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1.0 Orion’s Rocket Ready to Rock n’ Roll for Critical December Test Flight

The huge rocket that will blast NASA’s first Orion spacecraft into orbit is ready to Rock ‘n’ Roll on a critical two orbit test flight scheduled for December. And Orion is so big and heavy that she’s not launching on just any old standard rocket. To blast the uncrewed Orion to orbit on its maiden mission requires the most powerful booster on Planet Earth – namely the United Launch Alliance Delta IV Heavy rocket. Liftoff of the state-of-the-art Orion spacecraft on the unmanned Exploration Flight Test-1 (EFT-1) mission is slated for December 4, 2014 from Space Launch Complex 37 (SLC-37) at Cape Canaveral Air Force Station in Florida. Just days ago, the launch team successfully completed a countdown and wet dress rehearsal fueling test on the rocket itself – minus Orion – at launch complex 37. The high fidelity rehearsal included fully powering up the booster and loading the tanks with cryogenic fuel and oxidizer, liquid oxygen and liquid hydrogen. ULA technicians and engineers practiced the countdown on Nov. 5 which included fueling the core stages of the Delta IV Heavy rocket. “Working in control rooms at Cape Canaveral Air Force Station in Florida, countdown operators followed the same steps they will take on launch day. The simulation also allowed controllers to evaluate the fuel loading and draining systems on the complex rocket before the Orion spacecraft is placed atop the launcher,” said NASA. Today’s scheduled rollout of Orion to the launch pad for hoisting atop the rocket was scrubbed due to poor weather. The triple barreled Delta IV Heavy booster became the world’s most powerful rocket upon the retirement of NASA’s Space Shuttle program in 2011 and is the only rocket sufficiently powerful to launch the Orion EFT-1 spacecraft. The first stage of the mammoth Delta IV Heavy generates some 2 million pounds of liftoff thrust. “The team has worked extremely hard to ensure this vehicle is processed with the utmost attention to detail and focus on mission success,” according to Tony Taliancich, ULA’s director of East Coast Launch Operations. “The Delta IV Heavy is the world’s most powerful launch vehicle flying today, and we are excited to be supporting our customer for this critical flight test to collect data and reduce overall mission risks and costs for the program.” From now until launch technicians will continue to conduct the final processing, testing and checkout of the Delta IV Heavy booster. The Delta IV Heavy first stage is comprised of a trio of three Common Booster Cores (CBCs). Each CBC measures 134 feet in length and 17 feet in diameter. They are equipped with an RS-68 engine powered by liquid hydrogen and liquid oxygen propellants producing 656,000 pounds of thrust. Together they generate 1.96 million pounds of thrust. The first CBC booster was attached to the center booster in June. The second one was attached in early August. This fall I visited the ULA’s Horizontal Integration Facility (HIF) during a media tour after the three CBCs had been joined together as well as earlier this year after the first two CBCs arrived by barge from their ULA assembly plant in Decatur, Alabama, located about 20 miles west of Huntsville. See my photos herein. Orion is NASA’s next generation human rated vehicle that will eventually carry America’s astronauts beyond Earth on voyages venturing farther into deep space than ever before – beyond the Moon to Asteroids, Mars and other destinations in our Solar System. The two-orbit, four and a half hour EFT-1 flight will lift the Orion spacecraft and its attached second stage to an orbital altitude of 3,600 miles, about 15 times higher than the International Space Station (ISS) – and farther than any human spacecraft has journeyed in 40 years. “This mission is a stepping stone on NASA’s journey to Mars,” said NASA Associate Administrator Robert Lightfoot “The EFT-1 mission is so important to NASA. We will test the capsule with a reentry velocity of about 85% of what’s expected by [astronauts] returning from Mars.” “We will test the heat shield, the separation of the fairing and exercise over 50% of the eventual software and electronic systems inside the Orion spacecraft. We will also test the recovery systems coming back into the Pacific Ocean.”

Source: Universe Today

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The newest node in NASA's Mars telecommunications network -- a radio aboard the MAVEN orbiter custom-designed for data links with robots on the surface of Mars -- handled a copious 550 megabits during its first relay of real Mars data. MAVEN's Electra UHF radio received the transmission from NASA's Curiosity Mars rover on Nov. 6, using an adaptive data rate as the orbiter passed through the sky over the rover. The data that MAVEN relayed to NASA's Deep Space Network of large dish antennas on Earth included several images of terrain that Curiosity has been examining at the base of Mars' Mount Sharp. The test also included relaying data to Curiosity from Earth via MAVEN. MAVEN (for Mars Atmosphere and Volatile EvolutioN) entered orbit around Mars on Sept. 21. The orbiter is finishing a commissioning phase -- including calibration of its science instruments and fine tuning of its orbit -- before its prime science phase starts. MAVEN will investigate the upper atmosphere of Mars to provide understanding about processes that led to the loss of much of the original Martian atmosphere. Two older NASA orbiters, Mars Odyssey and Mars Reconnaissance Orbiter, currently provide data relay for NASA’s two active Mars rovers while also continuing to study Mars. Using relay via orbiters, compared with the rovers' capability to transmit directly to Earth, greatly increases science data return from the Martian surface. MAVEN will be available during its prime science mission to provide relay services if issues arise with the other orbiters, and it may routinely provide relay support during an anticipated extended mission. The Electra design is also on UHF radios aboard Curiosity and Mars Reconnaissance Orbiter. It includes relay-enhancing features such as the ability to automatically adjust data rate to signal strength as the distance to the rover changes during the orbiter's overflight. MAVEN's orbit is more elongated than the orbits of either Mars Odyssey or Mars Reconnaissance Orbiter. During the Nov. 6 test, MAVEN's distance from Curiosity ranged from about 680 miles to 2,300 miles (1,110 to 3,700 kilometers), farther than is typical in communication sessions between the Curiosity rover and the other orbiters. MAVEN's principal investigator is based at the University of Colorado's Laboratory for Atmospheric and Space Physics, and NASA's Goddard Space Flight Center in Greenbelt, Maryland, manages the MAVEN project. NASA’s Jet Propulsion Laboratory, a division of the California Institute of Technology in Pasadena, supplied and operates MAVEN's Electra payload and provides Deep Space Network support for the mission.
NASA's Cassini mission continues its adventures in extraterrestrial oceanography with new findings about the hydrocarbon seas on Saturn's moon Titan. During a flyby in August, the spacecraft sounded the depths near the mouth of a flooded river valley and observed new, bright features in the seas that might be related to the mysterious feature that researchers dubbed the "magic island." The findings are being presented this week at the Division for Planetary Sciences Meeting of the American Astronomical Society held in Tucson, Arizona. To the delight of Cassini scientists, two new bright features appeared in Titan's largest sea, Kraken Mare, during the August 21 flyby. In contrast to a previously reported bright, mystery feature in another of Titan's large seas, Ligeia Mare, the new features in Kraken Mare were observed in both radar data and images from Cassini's Visible and Infrared Mapping Spectrometer (VIMS). Having observations at two different wavelengths provides researchers with important clues to the nature of these enigmatic objects. The VIMS data suggest the new features might have similarities to places in and around the seas that the Cassini team has interpreted as waves or wet ground. The observations support two of the possible explanations the team thinks are most likely -- that the features might be waves or floating debris. Unfortunately for mystery lovers, the August Titan flyby marked the final opportunity for Cassini's radar to observe Kraken Mare. However, the spacecraft is scheduled to observe the original "magic island" feature in Ligeia Mare once more, in January 2015. The August Titan flyby also included a segment designed to collect altimetry (or height) data, using the spacecraft's radar instrument along a 120-mile (200-kilometer) shore-to-shore track of Kraken Mare. For a 25-mile (40-kilometer) segment of this data along the sea's eastern shoreline, Cassini's radar beam bounced off the sea bottom and back to the spacecraft, revealing the sea's depth in that area. This region, which is near the mouth of a large, flooded river valley, showed depths of 66 to 115 feet (20 to 35 meters). Cassini will perform this experiment one last time in January 2015, to try to measure the depth of Punga Mare. Punga Mare is the smallest of three large seas in Titan's far north, and the only sea whose depth has not been observed by Cassini. Scientists think that, for the areas in which Cassini did not observe a radar echo from the seafloor, Kraken Mare might be too deep for the radar beam to penetrate. Alternatively, the signal over this region might simply have been absorbed by the liquid, which is mostly methane and ethane. The altimetry data for the area in and around Kraken Mare also showed relatively steep slopes leading down to the sea, which also suggests the Kraken Mare might indeed be quite deep. The Cassini-Huygens mission is a cooperative project of NASA, the European Space Agency and the Italian Space Agency. JPL, a division of the California Institute of Technology, Pasadena, manages the mission for NASA's Science Mission Directorate in Washington. The VIMS team is based at the University of Arizona in Tucson. The radar instrument was built by JPL and the Italian Space Agency, working with team members from the US and several European countries.
The Night Sky

Tuesday, November 11
Very high now in the north, in the fall Milky Way, is dim Cepheus, husband in myth to brighter Cassiopeia. Its constellation pattern hosts two landmark variable stars, Delta (δ) and Mu (μ) Cephei, for binoculars or even the naked eye. Delta is the prototype Cepheid. Mu is one of the largest stars known. See Gary Seronik’s Binocular Highlight column and chart in the November Sky & Telescope, page 45.

Wednesday, November 12
Now that the waning Moon doesn’t rise until about 10 p.m., evening is for deep-sky observing again. If your scope is big enough and your sky dark enough to show 12th- or 13th-magnitude galaxies (maybe within reach of a 6- or 8-inch scope in the exurbs), see how many galaxies you can log inside the Circlet of Pisces using Ken Hewitt-White’s Going Deep column and chart in the November Sky & Telescope, page 60. The Moon with Jupiter and the Sickle of Leo in early dawn.

Thursday, November 13
Jupiter and the waning Moon shine high in the south in early dawn Friday morning the 14th, with fainter Regulus to their left, as shown here. Although they look close together, Jupiter is 2,600 times farther than the Moon, and Regulus is 950,000 times farther than Jupiter.

Friday, November 14
Last-quarter Moon (exact at 10:16 a.m. EST). The Moon rises around midnight tonight with Jupiter to its left (for North America.) By dawn Saturday morning the 15th, the Moon is below Regulus with Jupiter now high to their upper right.

Saturday, November 15
Mars is right over the handle of the Sagittarius Teapot as twilight fades and the stars come out, as shown in the last illustration below. Binoculars will help.

Source: Sky & Telescope
ISS Sighting Opportunities

For Denver:

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

NASA-TV Highlights  (all times Eastern Daylight Time) edited list see web site

8 a.m., Tuesday, November 11 - Replay of Orion First Flight Space Craft Roll Out Media Briefing (all channels)
9 a.m., Tuesday, November 11 - Video File of the ISS Expedition 42/43 Crew News Conference at Star City, Russia and Ceremonial Visit to Red Square in Moscow (Also included in the normal Video File Feed) (all channels)
12 p.m., Tuesday, November 11 - Video File of the ISS Expedition 42/43 Crew News Conference at Star City, Russia and Ceremonial Visit to Red Square in Moscow (Also included in the normal Video File Feed) (all channels)
2 p.m., Tuesday, November 11 - Replay of Orion First Flight Space Craft Roll Out Media Briefing (all channels)
4 p.m., Tuesday, November 11 - Video File of the ISS Expedition 42/43 Crew News Conference at Star City, Russia and Ceremonial Visit to Red Square in Moscow (Also included in the normal Video File Feed) (all channels)
8 p.m., Tuesday, November 11 - Replay of Orion First Flight Space Craft Roll Out Media Briefing (all channels)
10 p.m., Tuesday, November 11 - Replay of Orion First Flight Space Craft Roll Out Media Briefing (all channels)
9 a.m., Wednesday, November 12 - Live coverage of the European Space Agency (ESA) Rosetta landing mission’s of probe on a comet (all channels)
12 p.m., Wednesday, November 12 - Video File of the ISS Expedition 42/43 Crew News Conference at Star City, Russia and Ceremonial Visit to Red Square in Moscow (Also included in the normal Video File Feed) (all channels)
4 p.m., Wednesday, November 12 - Video File of the ISS Expedition 42/43 Crew News Conference at Star City, Russia and Ceremonial Visit to Red Square in Moscow (Also included in the normal Video File Feed) (all channels)
10 a.m., Thursday, November 13 - Video File of the ISS Expedition 42/43 Crew Departure from Star City, Russia for Baikonur, Kazakhstan (Recorded Nov. 11) (all channels)
1 p.m., Thursday, November 13 - Live coverage of Smithsonian National Air and Space Museum presentation “Countdown to Launch” with Jim Norman, Tim Dunn and Albert Sierra (all channels)

Watch NASA TV online by going to the NASA website.
Space Calendar

- Nov 11 - Asteroid 2014 UF192 Near-Earth Flyby (0.061 AU)
- Nov 11 - Asteroid 3353 Jarvis Closest Approach To Earth (0.975 AU)
- Nov 11 - Asteroid 7079 Baghdad Closest Approach To Earth (1.177 AU)
- Nov 11 - Asteroid 2201 Oljato Closest Approach To Earth (1.537 AU)
- Nov 11 - Asteroid 18458 Caesar Closest Approach To Earth (1.620 AU)
- Nov 11 - Asteroid 1388 Aphrodite Closest Approach To Earth (2.056 AU)
- Nov 12 - Rosetta (Philae), Comet 67P/Churyumov-Gerasimenko Landing
- Nov 12 - Asteroid 2012 VG5 Near-Earth Flyby (0.096 AU)
- Nov 12 - Asteroid 25924 Douglasadams Closest Approach To Earth (1.766 AU)
- Nov 12 - Asteroid 7367 Giotto Closest Approach To Earth (2.506 AU)
- Nov 12 - Audouin Dollfus' 90th Birthday (1924)
- Nov 12 - 135th Anniversary (1879), Meteorite Fall in Huang-hsiang, China (Hit Houses)
- Nov 13 - Venus Passes 1.6 Degrees From Saturn
- Nov 13 - Asteroid 2014 VQ Near-Earth Flyby (0.092 AU)
- Nov 13 - Asteroid 1951 Lick Closest Approach To Earth (2.186 AU)
- Nov 13 - Plutino 2003 UZ413 At Opposition (42.352 AU)
- Nov 13 - Kuiper Belt Object 2012 VP113 At Opposition (82.206 AU)
- Nov 13 - 5th Anniversary (2009), Rosetta, 3rd Earth Flyby
- Nov 14 - Comet P/2009 K1 (Gibbs) At Opposition (3.815 AU)
- Nov 14 - Asteroid 2009 LD Near-Earth Flyby (0.055 AU)
- Nov 14 - Asteroid 2014 UL192 Near-Earth Flyby (0.083 AU)
- Nov 14 - Asteroid 7536 Fahrenheit Closest Approach To Earth (2.049 AU)
- Nov 14 - Asteroid 2421 Nininger Closest Approach To Earth (2.170 AU)
- Nov 14 – 45th Anniversary (1969), Apollo 12 Launch (Manned Moon Mission)
- Nov 15 - Comet 40P/Vaisala Perihelion (1.819 AU)
- Nov 15 - Comet C/2013 G3 (PANSTARRS) Perihelion (3.852 AU)
- Nov 15 - Comet 269P/Jedicke Perihelion (4.079 AU)
- Nov 15 - Asteroid 12655 (5041 T-3) Occults HIP 1191 (5.7 Magnitude Star)
- Nov 15 - Asteroid 2014 UL115 Near-Earth Flyby (0.072 AU)
- Nov 15 - Plutino 84719 (2002 VR128) At Opposition (37.762 AU)
- Nov 15 - 10th Anniversary (2004), SMART-1, Moon Orbit Insertion
- Nov 15 - 40th Anniversary (1974), Intasat Launch (Spain's 1st Satellite)
- Nov 15 - Dirk Klinkenberg's 205th Birthday (1709)

Source: JPL Space Calendar
Food for Thought

The Science of 'Interstellar': Black Holes, Wormholes and Space Travel

The sci-fi epic "Interstellar" is just a movie, but it throws a lot of science on the screen for space geeks to sink their teeth into. "Interstellar," which opened in theaters across the United States on Friday (Nov. 7), delves into black holes and wormholes, and it touches down on more than one alien planet. The film apparently takes its science seriously; renowned theoretical physicist Kip Thorne served as an adviser and executive producer on "Interstellar." Wormhole travel across the universe and supergiant black holes are just some of the wonders seen in the film "Interstellar." See how the science of "Interstellar" works in this infographic.

"Interstellar" is set at some nebulous point in the not-too-distant future, when global crop failures threaten humanity with extinction. So a small band of explorers, led by a pilot-turned-farmer named Cooper (McConaughey), blasts off to search for an exoplanet that could serve as a new home for the human race. The astronauts are aided in their quest by a wormhole — a sort of tunnel that allows relatively quick travel between widely separated parts of the universe — which had mysteriously appeared near Saturn some years before. Cooper steers the pioneers' ship, called Endurance, through the wormhole into a planet-rich portion of a faraway galaxy. Though wormholes are a favored sci-fi trope, nobody knows whether or not they actually exist. According to Einstein's theory of general relativity, they are possible, but no sign of them has ever been spotted. Furthermore, scientists say, a wormhole would likely collapse quickly unless it was propped open using some kind of negative-energy matter. So the big wormhole in "Interstellar" would require some serious and exotic engineering work — but I'll stop here, so I don't give too much away about the film. The "Interstellar" visual-effects team used equations provided by Thorne to come up with their representation of the wormhole, depicting its entrance as a shimmering sphere — just as it likely would look in real life, Thorne.
said. "Neither wormholes nor black holes have been depicted in any Hollywood movie in the way that they actually would appear," Thorne said recently in an "Interstellar" science video produced by Wired magazine. "This is the first time the depiction began with Einstein's general relativity equations." Much of the action in "Interstellar" revolves around a giant black hole, which Cooper and his crewmates call "Gargantua." Thorne said he and the visual-effects crew took a great deal of care to depict the light-gobbling monster accurately. The on-screen result is an exotic object that twists its infalling disk of dust and gas into complex shapes, with the overall effect further complicated by gravitational lensing — a real astronomical phenomenon in which a massive foreground object (such as a black hole) warps the light emitted by stars and other bodies located much farther away. The collaboration between Thorne and the "Interstellar" visual-effects people was so successful that it will extend into the scientific literature, the physicist said. "We're going to write several technical papers about this — one aimed at the astrophysics community, and then something for the computer-graphics community — saying, 'Here are some things we've discovered about gravitational lensing by rapidly spinning black holes that we never knew before,'" Thorne said in the Wired video. In the movie, however, Cooper and his crew spend some time in close proximity to the black hole, which strains credulity. The astronauts would likely be killed by the energetic radiation thrown off by the superhot disk of material circling Gargantua, Roberto Trotta, an astrophysicist at Imperial College London, noted in an article for the British newspaper The Guardian. Or they'd be "spaghettified" by the intense gravitational pull, which would be much stronger at one end of their bodies than the other, Trotta added. And that's not the only issue. The astronauts land on a world that orbits very close to Gargantua — so close that, as the film depicts it, for every hour spent on the exoplanet's surface, seven years elapse on Earth. Such "time dilation" does indeed occur in the presence of gravitational fields, but there's no way it could be so extreme, according to Trotta. "You would need such a strong gravitational field that you need to be close to what is called the Schwarzschild radius of the object — essentially the event horizon of a black hole," he wrote in The Guardian. (The event horizon is the point beyond which nothing, not even light, can escape a black hole's clutches.) "There is simply no planet that can have this kind of gravity, and if you tried to land on the surface, it would be so strong it would crush you. The numbers simply do not work." In fact, a planet so close to a black hole could not even exist, Trotta observed: Tidal forces generated by the black hole's immense gravity would tear the planet apart. Such details will rankle some filmgoers, while other folks won't mind suspending their disbelief. But most people who see "Interstellar" will probably agree that it’s a stunning visual spectacle. One of the alien planets depicted in the film, for example, is a water world featuring mysterious gigantic waves, while another is a frigid realm whose clouds are frozen solid. These worlds are gorgeously rendered, as are the many spaceflight sequences throughout the movie. The spaceships in "Interstellar" are also nicely conceived and designed. Endurance is a ring-shaped vehicle consisting of 12 boxy modules, some of which can be shuttled to the surface of an exoplanet to set up a base. The mothership carries two heavy-lift "landers" to perform this work, as well as two more-agile "Rangers," which the crew uses for planetary exploration. And Endurance rotates 5.6 times per minute to generate Earth-equivalent gravity aboard the ship — a detail the sticklers in the audience will doubtless appreciate.

Space.com

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**Space Image of the Week**

The Cat's Eye Nebula from Hubble

![Image](image_url)

**Image Credit:** NASA, ESA, HEIC, and The Hubble Heritage Team (STScI/AURA)

**Explanation:** To some, it may look like a cat's eye. The alluring Cat's Eye nebula, however, lies three thousand light-years from Earth across interstellar space. A classic planetary nebula, the Cat's Eye (NGC 6543) represents a final, brief yet glorious phase in the life of a sun-like star. This nebula's dying central star may have produced the simple, outer pattern of dusty concentric shells by shrugging off outer layers in a series of regular convulsions. But the formation of the beautiful, more complex inner structures is not well understood. Seen so clearly in this digitally sharpened Hubble Space Telescope image, the truly cosmic eye is over half a light-year across. Of course, gazing into this Cat's Eye, astronomers may well be seeing the fate of our sun, destined to enter its own planetary nebula phase of evolution ... in about 5 billion years.

Source: [NASA APOD](https://apod.nasa.gov/apod/)

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