Contents

In the News

Story 1:
Ten Thousandth Near-Earth Object Unearthed in Space

Story 2:
New class of NASA astronauts picked for training

Story 3:
Russian spacewalk paves way for new lab module

Departments

The Night Sky

ISS Sighting Opportunities

NASA-TV Highlights

Space Calendar

Food for Thought

Space Image of the Week
1.0 Ten Thousandth Near-Earth Object Unearthed in Space

More than 10,000 asteroids and comets that can pass near Earth have now been discovered. The 10,000th near-Earth object, asteroid 2013 MZ5, was first detected on the night of June 18, 2013, by the Pan-STARRS-1 telescope, located on the 10,000-foot (convert) summit of the Haleakala crater on Maui. Managed by the University of Hawaii, the PanSTARRS survey receives NASA funding. Ninety-eight percent of all near-Earth objects discovered were first detected by NASA-supported surveys. "Finding 10,000 near-Earth objects is a significant milestone," said Lindley Johnson, program executive for NASA's Near-Earth Object Observations Program at NASA Headquarters, Washington. "But there are at least 10 times that many more to be found before we can be assured we will have found any and all that could impact and do significant harm to the citizens of Earth." During Johnson's decade-long tenure, 76 percent of the NEO discoveries have been made. Near-Earth objects (NEOs) are asteroids and comets that can approach the Earth's orbital distance to within about 28 million miles (45 million kilometers). They range in size from as small as a few feet to as large as 25 miles (41 kilometers) for the largest near-Earth asteroid, 1036 Ganymed.

Asteroid 2013 MZ5 is approximately 1,000 feet (300 meters) across. Its orbit is well understood and will not approach close enough to Earth to be considered potentially hazardous. "The first near-Earth object was discovered in 1898," said Don Yeomans, long-time manager of NASA's Near-Earth Object Program Office at the Jet Propulsion Laboratory in Pasadena, Calif. "Over the next hundred years, only about 500 had been found. But then, with the advent of NASA's NEO Observations program in 1998, we've been racking them up ever since. And with new, more capable systems coming on line, we are learning even more about where the NEOs are currently in our solar system, and where they will be in the future." Of the 10,000 discoveries, roughly 10 percent are larger than six-tenths of a mile (one kilometer) in size - roughly the size that could produce global consequences should one impact the Earth. However, the NASA NEOO program has found that none of these larger NEOs currently pose an impact threat and probably only a few dozen more of these large NEOs remain undiscovered.

The vast majority of NEOs are smaller than one kilometer, with the number of objects of a particular size increasing as their sizes decrease. For example, there are expected to be about 15,000 NEOs that are about one-and-half football fields in size (460 feet, or 140 meters), and more than a million that are about one-third a
football field in size (100 feet, or 30 meters). A NEO hitting Earth would need to be about 100 feet (30 meters) or larger to cause significant devastation in populated areas. Almost 30 percent of the 460-foot-sized NEOs have been found, but less than 1 percent of the 100-foot-sized NEOs have been detected.

When it originated, the NASA-instituted Near-Earth Object Observations Program provided support to search programs run by the Massachusetts Institute of Technology's Lincoln Laboratory (LINEAR); the Jet Propulsion Laboratory (NEAT); the University of Arizona (Spacewatch, and later Catalina Sky Survey) and the Lowell Observatory (LONEOS). All these search teams report their observations to the Minor Planet Center, the central node where all observations from observatories worldwide are correlated with objects, and they are given unique designations and their orbits are calculated. "When I began surveying for asteroids and comets in 1992, a near-Earth object discovery was a rare event," said Tim Spahr, director of the Minor Planet Center. "These days we average three NEO discoveries a day, and each month the Minor Planet Center receives hundreds of thousands of observations on asteroids, including those in the main-belt. The work done by the NASA surveys, and the other international professional and amateur astronomers, to discover and track NEOs is really remarkable."

Within a dozen years, the program achieved its goal of discovering 90 percent of near-Earth objects larger than 3,300 feet (1 kilometer) in size. In December 2005, NASA was directed by Congress to extend the search to find and catalog 90 percent of the NEOs larger than 500 feet (140 meters) in size. When this goal is achieved, the risk of an unwarned future Earth impact will be reduced to a level of only one percent when compared to pre-survey risk levels. This reduces the risk to human populations, because once an NEO threat is known well in advance, the object could be deflected with current space technologies. Currently, the major NEO discovery teams are the Catalina Sky Survey, the University of Hawaii's Pan-STARRS survey and the LINEAR survey. The current discovery rate of NEOs is about 1,000 per year. NASA's Near-Earth Object Observations Program manages and funds the search for, study of and monitoring of asteroids and comets whose orbits periodically bring them close to Earth. The Minor Planet Center is funded by NASA and hosted by the Smithsonian Astrophysical Observatory in Cambridge, MA. JPL manages the Near-Earth Object Program Office for NASA's Science Mission Directorate in Washington. JPL is a division of the California Institute of Technology in Pasadena. More information about asteroids and near-Earth objects is available at: http://neo.jpl.nasa.gov/, http://www.jpl.nasa.gov/asteroidwatch

Source: NASA JPL
NASA has selected eight new candidates -- four men and four women -- to join the ranks of its astronaut corps for missions to the International Space Station and beyond. Picked from the second-highest number of applicants in any previous rounds of astronaut selections, the space agency said more than 6,000 people applied for this 21st astronaut class. NASA has selected and trained 330 astronauts since the initial astronaut class of 1959. Most recently in 2009, NASA selected nine candidates. The latest trainees could become the first Americans to launch from U.S. since retirement of the space shuttle. "These new space explorers asked to join NASA because they know we're doing big, bold things here -- developing missions to go farther into space than ever before," said NASA Administrator Charles Bolden. "They're excited about the science we're doing on the International Space Station and our plan to launch from U.S. soil to there on spacecraft built by American companies. And they're ready to help lead the first human mission to an asteroid and then on to Mars."

The astronaut candidates are:

**Josh A. Cassada**, Ph.D., 39, is originally from White Bear Lake, Minn. Cassada is a former naval aviator who holds an undergraduate degree from Albion College, and advanced degrees from the University of Rochester, N.Y. Cassada is a physicist by training and currently is serving as co-founder and Chief Technology Officer for Quantum Opus.

**Victor J. Glover**, 37, Lt. Commander, U.S. Navy, hails from Pomona, Calif., and Prosper, Texas. He is an F/A-18 pilot and graduate of the U.S. Air Force Test Pilot School, Edwards, Calif. Glover holds degrees from California Polytechnic State University, San Luis Obispo, Calif.; Air University and the Naval Postgraduate School, Monterey, Calif. He currently is serving as a Navy Legislative Fellow in the U.S. Congress.


**Christina M. Hammock**, 34, calls Jacksonville, N.C., home. Hammock holds undergraduate and graduate degrees from North Carolina State University, Raleigh, N.C. She currently is serving as National Oceanographic and Atmospheric Administration Station Chief in American Samoa.
Nicole Aunapu Mann, 35, Major, U.S. Marine Corps, originally is from Penngrove, Calif. She is a graduate of the U.S. Naval Academy, Stanford University and the U.S. Naval Test Pilot School, Patuxent River, Md. Mann is an F/A 18 pilot, currently serving as an Integrated Product Team Lead at the U.S. Naval Air Station, Patuxent River.

Anne C. McClain, 34, Major, U.S. Army, lists her hometown as Spokane, Wash. She is a graduate of the U.S. Military Academy at West Point, Va.; the University of Bath and the University of Bristol, both in the United Kingdom. McClain is an OH-58 helicopter pilot, and a recent graduate of the U.S. Naval Test Pilot School at Naval Air Station, Patuxent River.

Jessica U. Meir, Ph.D., 35, is from Caribou, Maine. She is a graduate of Brown University, has an advanced degree from the International Space University, and earned her doctorate from Scripps Institution of Oceanography. Meir currently is an Assistant Professor of Anesthesia at Harvard Medical School, Massachusetts General Hospital, Boston.

Andrew R. Morgan, M.D., 37, Major, U.S. Army, considers New Castle, Pa., home. Morgan is a graduate of the U.S. Military Academy at West Point, and earned a doctorate of medicine from the Uniformed Services University of the Health Sciences, Bethesda, Md. He has experience as an emergency physician and flight surgeon for the Army special operations community, and currently is completing a sports medicine fellowship.

The new astronaut candidates will begin training at NASA's Johnson Space Center in Houston in August. "This year we have selected eight highly qualified individuals who have demonstrated impressive strengths academically, operationally and physically," said Janet Kavandi, director of Flight Crew Operations at Johnson. "They have diverse backgrounds and skill sets that will contribute greatly to the existing astronaut corps. Based on their incredible experiences to date, I have every confidence that they will apply their combined expertise and talents to achieve great things for NASA and this country in the pursuit of human exploration."
Cosmonauts Fyodor Yurchikhin and Alexander Misurkin staged a successful six-hour 34-minute spacewalk Monday, installing cable clamps, attaching handrails and testing rendezvous equipment to help pave the way for installation of a new Russian laboratory module later this year. They also replaced a flow control valve in the coolant system of the Zarya module, retrieved space exposure experiment pallets and installed a new experiment to monitor the station's immediate environment. When all was said and done, they accomplished all of their major objectives with the exception of two pairs of handrails, called gap spanners, that will be installed during an upcoming spacewalk. The spacewalk began at 9:32 a.m. EDT (GMT -4) when Yurchikhin, call sign EV-1, and Misurkin, EV-2, opened the hatch of the Pirs airlock compartment as the station sailed 250 miles above the south Pacific Ocean. Misurkin made his way outside a few moments later, followed by Yurchikhin.

Along with routine maintenance, much of the work carried out during today's spacewalk included installation of cable clamps and other equipment needed to route data and power to and from the Multi-Purpose Laboratory module, also known as Nauka, tentatively scheduled for launch in December. To make way for the new module, the Pirs docking and airlock compartment will be jettisoned this Fall and the MLM will use its own propulsion and guidance system to fly to an automated docking at the Zvezda command module's Earth-facing port. But first, Russian spacewalkers must route power and data lines on Zvezda's hull and make sure docking equipment will work properly after Pirs is jettisoned. It will take another three Russian spacewalks and two by NASA astronauts to complete the preparations. "There are quite a (few) tasks that need to be performed by the Russian EVA crew members before MLM arrives," said Lawrence Thomas, NASA's lead spacewalk planner for Expedition 36. "Not only do they need to route power and data cables and reconfigure (rendezvous) equipment for the arrival of the MLM itself, it's part of a larger reconfiguration effort." Because the MLM will replace the Pirs module, which serves as the Russian airlock, the Poisk module must be configured to handle spacewalks. "So there is a lot of hardware we're going to have to move around," Thomas said. "There's EVA hardware on (Pirs) that will have to be removed and re-installed on (Poisk), there are some antennas that will have to be moved around and there's also some science equipment on (Pirs) that's going to have to be relocated before it deorbits."

For today's excursion, Yurchikhin and Misurkin began by replacing a cooling system flow control valve on the Zarya module and installing additional power and data cable clamps needed for the MLM. On the Zvezda module, the spacewalkers reconfigured KURS docking gear, used by approaching Soyuz and Progress spacecraft to home in for docking at Pirs, and installed spacewalk handrails needed during upcoming EVAs. They also retrieved two space exposure pallets and installed the "Indicator" experiment. "The tasks for this EVA in particular, there's not one that's particularly hard in comparison to other things we've done," Thomas said. "One thing that I've always admired about Russian EVA hardware, they always design it to where it's very user friendly, very simple interfaces, very intuitive." The spacewalk ended at 4:06 p.m. when the cosmonauts returned to Pirs and closed the hatch to begin repressurization.
This was the 169th spacewalk devoted to station assembly and maintenance since construction began in 1998, the third so far this year, the sixth for Yurchikhin and the first for Misurkin. Four more Russian spacewalks are planned for 2013, along with two U.S. excursions July 9 and 16. With today’s EVA, 111 astronauts and cosmonauts representing eight nations have logged 1,067 hours and 43 minutes -- 44.5 days -- of spacewalk time outside the International Space Station. Yurchikin's total now stands at 38 hours and 26 minutes, moving him up to 24th on the list of most experienced spacewalkers, one minute ahead of crewmate Pavel Vinogradov. Misurkin, making his first spaceflight, arrived at the space station March 28, along with Vinogradov, commander of the Soyuz TMA-08M ferry craft, and NASA astronaut Christopher Cassidy. Yurchikhin arrived May 28 aboard the Soyuz TMA-09M spacecraft, accompanied by NASA shuttle veteran Karen Nyberg and Luca Parmitano, a European Space Agency astronaut. Yurchikhin first flew to the space station in 2002 as a shuttle astronaut on a mission to attach part of the lab's solar power truss. He then completed two long-duration stays, riding aloft aboard Soyuz spacecraft in 2007 and 2010. He has now logged nearly 400 days in space. When Vinogradov, Misurkin and Cassidy depart in September, Yurchikhin will take over as commander of Expedition 37.

Source: Spaceflight Now

Return to Contents
The Night Sky

Monday, June 24
• Look a third of the way from Arcturus to Vega for dim Corona Borealis, the semicircular Northern Crown. It has one moderately bright star, Alphecca (magnitude 2.2). Look two thirds of the way for the dim Keystone of Hercules, whose brightest star is magnitude 2.8.

Tuesday, June 25
• During bright twilight today and tomorrow, Venus forms an almost straight line with Pollux and Castor low in the west-northwest. Bring binoculars, and look for them to Venus's right. And can you still detect Mercury below Venus? It's nearly as far below Venus (6°) as Pollux is to the right.

Wednesday, June 26
• Now that it's summer, the Summer Triangle stands high in full glory after dusk. Its top star is bright Vega high in the east. Deneb is the brightest star to Vega's lower left. Farther to Vega's lower right is Altair. The Summer Triangle is big: 35° long. Where the sky is dark, you can see that the Milky Way runs through it.

Thursday, June 27
• The interesting binocular field around Antares holds the dim glow of the globular cluster M4, as many skywatchers well know. But do you also know about Rho Ophiuchi, the fine binocular triple star in the same field? It's the top star of a loop of five including Antares, as shown in Gary Seronik's Binocular Highlight column in the June Sky & Telescope, page 45.

Friday, June 28
• The Big Dipper, still high in the northwest, is moving a little lower now and starting to dip around toward the right. Follow the curve of its tail a little more than a Dipper-length left to bright Arcturus high in the southwest.

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](https://nasa.gov)

NASA-TV Highlights

(all times Eastern Daylight Time)

**June 24, Monday**
9 a.m. - ISS Expedition 36 Russian Spacewalk Coverage (Spacewalk scheduled at begin at 9:35 a.m. ET) - JSC (Public and Media Channels)

**June 25, Tuesday**
1:30 p.m. - IRIS (Interface Region Imaging Spectrograph) Google+ Hangout from Vandenberg AFB, Calif. - KSC (All Channels)
3 p.m. - IRIS (Interface Region Imaging Spectrograph) Prelaunch News Conference from Vandenberg AFB, Calif. - KSC (All Channels)
3:45 p.m. – IRIS (Interface Region Imaging Spectrograph) Mission Science Briefing from Vandenberg AFB, Calif. – KSC (All Channels)

**Wednesday, June 26**
9 p.m. - IRIS (Interface Region Imaging Spectrograph) Mission Launch Coverage from Vandenberg AFB, Calif. (10:27 p.m. launch) - KSC (All Channels)

**June 27, Thursday**
6 a.m. - ISS Expedition 36 In-Flight Event for ESA - JSC (All Channels)

12:05 p.m. - ISS Mission Control On-Console Interview with the Digital Learning Network - JSC (All Channels)

**June 28, Friday**
6:35 a.m. - ISS Expedition 36 In-Flight Interviews with CBS “This Morning” and CNN.com’s “CNN Leading Women” Website Program - JSC (All Channels)

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

- Jun 24 - O3b F-1, F-2, F-3 & F-4 Soyuz STB-Fregat Launch
- Jun 24 - Moon Occults Pluto
- Jun 24 - Comet 112P/Urata-Nijjima Perihelion (1.455 AU)
- Jun 24 - Comet P/2012 F2 (PANSTARRS) Closest Approach To Earth (1.971 AU)
- Jun 24 - Comet 201P/LONEOS At Opposition (3.452 AU)
- Jun 24 - Asteroid 4444 Escher Closest Approach To Earth (1.036 AU)
- Jun 24 - Asteroid 5676 Voltaire Closest Approach To Earth (1.419 AU)
- Jun 24 - Asteroid 13688 Oklahoma Closest Approach To Earth (1.755 AU)
- Jun 24 - Asteroid 4766 Malin Closest Approach To Earth (1.927 AU)
- Jun 25 - Comet C/2013 G2 (McNaught) At Opposition (2.109 AU)
- Jun 25 - Comet 11P/Tempel-Swift-LINEAR At Opposition (2.664 AU)
- Jun 25 - Comet P/2010 H5 (Scotti) Closest Approach To Earth (5.751 AU)
- Jun 25 - Asteroid 2002 LT24 Near-Earth Flyby (0.059 AU)
- Jun 26 - [Jun 19] Shenzhou 10 Returns to Earth
- Jun 26 - Updated [Jun 18] Interface Region Imaging Spectrograph (IRIS) Pegasus XL Launch
- Jun 26 - Comet 250P/Larson At Opposition (3.953 AU)
- Jun 26 - Asteroid 2010 NY65 Near-Earth Flyby (0.063 AU)
- Jun 26 - Asteroid 2062 Aten Closest Approach To Earth (0.236 AU)
- Jun 26 - Asteroid 3834 Zappafrank Closest Approach To Earth (1.231 AU)
- Jun 26 - Asteroid 5790 Nagasaki Closest Approach To Earth (1.439 AU)
- Jun 26 - Asteroid 30857 Parsec Closest Approach To Earth (1.528 AU)
- Jun 26 - Asteroid 2247 Hiroshima Closest Approach To Earth (1.574 AU)
- Jun 26 - Asteroid 9860 Archaeopteryx Closest Approach To Earth (1.960 AU)
- Jun 26 - 35th Anniversary (1978), SEASAT 1 Launch
- Jun 27 - Asteroid 3501 Veefer Occults HIP 57791 (5.6 Magnitude Star)
- Jun 27 - Asteroid 8444 Popovich Closest Approach To Earth (0.956 AU)
- Jun 27 - Asteroid 3917 Franz Schubert Closest Approach To Earth (1.375 AU)
- Jun 27 - Asteroid 439 Ohio Closest Approach To Earth (2.381 AU)
- Jun 27 - Kuiper Belt Object 307261 (2002 MS4) At Opposition (46.018 AU)
- Jun 28 - Comet P/2003 U2 (LINEAR) Perihelion (1.691 AU)
- Jun 28 - Comet 96P/Machholz At Opposition (3.241 AU)
- Jun 28 - Comet P/1999 XN120 (Catalina) At Opposition (4.042 AU)
- Jun 28 - Comet C/2012 S4 (PANSTARRS) Perihelion (4.349 AU)
- Jun 28 - Comet P/2010 H5 (McNaught) At Opposition (5.753 AU)
- Jun 28 - Asteroid 293726 (2007 RQ17) Near-Earth Flyby (0.036 AU)

Source: JPL Space Calendar
NASA's Cassini spacecraft, now exploring Saturn, will take a picture of our home planet from a distance of hundreds of millions of miles on July 19. NASA is inviting the public to help acknowledge the historic interplanetary portrait as it is being taken. Earth will appear as a small, pale blue dot between the rings of Saturn in the image, which will be part of a mosaic, or multi-image portrait, of the Saturn system Cassini is composing.

"While Earth will be only about a pixel in size from Cassini's vantage point 898 million [1.44 billion kilometers] away, the team is looking forward to giving the world a chance to see what their home looks like from Saturn," said Linda Spilker, Cassini project scientist at NASA's Jet Propulsion Laboratory in Pasadena, Calif. "We hope you'll join us in waving at Saturn from Earth, so we can commemorate this special opportunity."

Cassini will start obtaining the Earth part of the mosaic at 2:27 p.m. PDT (5:27 p.m. EDT or 21:27 UTC) and end about 15 minutes later, all while Saturn is eclipsing the sun from Cassini's point of view. The spacecraft's unique vantage point in Saturn's shadow will provide a special scientific opportunity to look at the planet's rings. At the time of the photo, North America and part of the Atlantic Ocean will be in sunlight. Unlike two previous Cassini eclipse mosaics of the Saturn system in 2006, which captured Earth, and another in 2012, the July 19 image will be the first to capture the Saturn system with Earth in natural color, as human eyes would see it. It also will be the first to capture Earth and its moon with Cassini's highest-resolution camera. The probe's position will allow it to turn its cameras in the direction of the sun, where Earth will be, without damaging the spacecraft's sensitive detectors. "Ever since we caught sight of the Earth among the rings of Saturn in September 2006 in a mosaic that has become one of Cassini's most beloved images, I have wanted to do it all over again, only better," said Carolyn Porco, Cassini imaging team lead at the Space Science Institute in Boulder, Colo. "This time, I wanted to turn the entire event into an opportunity for everyone around the globe to savor the uniqueness of our planet and the preciousness of the life on it." Porco and her imaging team associates examined Cassini's planned flight path for the remainder of its Saturn mission in search of a time when Earth would not be obstructed by Saturn or its rings. Working with other Cassini team members, they found the July
19 opportunity would permit the spacecraft to spend time in Saturn's shadow to duplicate the views from earlier in the mission to collect both visible and infrared imagery of the planet and its ring system.

"Looking back towards the sun through the rings highlights the tiniest of ring particles, whose width is comparable to the thickness of hair and which are difficult to see from ground-based telescopes," said Matt Hedman, a Cassini science team member based at Cornell University in Ithaca, N.Y., and a member of the rings working group. "We're particularly interested in seeing the structures within Saturn's dusty E ring, which is sculpted by the activity of the geysers on the moon Enceladus, Saturn's magnetic field and even solar radiation pressure." This latest image will continue a NASA legacy of space-based images of our fragile home, including the 1968 "Earthrise" image taken by the Apollo 8 moon mission from about 240,000 miles (380,000 kilometers) away and the 1990 "Pale Blue Dot" image taken by Voyager 1 from about 4 billion miles (6 billion kilometers) away.

The Cassini-Huygens mission is a cooperative project of NASA, the European Space Agency and the Italian Space Agency. JPL manages the Cassini-Huygens mission for NASA's Science Mission Directorate in Washington, and designed, developed and assembled the Cassini orbiter and its two onboard cameras. The imaging team consists of scientists from the United States, the United Kingdom, France and Germany. The imaging operations center is based at the Space Science Institute in Boulder, Colo.

Source: NASA JPL
**Space Image of the Week**

*Edge-on NGC 3628*
Image Credit & Copyright: Alessandro Falesiedi

**Explanation:** Sharp telescopic views of magnificent edge-on spiral galaxy NGC 3628 show a puffy galactic disk divided by dark dust lanes. Of course, this deep galactic portrait puts some astronomers in mind of its popular moniker, The Hamburger Galaxy. The tantalizing island universe is about 100,000 light-years across and 35 million light-years away in the northern springtime constellation Leo. NGC 3628 shares its neighborhood in the local Universe with two other large spirals M65 and M66 in a grouping otherwise known as the Leo Triplet. Gravitational interactions with its cosmic neighbors are likely responsible for the extended flare and warp of this spiral's disk.

Source: [NASA APOD](https://apod.nasa.gov/apod/ap110314.html)