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1. New Horizons Returns First, Best Images of Pluto

NASA’s New Horizons spacecraft has sent back the first in a series of the sharpest views of Pluto it obtained during its July flyby – and the best close-ups of Pluto that humans may see for decades.

Each week the piano-sized New Horizons spacecraft transmits data stored on its digital recorders from its flight through the Pluto system on July 14. These latest pictures are part of a sequence taken near New Horizons’ closest approach to Pluto, with resolutions of about 250-280 feet (77-85 meters) per pixel – revealing features less than half the size of a city block on Pluto’s diverse surface. In these new images, New Horizons captured a wide variety of cratered, mountainous and glacial terrains.

“These close-up images, showing the diversity of terrain on Pluto, demonstrate the power of our robotic planetary explorers to return intriguing data to scientists back here on planet Earth,” said John Grunsfeld, former astronaut and associate administrator for NASA’s Science Mission Directorate. “New Horizons thrilled us during the July flyby with the first close images of Pluto, and as the spacecraft transmits the treasure trove of images in its onboard memory back to us, we continue to be amazed by what we see.”
These latest images form a strip 50 miles (80 kilometers) wide on a world 3 billion miles away. The pictures trend from Pluto’s jagged horizon about 500 miles (800 kilometers) northwest of the informally named Sputnik Planum, across the al-Idrisi mountains, over the shoreline of Sputnik, and across its icy plains. (To view the strip in the highest resolution possible, click here and zoom in.)

“These new images give us a breathtaking, super-high resolution window into Pluto’s geology,” said New Horizons Principal Investigator Alan Stern, of the Southwest Research Institute (SwRI) in Boulder, Colorado. “Nothing of this quality was available for Venus or Mars until decades after their first flybys; yet at Pluto we’re there already – down among the craters, mountains and ice fields – less than five months after flyby! The science we can do with these images is simply unbelievable.”

The images were captured with the telescopic Long Range Reconnaissance Imager (LORRI) aboard New Horizons, about 15 minutes before New Horizons’ closest approach to Pluto – from a range of just 10,000 miles (17,000 kilometers). They were obtained with an unusual observing mode; instead of working in the usual “point and shoot,” LORRI snapped pictures every three seconds while the Ralph/Multispectral Visual Imaging Camera (MVIC) aboard New Horizons was scanning the surface. This mode requires unusually short exposures to avoid blurring the images.

These new images are six times better than the resolution of the global Pluto map New Horizons obtained, and five times better than the best images of Pluto’s cousin Triton, Neptune’s large moon, obtained by Voyager 2 in 1989.

Mission scientists expect more imagery from this set over the next several days, showing even more terrain at this highest resolution.

Source: NASA
2. ALMA Spots Monstrous Baby Galaxies Cradled in Dark Matter

Astronomers discovered a nest of monstrous baby galaxies 11.5 billion light-years away using the Atacama Large Millimeter/submillimeter Array (ALMA).

The young galaxies seem to reside at the junction of gigantic filaments in a web of dark matter. These findings are important for understanding how monstrous galaxies like these are formed and how they evolve into huge elliptical galaxies.

We are living in a relatively quiet period in the history of the Universe. Ten billion years ago, long before the Sun and Earth were formed, areas of the Universe were inhabited by monstrous galaxies with star formation rates hundreds or thousands of times what we observe today in the Milky Way galaxy. There aren’t any monstrous galaxies left in the modern Universe, but astronomers believe that these young galaxies matured into giant elliptical galaxies which are seen in the modern Universe.

Current galaxy formation theories predict that these monstrous galaxies form in special environments where dark matter is concentrated. But up until now it has been difficult to determine the positions of active star forming galaxies with enough precision to actually test this prediction. Part of the problem is that monstrous star-forming galaxies are often obscured in dust, making them difficult to observe in visible light. Dusty galaxies do emit strong radio waves with submillimeter wavelengths, but radio telescopes typically have not had the resolution needed to pin-point individual galaxies.

To search for monstrous galaxies, the research team led by Hideki Umehata (a postdoctoral fellow of the Japan Society for the Promotion of Science staying at the European Southern Observatory, Germany), Yoichi Tamura (an assistant professor at the University of Tokyo), and Kotaro Kohno (a professor at the University of
Tokyo) used ALMA to make extensive observations of a small part of the sky called SSA22 in the constellation Aquarius (the Water-Bearer).

Before their ALMA observations, the team searched for baby galaxies in SSA22 with ASTE, a 10-m submillimeter telescope operated by NAOJ. While the sensitivity and resolution was not sufficient to be sure, in the ASTE images they could see indications that there might be a cluster of monstrous galaxies. With ten times better sensitivity and 60 times better resolution, ALMA enabled astronomers to pinpoint the locations of nine monstrous galaxies in SSA22.

The team compared the positions of these galaxies with the location of a cluster of young galaxies 11.5 billion light-years from Earth in SSA22 which had been studied in visible light by the Subaru Telescope, operated by the National Astronomical Observatory of Japan (NAOJ). The shape of the cluster observed by the Subaru Telescope indicates the presence of a huge 3D web of invisible dark matter. This dark matter filamentary structure is thought to be a progenitor of large scale structures in the Universe. One of the best known examples of large scale structure in the modern Universe is the cosmic Great Wall, a gigantic filamentary structure spanning over 500 million light-years. The filamentary structure in SSA22 could be called a proto-Great Wall.

The team found that their young monstrous galaxies seemed to be located right at the intersection of the dark matter filaments. This finding supports the model that monstrous galaxies form in areas where dark matter is concentrated. And since modern large elliptical galaxies are simply monstrous galaxies which have mellowed with age, they too must have originated at nexuses in the large scale structure.

This result is a very important step for a comprehensive understanding of the relation between the dark matter distribution and monstrous galaxies. The team will continue its extensive search for monstrous galaxies to look back even farther into the early history of the Universe to study the evolution of the large scale structure.

This observation result was published as Umehata et al. "ALMA Deep Field in SSA22: A concentration of dusty starbursts in a z=3.09 protocluster core" in the Astrophysical Journal Letters, issued on Dec. 4, 2015.
On Thursday, Dec. 3, NASA at the Kennedy Space Center in Florida will team with industry partners to launch science and supplies to the International Space Station. The event is one more example of how the goal of establishing Kennedy as a 21st century, multi-user spaceport for both government and commercial customers has been achieved.

As part of NASA's Commercial Resupply Services Program, the Orbital ATK Cygnus OA-4 spacecraft will launch atop a United Launch Alliance (ULA) Atlas V rocket. The capsule, which was processed in the Space Station Processing Facility, will deliver more than 7,000 pounds of equipment and research materials that ultimately can lead to improved life on Earth and drive progress toward future space exploration.

The space station resupply mission comes just a year after the first flight of NASA's new Orion spacecraft when it became the first human-rated vehicle to leave low-Earth orbit in 42 years. Launched Dec. 5, 2014, on a ULA Delta IV Heavy rocket, Orion soared 3,604 miles above Earth.

The flawless flight test was a first step in the agency's plans to send humans on the journey to Mars. It also demonstrated that through Kennedy's leadership, the center's workforce accomplished the considerable task of reinventing their approach to operating the world's leading spaceport.

For more than 30 years, Kennedy was a hub of activity supporting processing, launch and landings during America's Space Shuttle Program. Thousands of skilled engineers and technicians supported missions that made possible unprecedented achievements in the utilization of space. Shuttle crews deployed and serviced the Hubble Space Telescope, and built the International Space Station involving the world's best innovators.

Following the conclusion of shuttle flights and reductions in the size of the workforce, a new approach was required. Additionally, President Barack Obama challenged NASA and the nation to develop a new spacecraft, designed for long journeys to allow the nation to send humans to an asteroid and, ultimately, a landing on Mars.

Kennedy Director Bob Cabana points out that the Florida spaceport now is well on its way to meeting the president's challenge.

"Here at the Kennedy Space Center, we are continuing to help develop the Orion crew vehicle, and support the Space Launch System rocket with exploration ground systems that will one day send astronauts on trips beyond low-Earth orbit," he said.

The SLS will be the most powerful rocket ever built and will enable astronauts in the Orion spacecraft to explore distant destinations.
The space center's NASA-industry team also has met Cabana's objective for a spaceport ready to meet diverse challenges of the future.

"Our confidence in meeting the president's objective and our future challenges is based on the fact that we have an outstanding, highly skilled workforce," he said. "They have already achieved the goal of building a 21st century space launch complex with modernized infrastructure for more cost-effective operations, serving multiple users."

Making the best use of taxpayer funded resources has been a key objective from reorganization of the space center's management structure to providing optimum utilization of available assets.

Existing historic buildings and launch sites in use for more than 50 years are being converted to support a modern spaceport equipped with state-of-the art technology meeting the diverse needs of another half-century.

Ongoing improvements over the past few years include upgrades to facilities such as the Vehicle Assembly Building, mobile launcher, crawler–transporter and Launch Complex 39B - a historic pad that will launch astronauts aboard the Orion spacecraft, atop an SLS rocket.

Other center facilities no longer needed are being turned over to industry partners to take advantage of their unique capabilities.

In June 2012, NASA signed a partnership agreement with Craig Technologies to maintain an inventory of unique processing and manufacturing equipment for future mission support at the Cape Canaveral, Florida, site formerly known as the NASA Shuttle Logistics Depot. In its new role, it is now the Aerospace and Defense Manufacturing Center.

During the past year, NASA signed a 30-year property agreement with Space Florida for the operations and management of the Shuttle Landing Facility. Now a variety of commercial and government partners will have access to use the three-mile long runway.

In September, Blue Origin announced they plan to build rockets at Exploration Park on Kennedy property. The company also leased Launch Complex 36 at Cape Canaveral Air Force Station where they plan to launch their orbital launch vehicle.

While partners from industry and academia are finding new uses for Kennedy's unique assets, commercial providers soon will take astronauts to and from the International Space Station.

Through NASA's Commercial Crew Program, commercial partners SpaceX and The Boeing Company are developing safe, reliable and cost-effective access to and from low-Earth orbit with American-built rockets by the end of 2017. Boeing's CST-100 Starliner and SpaceX's Crew Dragon are the next step toward ferrying astronauts to and from the ISS.

To prepare for these next steps in crew transportation, Bay 3 of the space shuttle era's Orbiter Processing Facility now is being modernized by Boeing as the Commercial Crew and Cargo Processing Facility. There, Boeing plans to prepare its Starliner spacecraft under development.

In 2014, NASA signed a property agreement with SpaceX for the use and operation of Launch Complex 39A where it will launch the Falcon 9 Heavy rocket with its Crew Dragon spacecraft.

These are all tangible steps toward meeting the president's challenge and firmly establishing that Kennedy has become a 21st century, multi-user spaceport regularly launching to low-Earth orbit and beyond.
Missions beyond low-Earth orbit are already underway, including the extensive robotic reconnaissance of Mars. In 2011, the Kennedy team launched the Mars Science Laboratory with its Curiosity rover now studying the surface. In 2013, the Mars Atmosphere and Volatile Evolution, or MAVEN, spacecraft was launched from Cape Canaveral and now is orbiting the Red Planet. Scheduled for launch in 2016, the InSight mission will launch a lander to Mars designed to drill beneath the surface and investigate the planet's deep interior.

"Allowing industry to provide our transportation to low-Earth orbit, means the NASA team can focus on what we do best – exploration," said Cabana. "We've got a lot of work going on here at Kennedy as we advance the mission to put boots on Mars."

Source: NASA
The Night Sky

Friday, December 4

• The big Summer Triangle remains laid out the western sky after dark these cold evenings. Its brightest star is Vega, the brightest in the whole area. Look above Vega for Deneb. Farther to Vega's left or lower left is Altair.

• Before and during dawn on Saturday the 5th, bright Venus in the southeast anchors a diagonal line that stretches upper right past Spica to connect Mars, the waning Moon, and then Jupiter.

Saturday, December 5

• In early dawn on Sunday morning the 6th, the waning crescent Moon hangs roughly between Mars and Spica.

Sunday, December 6

• By about 10 p.m. now (depending in how far east or west you live in your time zone), the dim Little Dipper hangs straight down from Polaris.

• Before and during dawn tomorrow morning the 7th, Venus and the crescent Moon pair beautifully close together in the southeast, roughly as shown here.

Monday, December 7

• The Moon occults Venus in broad daylight for essentially all of North and Central America. The Moon is a thin waning crescent about 43° west of the Sun. Venus will disappear behind its sunlit limb, which has a much dimmer surface brightness than Venus does. Venus will reappear from behind the Moon's dark limb up to an hour or more later.

The occultation happens in the middle of the day for the East, and in the morning for the West. In Alaska it happens during dawn. See the December Sky & Telescope, page 46, for timetables.

Source:  Sky & Telescope

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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)

Friday, December 4
6 p.m., Coverage of the Deployment of the Solar Arrays on the Orbital ATK Cygnus CRS-4 Cargo Craft (Solar Array deployment is initiated at appx. 6:28 p.m. ET and is complete by appx. 6:46 p.m. ET) (Starts at 6:20 pm) (all channels)
7:30 p.m., Orbital ATK Cygnus CRS-4 Post-Launch News Conference (time subject to change) (all channels)

Saturday, December 5
6 a.m., NASA Marks the One Year Anniversary of Orion EFT-1 – Orion: Trial By Fire Replay of the Original Mission Coverage as Aired on December 5, 2014 (all channels)

Monday, December 7
4:30 a.m., Coverage of the Rendezvous and Grapple of the Orbital Sciences/ATK Cygnus CRS-4 Cargo Craft at the ISS (Grapple scheduled at 6:15 a.m. ET) (Starts at 6:45 a.m.) (all channels)
8 a.m., Coverage of the Installation of the Orbital Sciences/ATK Cygnus CRS-4 Cargo Craft to the Unity Module of the ISS (all channels)

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

- Dec 04 - Cygnus CRS-4 (OA-4)/ SERPENS/ Flock-2e 1-42/ CADRE/ MinXSS/ Nodes 1&2/ STMSat 1
  Atlas 5 Launch (International Space Station)
- Dec 04 - Comet C/2015 GX (PANSTARRS) At Opposition (1.512 AU)
- Dec 04 - Comet P/2015 W2 (Catalina) At Opposition (1.761 AU)
- Dec 04 - Apollo Asteroid 2015 VQ2 Near-Earth Flyby (0.053 AU)
- Dec 04 - Apollo Asteroid 2013 RZ53 Near-Earth Flyby (0.078 AU)
- Dec 04 - Atira Asteroid 2008 UU90 Closest Approach To Earth (0.788 AU)
- Dec 04 - Asteroid 5066 Garradd Closest Approach To Earth (1.252 AU)
- Dec 04 - Roger Cayrel's 90th Birthday (1925)
- Dec 05 - Comet 230P/LINEAR Closest Approach To Earth (0.548 AU)
- Dec 05 - Comet 105P/Singer Brewster At Opposition (3.813 AU)
- Dec 05 - Apollo Asteroid 2015 XP Near-Earth Flyby (0.004 AU)
- Dec 05 - Apollo Asteroid 2011 WN15 Near-Earth Flyby (0.083 AU)
- Dec 05 - Amor Asteroid 2015 SV2 Near-Earth Flyby (0.099 AU)
- Dec 05 - Asteroid 439 Ohio Closest Approach To Earth (2.005 AU)
- Dec 06 - Cassini, Distant Flyby of Epimetheus, Atlas & Prometheus
- Dec 06 - Moon Occults Mars
- Dec 06 - Comet 329P/LINEAR-Catalina Perihelion (1.660 AU)
- Dec 06 - Comet 193P/LINEAR-NEAT Closest Approach To Earth (2.317 AU)
- Dec 06 - Comet C/2013 V4 (Catalina) At Opposition (4.537 AU)
- Dec 06 - Asteroid 16200 (2000 BT28) Occults HIP 26382 (5.5 Magnitude Star)
- Dec 06 - Apollo Asteroid 2015 WA13 Near-Earth Flyby (0.019 AU)
- Dec 06 - Apollo Asteroid 2015 XB Near-Earth Flyby (0.044 AU)
- Dec 06 - Amor Asteroid 2015 VA3 Near-Earth Flyby (0.083 AU)
- Dec 06 - Aten Asteroid 2010 TK7 (Earth Trojan) Closest Approach To Earth (0.198 AU)
- Dec 06 - Asteroid 11548 Jerrylewis Closest Approach To Earth (1.298 AU)
- Dec 06 - Asteroid 3904 Honda Closest Approach To Earth (1.368 AU)
- Dec 06 - Asteroid 8672 Morse Closest Approach To Earth (1.809 AU)
- Dec 06 - Asteroid 17656 Hayabusa Closest Approach To Earth (1.917 AU)
- Dec 06 - Asteroid 3780 Maury Closest Approach To Earth (1.933 AU)
- Dec 06 - Asteroid 13330 Donavann Closest Approach To Earth (2.270 AU)
- Dec 06 - Yoshiyo Nishina's 125th Birthday (1890)
- Dec 07 - Akatsuki, Venus Orbit Insertion
- Dec 07 - Moon Occults Venus
- Dec 07 - Comet 94P/Russell At Opposition (2.050 AU)
- Dec 07 - Apollo Asteroid 2015 WF13 Near-Earth Flyby (0.028 AU)
- Dec 07 - Aten Asteroid 5381 Sekmet Closest Approach To Earth (0.368 AU)
- Dec 07 - Asteroid 6433 Enya Closest Approach To Earth (0.945 AU)
- Dec 07 - Asteroid 13188 Okinawa Closest Approach To Earth (1.313 AU)
- Dec 07 - Asteroid 6349 Acapulco Closest Approach To Earth (1.932 AU)
- Dec 07 - Asteroid 1958 Chandra Closest Approach To Earth (2.451 AU)
- Dec 07 - Phobos and Deimos Webcast: Phobos as an Exploration Destination and Base for Mars Exploration
- Dec 07 - Online Seminar: The Ecological Physiology of Earth's Second Oxygen Revolution
- Dec 07 - 20th Anniversary (1995), Galileo, Jupiter Orbit Insertion
- Dec 07 - Gerard Kuiper's 110th Birthday (1905)
- Dec 07 - 1830th Anniversary (185 AD), Chinese Emperor Lo-Yang Observes Supernova

Source: JPL Space Calendar

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Food for Thought

Dual Gemini Flights Achieved Crucial Spaceflight Milestones

The flights of two piloted spacecraft during December 1965 were major strides forward in advancing NASA's capabilities in human spaceflight. They also marked the point in which the United States clearly pulled ahead in the space race with the Soviet Union.

While Gemini VII orbited the Earth for two weeks, Gemini VI was launched, completing the first-ever rendezvous between two spacecraft in orbit. It was a transformative capability that was not only necessary for the Apollo moon landing missions, but crucial in building and operating the International Space Station. The rendezvous marked the first time a human spaceflight milestone was achieved by the United States first.

Although the Soviet Union twice had launched simultaneous pairs of Vostok spacecraft in 1962 and 1963, the cosmonauts only established radio contact, coming no closer than several miles of each other.

The original plan for Gemini VI was to launch an unpiloted Agena upper stage atop an Atlas rocket on Oct. 25, 1965. As the target vehicle completed its first orbit, a Titan II launch vehicle was to lift off with astronauts Wally Schirra and Tom Stafford aboard. Gemini VI then would rendezvous and dock with the Agena. After the Atlas rocket lifted off, the Agena's secondary engines fired to separate it from the launch vehicle. However, immediately after the Agena's primary engine fired, telemetry was lost and the target vehicle failed to reach orbit. The launch of Gemini VI was postponed.

Schirra was a member of the original seven astronauts having flown Mercury 8 for six orbits on Oct. 3, 1962. He would go on to command the first piloted Apollo mission in October 1968, becoming the only astronaut to fly in Mercury, Gemini and Apollo.

Stafford was one of nine pilots selected in NASA's second group of astronauts. He would serve as commander for Gemini IX in 1966, and Apollo 10, the lunar landing rehearsal mission, in 1969. He also commanded the crew of the American spacecraft that linked up with two Soviet cosmonauts as part of the Apollo-Soyuz Test Project in 1975.

Since the next Agena target vehicle would not be ready for several months, a new plan began to take shape for Schirra and Stafford. According to "On the Shoulders of Titans: A History of Project Gemini," Walter Burke, spacecraft chief at McDonnell Aircraft Corp., and his deputy, John Yardley, asked, "Why couldn't we launch a Gemini as a target instead of an Agena?" McDonnell was the contractor that built the Gemini spacecraft.

NASA officials at the agency's headquarters in Washington D.C., Cape Kennedy (now Cape Canaveral) in Florida and the Manned Spacecraft Center (now Johnson Space Center) in Texas quickly began drawing up a
plan to orbit Gemini VII on its planned two-week mission and, if there was no serious damage to Launch Pad 19, send up Gemini VI to rendezvous.

At first glance, some were skeptical. "When I first heard of this plan to rendezvous two spacecraft by launching the second spacecraft from the same pad in nine days I thought it was next to impossible," said Andre Meyer Jr., senior assistant to the Gemini Program manager: "It normally takes nine weeks or 63 days of actual work to clean up the pad, erect the booster, mate the spacecraft and check out the systems."

Wiley Williams, NASA's manager of Gemini Operations at the Kennedy Space Center, explained that, while challenging, the quick turnaround was achievable. "Barring unforeseen problems, we feel there is no reason why this schedule, tight as it is, cannot be met," he said at the time. "Our most critical period will be after Gemini VII is gone. We are planning for only a few days 'turnaround' time on the pad."

According to Charles Berry, M.D., chief of Medical Programs at the Manned Spacecraft Center, Gemini VII basically was an effort to better understand how humans adapt to microgravity. "It's the culmination of our efforts to double man's exposure to the space environment with a 14-day flight," he said. "The mission will show us that man, indeed, can adapt. That his body does not show changes that increase with his exposure to that environment. The additional data will allow us to medically commit man to a lunar mission."

The Gemini VII crew, Frank Borman and Jim Lovell, were both from the second group of astronauts. While Lovell would go on to be command pilot of Gemini XII in late 1966, both would fly together again, with Bill Anders, as part of Apollo 8, the first astronauts to orbit the moon in December 1968. As commander of Apollo 13 in 1970, Lovell became the first person to fly four times.

"We're on our way, Frank," said Lovell as Gemini VII launched Dec. 4, 1965. As the rocket exhaust began to clear, teams were standing by to begin preparing for Gemini VI. "I was in the control center at Cape Kennedy watching the launch of Gemini VII and as the spacecraft was continuing into orbit, I glanced at another TV monitor and it showed the next launch vehicle being wheeled out of the hanger," said NASA Gemini Program Manager Charles Matthews. "That's how fast the action was taking place."

The longest previous spaceflight was the eight-day mission of Gemini V. Borman noted that he and Lovell hoped to take advantage of the earlier experiences. "One of the things we got from Gemini V was that flying in the heavier spacesuits was very debilitating," he said. "So we were able to convince NASA that we should have a lightweight pressure suit which was developed in a very short period of time. It was very convenient because we could get out of it, and we did."

Borman and Lovell's work was set up to coincide with that of the prime shift team in Mission Control Houston, with both astronauts working and sleeping at the same time. The Gemini VII crew conducted 20 experiments, the most of any Gemini mission, including studies of nutrition in space.

The next attempt to launch Schirra and Stafford turned out to be one of the most harrowing in the history of America's still young space program. On Dec. 12, 1965, all had proceeded well right up to ignition of the twin Titan II first stage engines. Astronaut Alan Bean was serving as capsule communicator, or capcom.

"3, 2, 1, ignition ... shutdown Gemini VI," he said. After about 1.5 seconds of firing, the engines abruptly shut down. There was no liftoff.

"My clock has started," Schirra said. Since the clock had started in the spacecraft, the instruments were telling Schirra liftoff had taken place. Mission rules dictated that he should immediately pull a D-shaped ring above the center console and activate the ejection seats, blasting the astronauts safely away from the fully fueled Titan II which would be falling back to the launch pad. However, Schirra's experience from Mercury 8 paid off. He did not feel the motion of liftoff.
"I knew we hadn't gone anywhere," he said later. "This proves that man is better programed than any computer." An evaluation determined that a tail plug fell off prematurely causing the engine shutdown and the erroneous liftoff signal. Three days later, Schirra and Stafford were finally on their way to catch up with Borman and Lovell.

The radar on Gemini VI first made contact with Gemini VII after 3 hours and 15 minutes when they were 270 miles away. Soon thereafter, Schirra established voice contact with Borman. "We're looking for you," the Gemini VI command pilot said. "Hang on, we'll be up there shortly."

About six hours after liftoff, while passing over the Hawaii tracking station on Gemini VI’s fourth orbit, Schirra reported that he and Stafford had caught up with Borman and Lovell. "We're flying in formation with (Gemini VII)," Schirra said. "Everything is go here." "Roger, congratulations, excellent," said astronaut Elliott See, the capcom. "Thank you, it was a lot of fun," said Schirra.

During the next five and a half hours of station keeping, the crews moved as close as one foot, taking pictures and describing the appearance of each spacecraft. "Looks like the flag and the letters are seared as much at launch as they are when you come back at re-entry," Lovell said, describing the side of Gemini VI.

Later, Gemini VI fired its thrusters and slowly drifted out to 10 miles, preventing an accidental collision during their sleep period.

Before the end of the day, and noting the upcoming holiday, the Gemini VI crew had a surprise for everyone. "Gemini VII, this is Gemini VI," Schirra said. "We have an object, looks like a satellite going from north to south, probably in a polar orbit. He's in a very low trajectory. Looks like he might be going to re-enter soon. Stand by one ..."

At that point, the sound of "Jingle Bells" was heard being played by Schirra on a small harmonica with Stafford ringing a handful of small bells. "You're too much, VI," laughed See from mission control.

Gemini VI re-entered the next day, landing in the Atlantic Ocean within 10 miles of the aircraft carrier, USS Wasp. The recovery of Schirra and Stafford also was the first to be televised. Through a transportable satellite Earth station on the deck of the Wasp, television networks were able to provide live coverage.

Gemini VII remained in space two days after Gemini VI’s return, landing Dec. 18, 1965. Borman and Lovell held the world record for the longest human spaceflight until the 17-day Soyuz 9 mission in June 1970 and were U.S. record holders until the Skylab missions in 1973 and 1974.

"The VII and VI missions were a very fitting climax to a successful year of Gemini flights," said Matthews. "Gemini IV introduced us to spacewalking and was also the start of our buildup of long duration missions and went four days. Gemini V, in turn, went eight days. This effort on the (Gemini) 7/6 mission, is an example of the American spirit as it has existed throughout the years and is ample evidence that it exists today."

[NASA] EDITOR’S NOTE: This is the fourth in a series of feature articles marking the 50th anniversary of Project Gemini. The program was designed as a steppingstone toward landing on the moon. The investment also provided technology now used in NASA's work aboard the International Space Station and planning for the Journey to Mars. In March, read about the first docking mission and responding to an emergency in space. For more see "On the Shoulders of Titans: A History of Project Gemini."

Source: NASA
Enceladus: Ringside Water World

**Explanation:** Saturn's icy moon Enceladus poses above the gas giant's icy rings in this Cassini spacecraft image. The dramatic scene was captured on July 29, while Cassini cruised just below the ring plane, its cameras looking back in a nearly sunward direction about 1 million kilometers from the moon's bright crescent. At 500 kilometers in diameter, Enceladus is a surprisingly active moon though, its remarkable south polar geysers are visible venting beyond a dark southern limb. In fact, data collected during Cassini's flybys and years of images have recently revealed the presence of a global ocean of liquid water beneath this moon's icy crust. Demonstrating the tantalizing liquid layer's global extent, the careful analysis indicates surface and core are not rigidly connected, with Enceladus rocking slightly back and forth in its orbit.

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

Source: Astronomy Picture of the Day