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1. China Sets November Launch For Lunar Sample Return Mission

China plans to launch a robotic mission to return samples from the lunar surface, the first such mission in four decades, in November on top of the country’s new heavy-lift Long March 5 rocket, according to state media reports.

The government-run Xinhua news agency said the mission, which has been scheduled for launch in 2017 for some time, is on track for liftoff from the Wenchang space center on Hainan Island in November, citing sources at the China Aerospace Science and Technology Corp.

The Chang’e 5 mission will attempt to retrieve the first lunar surface samples for return to Earth since the Soviet Union’s robotic Luna 24 mission in August 1976.

The eight-ton (8.2-metric-ton) spacecraft will launch on a Long March 5 rocket, one of the most powerful boosters currently in service. The Long March 5 made a successful maiden flight last November.

Chang’e 5 will touch down on the moon, gather samples for delivery into a capsule on top of a small rocket, and the ascent vehicle will blast off to dock with a return module loitering in lunar orbit.

The return capsule, protected by a heat shield, will separate from the Chang’e 5 carrier craft on the trip back to Earth for a high-speed atmospheric re-entry and parachute-assisted landing. Scientists and recovery teams will be on standby to pick up the samples after the mission, which is expected to last several weeks.

A demonstrator probe launched by China in 2014 validated the technologies needed for a re-entry at interplanetary speeds. China’s crew-carrying Shenzhou capsules come down at slower speeds and encounter less extreme heating when returning to Earth from orbit several hundred miles up.
“The development of Chang‘e-5 has entered the end of its flight model phase, and relevant work is proceeding smoothly, according to CASC,” Xinhua reported.

China’s unpiloted moon missions began in 2007 with the launch of Chang‘e 1, the country’s first lunar orbiter. The Chang‘e 2 orbiter followed with a launch in 2010, and that spacecraft departed the moon’s vicinity after completing its primary mapping mission, conducting China’s first flyby of an asteroid in December 2012.

The Chang‘e 3 lander took off in December 2013 and made a soft touchdown in the moon’s Mare Imbrium region, deploying a mobile rover that spent several weeks driving across the surface.

The Chang‘e missions are named for a moon goddess in Chinese mythology.

Future Chinese lunar projects include Chang‘e 4, a copy of the Chang‘e 3 lander and rover, which will attempt the first-ever landing on the far side of the moon in 2018. China is developing a deep space communications satellite to relay commands and science data between ground controllers and Chang‘e 4, which will be out of reach of ground-based antennas after landing.

A duplicate of the Chang‘e 5 sample return craft, tentatively dubbed Chang‘e 6, could try for a rock retrieval mission on the far side of the moon in the early 2020s, assuming the near-side sample return goes well, Chinese officials said last year.

Chinese officials are discussing the possibility of sending astronauts to the moon, but the country’s near-term human spaceflight program has emphasized the construction of a permanently-occupied space station in Earth orbit, with completion of the outpost expected by 2022.

China is also developing a Mars rover to launch in 2020 on the nation’s first robotic expedition to another planet.

Source: SpaceflightNow.com

The November test launch of China’s heavy-lift Long March 5 rocket was successful. Credit: Xinhua
NASA's Fermi Sees Gamma Rays from 'Hidden' Solar Flares

These solar flares were imaged in extreme ultraviolet light by NASA's STEREO satellites, which at the time were viewing the side of the sun facing away from Earth. All three events launched fast coronal mass ejections (CMEs). Although NASA's Fermi Gamma-ray Space Telescope couldn't see the eruptions directly, it detected high-energy gamma rays from all of them. Scientists think particles accelerated by the CMEs rained onto the Earth-facing side of the sun and produced the gamma rays. The central image was returned by the STEREO A spacecraft, all others are from STEREO B. Credits: NASA/STEREO

An international science team says NASA's Fermi Gamma-ray Space Telescope has observed high-energy light from solar eruptions located on the far side of the sun, which should block direct light from these events. This apparent paradox is providing solar scientists with a unique tool for exploring how charged particles are accelerated to nearly the speed of light and move across the sun during solar flares.

"Fermi is seeing gamma rays from the side of the sun we're facing, but the emission is produced by streams of particles blasted out of solar flares on the far side of the sun," said Nicola Omodei, a researcher at Stanford University in California. "These particles must travel some 300,000 miles within about five minutes of the eruption to produce this light."

Omodei presented the findings on Monday, Jan. 30, at the American Physical Society meeting in Washington, and a paper describing the results will be published online in The Astrophysical Journal on Jan. 31.

On three occasions, NASA's Fermi Gamma-ray Space Telescope has detected gamma rays from solar storms on the far side of the sun, emission the Earth-orbiting satellite shouldn't be able to detect. Particles accelerated by these eruptions somehow reach around to produce a gamma-ray glow on the side of the sun facing Earth and Fermi.

Fermi has doubled the number of these rare events, called behind-the-limb flares, since it began scanning the sky in 2008. Its Large Area Telescope (LAT) has captured gamma rays with energies reaching 3 billion electron volts, some 30 times greater than the most energetic light previously associated with these "hidden" flares.
Thanks to NASA's Solar Terrestrial Relations Observatory (STEREO) spacecraft, which were monitoring the solar far side when the eruptions occurred, the Fermi events mark the first time scientists have direct imaging of beyond-the-limb solar flares associated with high-energy gamma rays.

"Observations by Fermi's LAT continue to have a significant impact on the solar physics community in their own right, but the addition of STEREO observations provides extremely valuable information of how they mesh with the big picture of solar activity," said Melissa Pesce-Rollins, a researcher at the National Institute of Nuclear Physics in Pisa, Italy, and a co-author of the paper.

The hidden flares occurred Oct. 11, 2013, and Jan. 6 and Sept. 1, 2014. All three events were associated with fast coronal mass ejections (CMEs), where billion-ton clouds of solar plasma were launched into space. The CME from the most recent event was moving at nearly 5 million miles an hour as it left the sun. Researchers suspect particles accelerated at the leading edge of the CMEs were responsible for the gamma-ray emission.

Large magnetic field structures can connect the acceleration site with distant part of the solar surface. Because charged particles must remain attached to magnetic field lines, the research team thinks particles accelerated at the CME traveled to the sun's visible side along magnetic field lines connecting both locations. As the particles impacted the surface, they generated gamma-ray emission through a variety of processes. One prominent mechanism is thought to be proton collisions that result in a particle called a pion, which quickly decays into gamma rays.

In its first eight years, Fermi has detected high-energy emission from more than 40 solar flares. More than half of these are ranked as moderate, or M class, events. In 2012, Fermi caught the highest-energy emission ever detected from the sun during a powerful X-class flare, from which the LAT detected high-energy gamma rays for more than 20 record-setting hours.

NASA's Fermi Gamma-ray Space Telescope is an astrophysics and particle physics partnership, developed in collaboration with the U.S. Department of Energy and with important contributions from academic institutions and partners in France, Germany, Italy, Japan, Sweden and the United States.

Combined images from NASA's Solar Dynamics Observatory (center) and the NASA/ESA Solar and Heliospheric Observatory (red and blue) show an impressive coronal mass ejection departing the far side of the sun on Sept. 1, 2014. This massive cloud raced away at about 5 million mph and likely accelerated particles that later produced gamma rays Fermi detected. 
Credits: NASA/SDO and NASA/ESA/SOHO

Source: NASA

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3. Dream Chaser Spacecraft Arrives at NASA Armstrong

Sierra Nevada Corporation delivered its Dream Chaser spacecraft Wednesday to NASA's Armstrong Flight Research Center in California, located on Edwards Air Force Base. The spacecraft will undergo several months of testing at the center in preparation for its approach and landing flight on the base's 22L runway.

The test series is part of a developmental space act agreement SNC has with NASA’s Commercial Crew Program. The upcoming test campaign will help SNC validate the aerodynamic properties, flight software and control system performance of the Dream Chaser.

The Dream Chaser is also being prepared to deliver cargo to the International Space Station under NASA’s Commercial Resupply Services 2 (CRS2) contract beginning in 2019. The data that SNC gathers from this test campaign will help influence and inform the final design of the cargo Dream Chaser, which will fly at least six cargo delivery missions to and from the space station by 2024.

Source: NASA

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Dream Chaser Spacecraft Joins Boulder County Morning Commuter Traffic

Morning commuters in Boulder and Longmont on Friday found themselves sharing the road with an oversized vehicle that appeared more appropriate for the airspace above them.

A spokeswoman for Louisville's Sierra Nevada Corporation confirmed that its Dream Chaser spacecraft has been "wrapped up" and was being transported to an undisclosed location for testing.

Motorists might well have seen the spacecraft, on a truck with police escort, on Arapahoe Road, Foothills Parkway or the Diagonal Highway before it headed east on Colo. 119 toward Interstate 25.

Sierra Nevada communications manager Kimberly Schwandt said Friday that she had no more details to provide about its destination.

Sierra Nevada's Dream Chaser spacecraft is a multi-mission, commercial, lifting-body vehicle capable of transporting services to low-Earth orbit destinations, including the International Space Station. Officials have said that payloads will be selected in early 2018 to allow time for development and integration into the Dream Chaser for expected launch in 2021.

Source: Boulder Daily Camera

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The Night Sky

Tuesday, January 31

- The waxing crescent Moon, bright Venus, and faint, distant Mars form a triangle in the west during and after dusk, as shown at right.

Wednesday, February 1

- As soon as it's dark, spot the equilateral Winter Triangle in the southeast. Sirius is the triangle's brightest and lowest star. Betelgeuse stands above Sirius by about two fists at arm's length. Left of their midpoint is Procyon.
- And, standing directly above Procyon now (depending on your latitude) is Gomeisa, Beta Canis Minoris, the only other easy naked-eye star of Canis Minor.

Thursday, February 2

- Right after dark this week, face east and look almost overhead. The bright star there is Capella, the Goat Star. To the right of it, by a couple of finger-widths at arm's length, is a small, narrow triangle of 3rd and 4th magnitude stars known as "the Kids." Although they're not exactly eye-grabbing, they form a never-forgotten asterism with Capella.
- Algol should be at minimum light for about two hours centered on 7:54 p.m. EST.

Friday, February 3

- First-quarter Moon (exact at 11:19 p.m. EST). At sunset the half-lit Moon is high in the south, and after dark it balances on the dim head of Cetus. Spot the stars of Aries to its upper right, and the Pleiades a little farther to its upper left.

Saturday, February 4

- In early evening the Pleiades stand above the Moon, and Aldebaran shines left of the Moon.
### ISS Sighting Opportunities (from Denver)

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Sighting information for other cities can be found at [NASA’s Satellite Sighting Information](https://nssdc.gsfc.nasa.gov/spaceflight/iss/iss_sighting.html).

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

**Wednesday, February 1**

- 9:30 a.m. - ISS Expedition 50 In-Flight Event for Social Media at Space Center, Houston with ISS Commander Shane Kimbrough and Flight Engineer Peggy Whitson of NASA (all channels)

Watch NASA TV online by going to the [NASA website](https://www.nasa.gov).
Space Calendar

- **Jan 31** - *Apollo Asteroid 2017 BJ30* Near-Earth Flyby (0.003 AU)
- Jan 31 - *Aten Asteroid 2017 BB7* Near-Earth Flyby (0.008 AU)
- Jan 31 - *Apollo Asteroid 2017 BN30* Near-Earth Flyby (0.026 AU)
- Jan 31 - *Apollo Asteroid 2017 BY5* Near-Earth Flyby (0.027 AU)
- Jan 31 - *Apollo Asteroid 2017 BT6* Near-Earth Flyby (0.034 AU)
- Jan 31 - *Comet 73P-J/Schwassmann-Wachmann* Closest Approach To Earth (1.728 AU)
- Jan 31 - 40th Anniversary (1977), *Louisville Meteorite* Fall (Hit Buildings, Car in Kentucky)
- Feb 01 - *Comet C/2016 T1 (Matheny)* Perihelion (2.298 AU)
- Feb 01 - *Comet 61P/Shajn-Schaldach* Closest Approach To Earth (2.785 AU)
- Feb 01 - *Apollo Asteroid 2017 BJ29* Near-Earth Flyby (0.069 AU)
- Feb 01 - *Comet 336P/McNaught* Perihelion (2.839 AU)
- Feb 01 - *Comet 193P/LINEAR-NEAT* At Opposition (3.554 AU)
- Feb 01 - *Comet 73P-BK/Schwassmann-Wachmann* Closest Approach To Earth (1.714 AU)
- Feb 02 - *Apollo Asteroid 2017 BB6* Near-Earth Flyby (0.014 AU)
- Feb 02 - *Comet 183P/Korlevic-Juric* Closest Approach To Earth (3.039 AU)
- Feb 02 - *Aten Asteroid 364136 (2006 CJ)* Near-Earth Flyby (0.080 AU)
- Feb 02 - *Asteroid 40227 Tahiti* Closest Approach To Earth (3.893 AU)
- Feb 02 - *Asteroid 3317 Paris* Closest Approach To Earth (4.823 AU)
- Feb 02 - 40th Anniversary (1977), Burnup of the *Salyut 4 Space Station* (USSR)
- Feb 02 - *Cuno Hoffmeister's* 125th Birthday (1892)
- **Feb 03** - *Echostar 23 Falcon 9 Launch*
- Feb 03 - *Moon Occults Dwarf Planet Ceres*
- Feb 03 - *Aten Asteroid 2005 VL1* Near-Earth Flyby (0.029 AU)
- Feb 03 - *Comet 336P/McNaught* Perihelion (2.782 AU)
- Feb 03 - *Asteroid 2991 Bilbo* Closest Approach To Earth (1.834 AU)
- Feb 03 - *Asteroid 4535 Adamcarolla* Closest Approach To Earth (1.869 AU)
- Feb 03 - *Asteroid 12397 Peterbrown* Closest Approach To Earth (1.918 AU)
- **Feb 03** - *International Academy of Astronautics (IAA) Regional Meeting*, Denver, Colorado
- Feb 03 - 15th Anniversary (2002), *Alby sur Cheran Meteorite* Fall (Hit Building in France)
- Feb 03 - 135th Anniversary (1882), *Mocs Meteorite Shower* in Romania
- Feb 04 - 50th Anniversary (1967), *Lunar Orbiter 3* Launch
- Feb 04 - *Comet 73P-BN/Schwassmann-Wachmann* Closest Approach To Earth (1.690 AU)
- Feb 04 - *Comet 327P/Van Ness* At Opposition (2.839 AU)
- Feb 04 - *Comet 314P/Montani* Closest Approach To Earth (3.299 AU)

Source: *JPL Space Calendar*

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Food for Thought

Extreme Space Weather-Induced Electricity Blackouts Could Cost U.S. More Than $40 Billion Daily

The daily U.S. economic cost from solar storm-induced electricity blackouts could be in the tens of billions of dollars, with more than half the loss from indirect costs outside the blackout zone, according to a new study.

Previous studies have focused on direct economic costs within the blackout zone, failing to take into account indirect domestic and international supply chain loss from extreme space weather.

"On average the direct economic cost incurred from disruption to electricity represents only 49 percent of the total potential macroeconomic cost," says the paper published in Space Weather, a journal of the American Geophysical Union. The paper was co-authored by researchers from the Cambridge Centre for Risk Studies at University of Cambridge Judge Business School; British Antarctic Survey; British Geological Survey and University of Cape Town.

Under the study’s most extreme blackout scenario, affecting 66 percent of the U.S. population, the daily domestic economic loss could total $41.5 billion plus an additional $7 billion loss through the international supply chain.

Electrical engineering experts are divided on the possible severity of blackouts caused by “Coronal Mass Ejections,” or magnetic solar fields ejected during solar flares and other eruptions. Some believe that outages would last only hours or a few days because electrical collapse of the transmission system would protect electricity generating facilities, while others fear blackouts could last weeks or months because those transmission networks could in fact be knocked out and need replacement.

Extreme space weather events occur often, but only sometimes affecting Earth. The best-known geomagnetic storm affected Quebec in 1989, sparking the electrical collapse of the Hydro-Quebec power grid and causing a widespread blackout for about nine hours.

There was a very severe solar storm in 1859 known as the “Carrington event” (after the name of a British astronomer). A widely cited 2012 paper by Pete Riley of Predictive Sciences Inc. said that the probability of another Carrington event occurring within the next decade is around 12 percent; a 2013 report by insurer Lloyd’s, produced in collaboration with Atmospheric and Environmental Research, said that while the
probability of an extreme solar storm is “relatively low at any given time, it is almost inevitable that one will occur eventually.”

“We felt it was important to look at how extreme space weather may affect domestic U.S. production in various economic sectors, including manufacturing, government and finance, as well as the potential economic loss in other nations owing to supply chain linkages,” says study co-author Edward Oughton of the Cambridge Centre for Risk Studies at Cambridge Judge Business School. “It was surprising that there had been a lack of transparent research into these direct and indirect costs, given the uncertainty surrounding the vulnerability of electrical infrastructure to solar incidents.”

The study’s scope was guided by a July 2015 conference held at Cambridge Judge.

Manufacturing is the U.S. economic sector most affected by those solar-induced blackouts, followed by government, finance and insurance, and property. Outside of the U.S., China would be most affected by the indirect cost of such U.S. blackouts, followed by Canada and Mexico – as “these countries provide a greater proportion of raw materials, and intermediate goods and services, used in production by U.S. firms.”

This figure shows the blackout zone, daily customer disruptions and daily lost GDP according to different scenarios. The S1 scenario occurs at 55±2.75 degrees geomagnetic latitude affected 8 percent of the US population and caused a direct economic loss to the US economy of $3.2 billion per day (8 percent of daily US GDP). In the S2 scenario (50±2.75 degrees geomagnetic latitude) a considerable proportion of industrial production was affected, along with 44 percent of the population. The S3 scenario (45±2.75 degrees geomagnetic latitude) affected 23 percent of the US population leading to an economic loss of $16.5 billion per day (41 percent of daily US GDP). In the much larger S4 scenario (50±7.75 degrees geomagnetic latitude), 66 percent of the population were affected. This leads to an estimated potential economic loss of $41.5 billion per day to the US economy (100 percent of daily US GDP), combined with a daily loss to the global economy of $7 billion. Credit: American Geophysical Union.

Source: American Geophysical Union
Space Image of the Week

Star Birth with a Chance of Winds?

Image credit: ESA/Hubble & NASA   Text credit: European Space Agency

**Explanation:** The lesser-known constellation of Canes Venatici (The Hunting Dogs), is home to a variety of deep-sky objects — including this beautiful galaxy, known as NGC 4861. Astronomers are still debating on how to classify it. While its physical properties — such as mass, size and rotational velocity — indicate it to be a spiral galaxy, its appearance looks more like a comet with its dense, luminous “head” and dimmer “tail” trailing off. Features more fitting with a dwarf irregular galaxy.

Although small and messy, galaxies like NGC 4861 provide astronomers with interesting opportunities for study. Small galaxies have lower gravitational potentials, which simply means that it takes less energy to move stuff about inside them than it does in other galaxies. As a result, moving in, around, and through such a tiny galaxy is quite easy to do, making them far more likely to be filled with streams and outflows of speedy charged particles known as galactic winds, which can flood such galaxies with little effort.

These galactic winds can be powered by the ongoing process of star formation, which involves huge amounts of energy. New stars are springing into life within the bright, colorful ‘head’ of NGC 4861 and ejecting streams of high-speed particles as they do so, which flood outwards to join the wider galactic wind. While NGC 4861 would be a perfect candidate to study such winds, recent studies did not find any galactic winds in it.

Source: NASA