never been to enable groundbreaking science."

Lucy, a robotic spacecraft, is scheduled to launch in October 2021. Lucy's slated to arrive at its first destination, a main belt asteroid, in 2025. From 2027 to 2033, Lucy will explore six Jupiter Trojan asteroids. These asteroids are trapped by Jupiter's gravity at Lagrange points in two swarms that share the planet's orbit, one leading and one trailing Jupiter in its 12-year circuit around the sun.

The Trojans are thought to be relics of a much earlier era in the history of the solar system, and may have formed far beyond Jupiter's current orbit. The asteroids captured at Jupiter's Lagrange points are named after heroes from the Trojan War, with L4 members named after the Greek camp and L5 asteroids named after the Trojan camp.

"This is a unique opportunity," said Harold F. Levison, principal investigator of the Lucy mission from the Southwest Research Institute in Boulder, Colorado. "Because the Trojans are remnants of the primordial material that formed the outer planets, they hold vital clues to deciphering the history of the solar system. Lucy, like the human fossil for which it is named, will revolutionize the understanding of our origins."

Lucy will build on the success of NASA's New Horizons mission to Pluto and the Kuiper Belt, using newer versions of the RALPH and LORRI science instruments that helped enable the mission's achievements. Several members of the Lucy mission team also are veterans of the New Horizons mission. Lucy also will build on the

success of the OSIRIS-REx mission to asteroid Bennu, with the OTES instrument and several members of the OSIRIS-REx team.

The Psyche mission will explore one of the most intriguing targets in the main asteroid belt – a giant metal asteroid, known as 16 Psyche, about three times farther away from the sun than is the Earth. This asteroid measures about 130 miles (210 kilometers) in diameter and, unlike most other asteroids that are rocky or icy bodies, is thought to be comprised mostly of metallic iron and nickel, similar to Earth's core. Scientists wonder whether Psyche could be an exposed core of an early planet that could have been as large as Mars, but which lost its rocky outer layers due to a number of violent collisions billions of years ago.

Astronomers have known for some time that 16 Psyche is a strange world. Discovered by Italian astronomer Annibale de Gasparis on March 17, 1852, later radar observations of 16 Psyche's gravitational perturbations on other asteroids suggest that this small world is actually a large naked metallic core, perhaps a remnant of a planet that never was. It's quite possible that 16 Psyche has shards of pure metal jutting out of its surface.

The mission will help scientists understand how planets and other bodies separated into their layers – including cores, mantles and crusts – early in their histories.

"This is an opportunity to explore a new type of world – not one of rock or ice, but of metal," said Psyche Principal Investigator Lindy Elkins-Tanton of Arizona State University in Tempe. "16 Psyche is the only known object of its kind in the solar system, and this is the only way humans will ever visit a core. We learn about inner space by visiting outer space."

Psyche, also a robotic mission, is targeted to launch in October of 2023, arriving at the asteroid in 2030, following an Earth gravity assist spacecraft maneuver in 2024 and a Mars flyby in 2025.

In addition to selecting the Lucy and Psyche missions for formulation, the agency will extend funding for the Near Earth Object Camera (NEOCam) project for an additional year. The NEOCam space telescope is designed to survey regions of space closest to Earth's orbit, where potentially hazardous asteroids may be found.

"These are true missions of discovery that integrate into NASA's larger strategy of investigating how the solar system formed and evolved," said NASA's Planetary Science Director Jim Green. "We've explored terrestrial planets, gas giants, and a range of other bodies orbiting the sun. Lucy will observe primitive remnants from farther out in the solar system, while Psyche will directly observe the interior of a planetary body. These additional pieces of the puzzle will help us understand how the sun and its family of planets formed, changed over time, and became places where life could develop and be sustained – and what the future may hold."

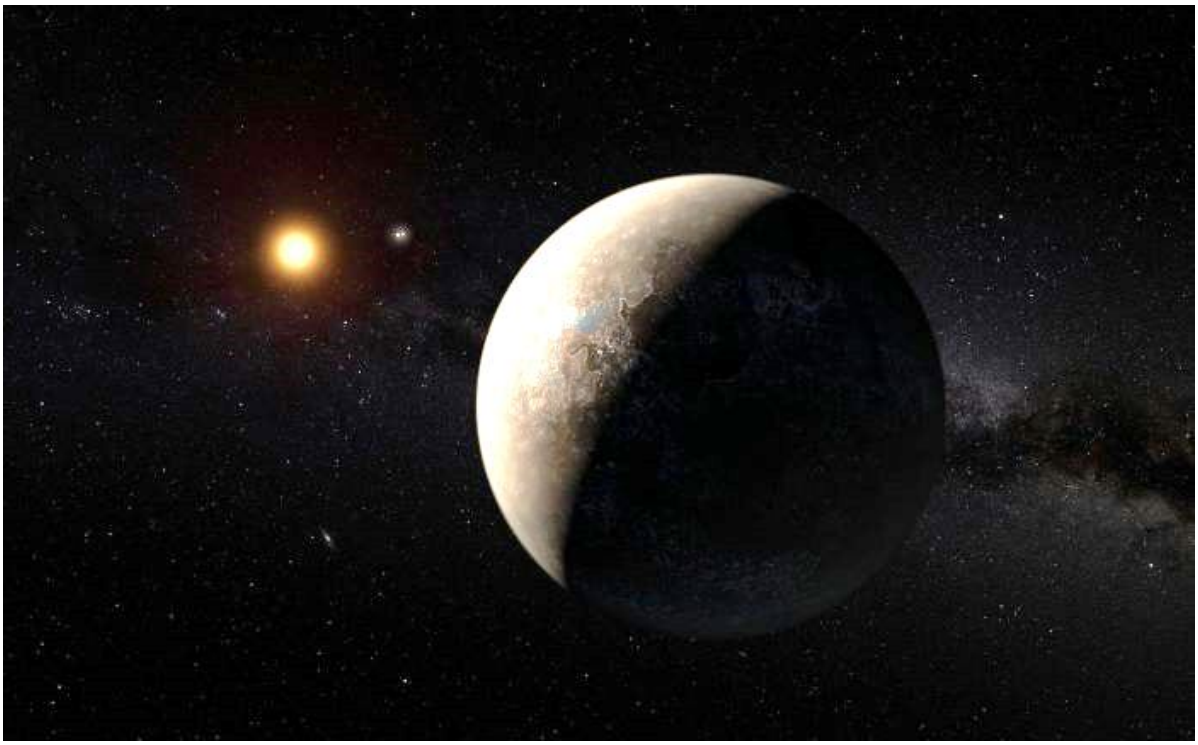
Discovery Program class missions like these are relatively low-cost, their development capped at about $450 million. They are managed for NASA's Planetary Science Division by the Planetary Missions Program Office at Marshall Space Flight Center in Huntsville, Alabama. The missions are designed and led by a principal investigator, who assembles a team of scientists and engineers, to address key science questions about the solar system.

The Discovery Program portfolio includes 12 prior selections such as the MESSENGER mission to study Mercury, the Dawn mission to explore asteroids Vesta and Ceres, and the InSight Mars lander, scheduled to launch in May 2018.

NASA's other missions to asteroids began with the NEAR orbiter of asteroid Eros, which arrived in 2000, and continues with Dawn, which orbited Vesta and now is in an extended mission phase at Ceres. The OSIRIS-REx mission, which launched on Sept. 8, 2016, is speeding toward a 2018 rendezvous with the asteroid Bennu, and will deliver a sample back to Earth in 2023. Each mission focuses on a different aspect of asteroid science to give scientists the broader picture of solar system formation and evolution.

Source: NASA and Sky and Telescope Return to Contents

3. A “Breakthrough” to Search for Planets in Closest Star System to Earth



Artist’s impression of the planet Proxima b orbiting the red dwarf star Proxima Centauri, the closest star to the Solar System. Credit: ESO/M. Kornmesser

Ever since the European Southern Observatory (ESO) announced that they had discovered an exoplanet in the nearby system of Proxima Centauri, there have been a lot of questions about this exoplanet. In addition to whether or not this planet could actually support life, astronomers have also been eager to see if its companion stars – Alpha Centauri A and B – have exoplanets too.

Prior to the discovery of Proxima b, Alpha Centauri was thought to host the closest exoplanets to Earth (Alpha Bb and Bc). However, time has cast doubt on the existence of the first, while the second’s existence remains unconfirmed. But thanks to a recent agreement between the ESO and Breakthrough Initiatives, we may yet find out if there are exoplanets in Alpha Centauri – which will come in handy when it comes time to explore there!

In accordance with this agreement, Breakthrough Initiatives will provide additional funds so that the ESO’s Very Large Telescope (VLT), located at the La Silla Paranal Observatory in Chile, can be modified to conduct a special search program of Alpha Centauri. This will involve upgrading the VLT Imager and Spectrometer for mid-Infrared (VISIR) instrument with new equipment that will enhance its planet-hunting abilities.

This includes a new instrument module that will allow the VLT to use a technique known as coronagraphy – a form of adaptive optics that corrects for a star’s brightness, thus making it easier for a telescope to spot the thermal glow of orbiting planets around them. While the Breakthrough Prize Foundation will pay a large fraction of the upgrade costs, the ESO will be making the VLT and its staff available to conduct the survey – which is scheduled for 2019.

Such an agreement is truly a win-win scenario. For the ESO, this will not only improve the VLT’s imaging abilities, but will also assist with the development of the European Extremely Large Telescope (E-ELT). This proposed array, which is scheduled for completion by 2024, will rely on the Mid-infrared E-ELT Imager and Spectrograph (METIS) instrument to hunt for potentially habitable exoplanets.

Any lessons learned from the upgrade of VISIR will allow them to develop the necessary expertise to run METIS, and will also allow them to test the effectiveness of the technology beforehand. For Breakthrough Initiatives,

determining if there are any planets in the Alpha Centauri system will go a long way towards helping them mount their historic mission to this star.

In the coming years, Breakthrough Initiatives hopes to mount the first interstellar voyage in history using a lightsail and nanocraft that would rely on lasers to push it up to relativistic speeds (20% the speed of light). Known as Breakthrough Starshot, this craft could be ready to launch in a few years' time, and would reach Alpha Centauri in just 20 years' time.

Once there, the nanocraft (using a series of microsensors) would relay information back to Earth about the Alpha Centauri system – which would include any information on its system of planets, and whether or not they are habitable. Hence, determining if there's anything there to study in the first place will help lay the groundwork for the mission.

As Professor Avi Loeb – the Frank B. Baird, Jr. Professor of Science at Harvard and a member of the Breakthrough Starshot Advisory Committee – told Universe Today via email:

"We hope that the partnership between the Breakthrough Prize Foundation and ESO will lead to the discovery of new habitable planets around the nearest stars. Once discovered, we could search for the molecular signatures of life in the atmosphere of these planets, and potentially even send a spacecraft that will reach them within our lifetime. The latter is the driver for the Starshot Initiative. The discovery of habitable nearby planets will provide us with targets for photography by gram-scale spacecrafts, launched at a fraction of the speed of light and equipped with cameras. For example, we would like to find out whether such planets are covered by blue oceans, green vegetation or yellow deserts."

Image of the Alpha Centauri AB system and its distant and faint companion, Proxima Centauri.

Credit: ESO

Source: UniverseToday.com

Return to Contents

The Night Sky

Tuesday, January 17

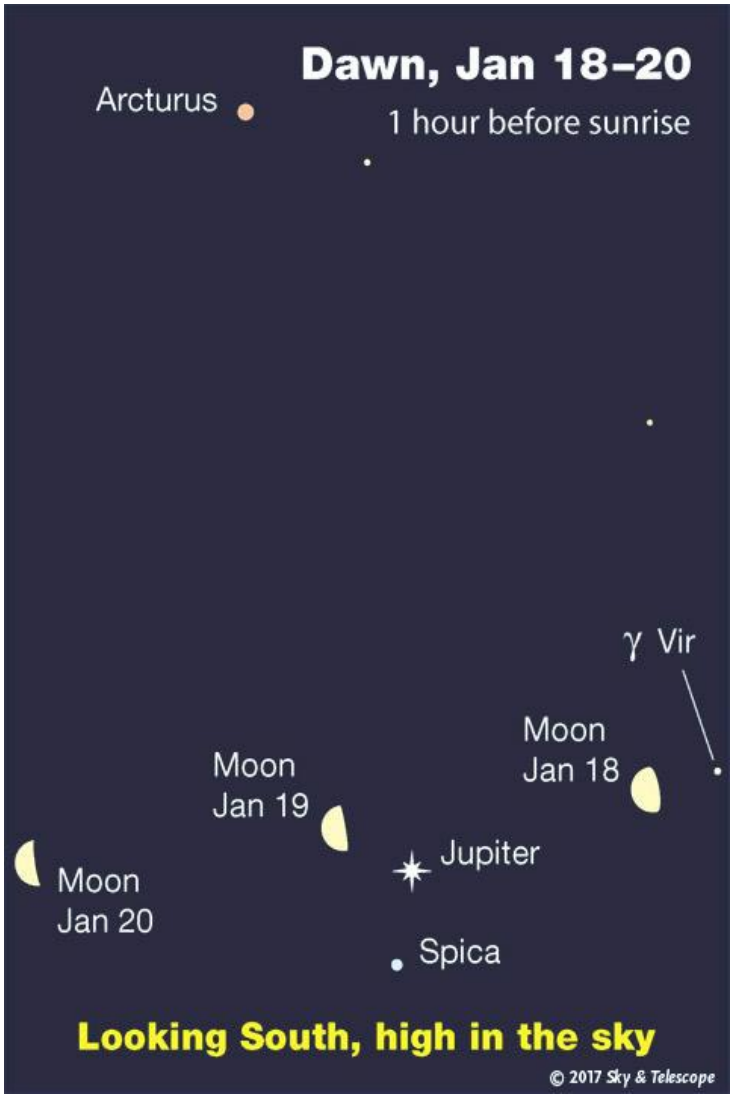
- Sirius twinkles brightly after dinnertime below Orion in the southeast. Around 8 or 9 p.m., depending on your location, Sirius shines *precisely below* fiery Betelgeuse in Orion's shoulder. How accurately can you time this event for your location, perhaps using a plumb bob or the vertical edge of a building? Of the two, Sirius leads early in the evening; Betelgeuse leads later. Welcome to pre-telescopic astronomy.

Wednesday, January 18

- The Moon, nearly last-quarter, rises around midnight tonight in the company of Jupiter and Spica; they're only a few degrees apart. By the beginning of dawn on Thursday morning the 19th, the bunch of three is standing in proud view high near the meridian, as shown at right.
- The deep, flat-bottomed eclipsing binary star RW Tauri drops from 8th to 12th magnitude and back tonight, centered on 11:20 p.m. EST. See the observing project in the January *Sky & Telescope*, page 48.

Thursday, January 19

- Last-quarter Moon (exactly so at 5:13 p.m. EST). The Moon rises around midnight or 1 a.m. tonight, now to the lower left of Jupiter and Spica. By dawn Friday morning they're again high in the south, with the Moon well left of Jupiter and Spica, as shown here.



Early risers: look out your south window for the Moon passing the Jupiter-Spica pair in early dawn

Friday, January 20

- After dinnertime, the bright, equilateral Winter Triangle glitters in the southeast. Sirius is its brightest and lowest star. Betelgeuse stands above Sirius by about two fists at arm's length. To the left of their midpoint is Procyon.

Saturday, January 21

- Is your sky dark enough for you to see the winter Milky Way? After dinnertime now, it runs vertically up and across the zenith: from Canis Major low in the southeast, up between Orion and Gemini, through Auriga and Perseus almost straight overhead, and down through Cassiopeia, Cepheus, and Cygnus to the northwest horizon.

Source: Sky and Telescope

Return to Contents

ISS Sighting Opportunities (from Denver)

Date	Visible	Max Height	Appears	Disappears
Tue Jan 17, 5:38 AM	2 min	49°	46° above N	29° above E
Wed Jan 18, 4:48 AM	< 1 min	17°	17° above E	17° above E
Wed Jan 18, 6:21 AM	5 min	31°	16° above W	11° above SSE
Thu Jan 19, 5:31 AM	3 min	52°	52° above S	10° above SE
Fri Jan 20, 4:41 AM	< 1 min	12°	12° above ESE	12° above ESE
Fri Jan 20, 6:14 AM	2 min	12°	12° above WSW	10° above SSW
Sat Jan 21, 5:25 AM	< 1 min	15°	15° above S	10° above S

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

NASA-TV Highlights **(all times Eastern Time Zone)**

Wednesday, January 18

- 8 a.m. - ISS Expedition 50 In-Flight Event with France 2 for the European Space Agency with Flight Engineer Thomas Pesquet of ESA (all channels)

Thursday, January 19

- 10:30 a.m. - ISS Expedition 50 In-Flight Educational Event with Iowa Public Television in Johnston, Iowa and Flight Engineer Peggy Whitson of NASA (starts at 10:25 a.m.) (all channels)
-

Watch NASA TV online by going to the NASA website.

Former astronaut Gene Cernan, a Navy pilot and veteran of NASA's pioneering Gemini program who was the second American to walk in space and then flew to the moon twice as an Apollo astronaut, becoming the last human to leave his bootprints on its dusty surface, died Monday after a long illness. He was 82.

Cernan is survived by his wife, Jan Nanna Cernan, his daughter, two step daughters and nine grandchildren.

Return to Contents

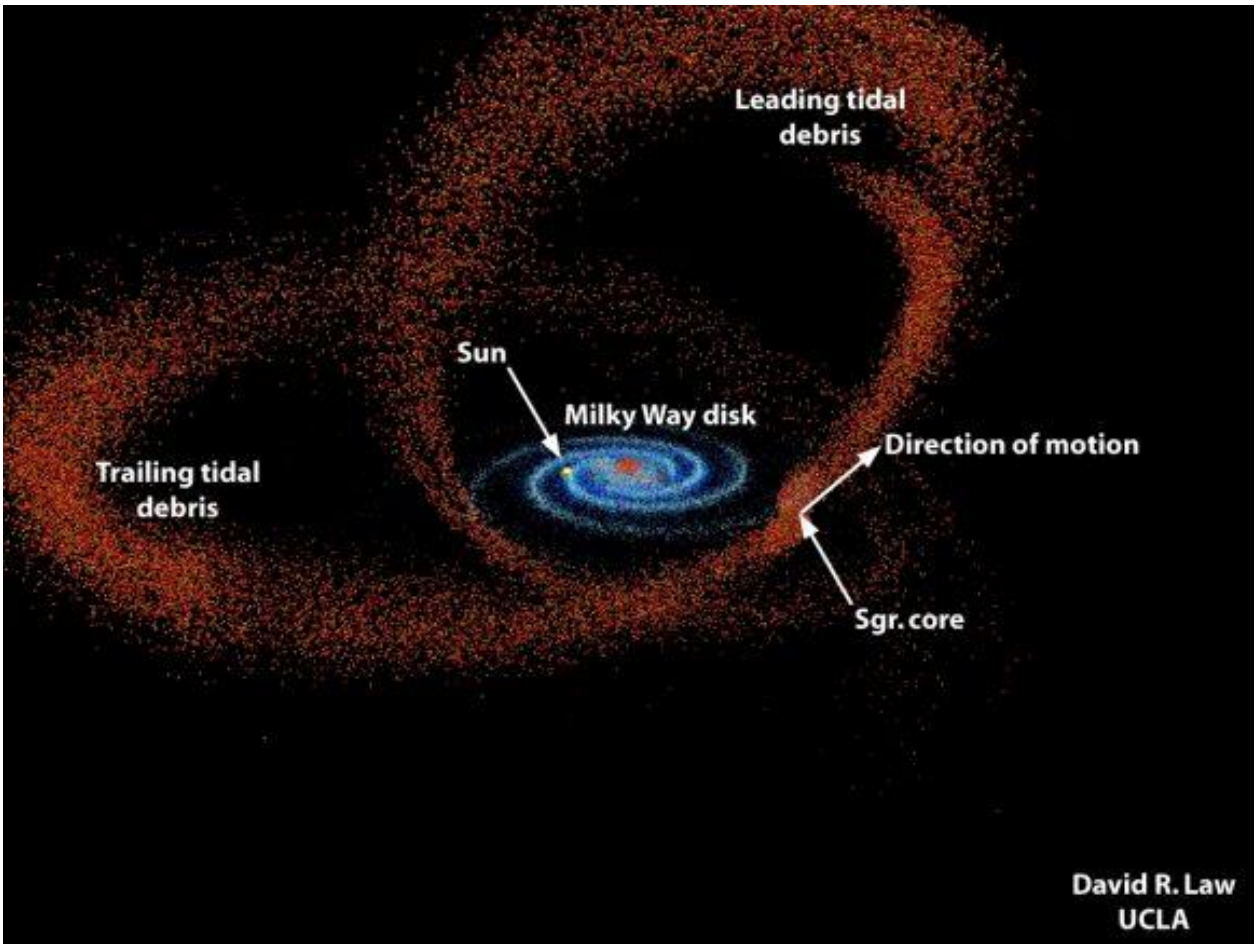
Space Calendar

- Jan 17 - Cassini, Distant Flyby of Titan
- Jan 17 - Comet 143P/Kowal-Mrkos Closest Approach To Earth (2.892 AU)
- Jan 17 - Asteroid 51828 Ilanramon Closest Approach To Earth (1.508 AU)
- Jan 17 - Asteroid 4342 Freud Closest Approach To Earth (2.023 AU)
- Jan 17 - 15th Anniversary (2002), Galileo, Io 33 Flyby
- Jan 17 - Elisabeth Hevelius' 370th Birthday (1647)
- Jan 18 - Comet P/2010 A2 (LINEAR) Closest Approach To Earth (1.045 AU)
- Jan 18 - Comet 105P/Singer Brewster Closest Approach To Earth (2.983 AU)
- Jan 18 - Comet P/2015 X3 (PANSTARRS) At Opposition (3.334 AU)
- Jan 18 - Comet C/2015 XY1 (Lemmon) Closest Approach To Earth (7.451 AU)
- Jan 18 - Asteroid 21 Lutetia Occults 2UCAC 40341430 (12.2 Magnitude Star)
- Jan 18 - Apollo Asteroid 2016 YC8 Near-Earth Flyby (0.024 AU)
- Jan 18 - Apollo Asteroid 2015 BB Near-Earth Flyby (0.035 AU)
- Jan 18 - Apollo Asteroid 2017 AP13 Near-Earth Flyby (0.080 AU)
- Jan 19 - **SBIRS GEO 3** **Atlas 5 Launch**
- Jan 19 - Mercury At Its Greatest Western Elongation (24 Degrees)
- Jan 19 - Amor Asteroid 2017 AO13 Near-Earth Flyby (0.061 AU)
- Jan 19 - Asteroid 163693 Atira Closest Approach To Earth (0.207 AU)
- Jan 19 - Asteroid 8277 Machu-Picchu Closest Approach To Earth (1.337 AU)
- Jan 19 - Asteroid 4433 Goldstone Closest Approach To Earth (1.741 AU)
- Jan 19 - Asteroid 1776 Kuiper Closest Approach To Earth (2.092 AU)
- Jan 19 - 15th Anniversary (2002), Discovery of SAU 090 Meteorite (Mars Meteorite)
- Jan 19 - 130th Anniversary (1887), John Thome's Discovery of the Great Southern Comet of 1887
- Jan 19 - Johann Bode's 270th Birthday (1747)
- Jan 20 - Comet P/2010 A2 (LINEAR) At Opposition (1.046 AU)
- Jan 20 - Comet P/2013 YG46 (Spacewatch) Perihelion (1.804 AU)
- Jan 20 - Comet 220P/McNaught At Opposition (3.092 AU)
- Jan 20 - Asteroid 4 Vesta Closest Approach To Earth (1.522 AU)
- Jan 20 - Kuiper Belt Object 20000 Varuna At Opposition (42.859 AU)

Source: JPL Space Calendar Return to Contents

Food for Thought

Stars at the Edge of our Galaxy May Have Been Stolen



A model of the tidally shredded Sagittarius dwarf galaxy wrapping around a 3-D representation of the Milky Way disk. Credit: UCLA/D.R. Law

Our Milky Way is a pretty vast and highly-populated space. All told, its stars number between 100 and 400 billion, with some estimates saying that it may have as many as 1 trillion. But just where did all these stars come from? Well, as it turns out, in addition to forming many of its own and merging with other galaxies, the Milky Way may have stolen some of its stars from other galaxies.

Such is the argument made by two astronomers from Harvard-Smithsonian Center for Astrophysics. According to their study, which has been accepted for publication in the *Astrophysical Journal*, they claim that roughly half of the stars that orbit at the extreme outer edge of the Milky Way were actually stolen from the nearby Sagittarius dwarf galaxy.

At one time, the Sagittarius Dwarf Elliptical Galaxy was thought to be the closest galaxy to our own (a position now held by the Canis Major dwarf galaxy). As one of several dozen dwarf galaxies that surround the Milky Way, it has orbited our galaxy several times in the past. With each passing orbit, it becomes subject to our galaxy's strong gravity, which has the effect of pulling it apart.

The long-term effects of this can be seen by looking to the farthest stars in our galaxy, which consist of the eleven stars that are at a distance of about 300,000 light-years from Earth (well beyond the Milky Way's spiral

disk). According the study produced by Marion Dierickx, a graduate student at Harvard University's Department of Astronomy, half of these stars were taken from the Sagittarius dwarf galaxy in the past.

Professor Avi Loeb, the Frank B. Baird, Jr. Professor of Science at Harvard and Marion Dierickx PhD advisor, co-authored the study – titled, "Predicted Extension of the Sagittarius Stream to the Milky Way Virial Radius". As he told Universe Today via email:

"We see evidence for streams of stars connected to the core of the galaxy, and indicating that this dwarf galaxy passed multiple times around the Milky Way center and was ripped apart by the tidal gravitational field of the Milky Way. We are all familiar with the tide in the ocean caused by the gravitational pull of the moon, but if the moon was a much more massive object – it would have pulled the oceans apart from the Earth and we would see a stream of vapor stretched away from the Earth."

For the sake of their study, Dierickx and Loeb ran computer models to simulate the movements of the Sagittarius dwarf over the past 8 billion years. These simulations reproduced the streams of stars stretching away from the Sagittarius dwarf galaxy to the center of our galaxy. They also varied Sagittarius' velocity and angle of approach to see if the resulting exchanges would match current observations.

"We attempted to match the distance and velocity data for the core of the Sagitarrius galaxy, and then compared the resulting prediction for the position and velocity of the streams of stars," said Loeb. "The results were very encouraging for some particular set of initial conditions regarding the start of the Sagittarius galaxy journey when the universe was roughly half its present age."

What they found was that over time, the Sagittarius dwarf lost about one-third of its stars and nine-tenths of its dark matter to the Milky Way. The end result of this was the creation of three distinct streams of stars that reach one million light-years from galactic center to the very edge of the Milky Way's halo. Interestingly enough, one of these streams has been predicted by simulations conducted by projects like the Sloan Digital Survey.

The simulations also showed that five of Sagittarius' stars would end becoming part of the Milky Way. What's more, the positions and velocities of these stars coincided with five of the most distant stars in our galaxy. The other six do not appear to be from Sagittarius dwarf, and may be the result of gravitational interactions with another dwarf galaxy in the past.

"The dynamics of stars in the extended arms we predict (which is the largest Galactic structure on the sky ever predicted) can be used to measure the mass and structure of the Milky Way," said Loeb. "The outer envelope of the Milky Way was never probed directly, because no other stream was known to extend that far."

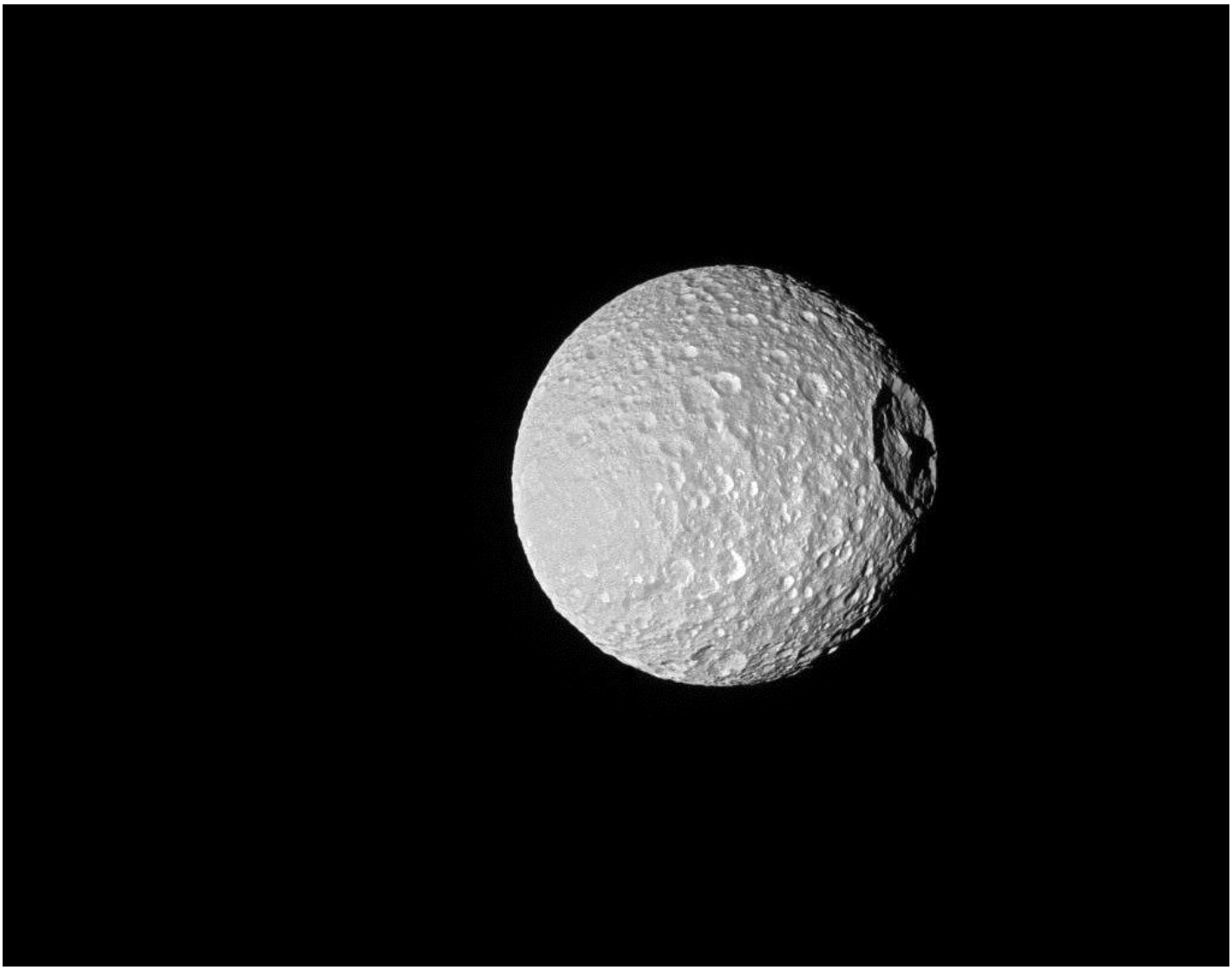
Given the way the simulations match up with current observations, Dierickx is confident that more Sagittarius dwarf interlopers are out there, just waiting to be found. For instance, future instruments – like the Large Synoptic Survey Telescope (LSST), which is expected to begin full-survey operations by 2022 – may be able to detect the two remaining streams of stars which were predicted by the survey.

Given the time scales and the distances involved, it is rather difficult to probe our galaxy (and by extension, the Universe) to see exactly how it evolved over time. Pairing observational data with computer models, however, has been proven to test our best theories of how things came to be. In the future, thanks to improved instruments and more detailed surveys, we just might know for certain!

And sure to check out this animation of the computer simulation, which shows the effects on the Milky Way's gravity on the Sagittarius dwarf galaxy's stars and dark matter.

Source: UniverseToday.com Return to Contents

Space Image of the Week



Mimas, Crater, and Mountain

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

Explanation: Mimas is an icy, crater-pocked moon of Saturn a mere 400 kilometers (250 miles) in diameter. Its largest crater Herschel is nearly 140 kilometers wide. About a third the diameter of Mimas itself, Herschel crater gives the small moon an ominous appearance, especially for scifi fans of the Death Star battlestation of Star Wars fame. In fact, only a slightly bigger impact than the one that created such a large crater on a small moon could have destroyed Mimas entirely.

In this Cassini image from October 2016, the anti-Saturn hemisphere of the synchronously rotating moon is bathed in sunlight, its large crater near the right limb. Casting a long shadow across the crater floor, Herschel's central mountain peak is nearly as tall as Mount Everest on planet Earth.

Source: NASA APOD

Return to Contents