Space News Update

— May 25, 2018 —

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1. Study of Ancient Fish Suggests Chicxulub Asteroid Strike Warmed Planet for 100,000 Years

A small team of researchers from the U.S. and Tunisia has found evidence that suggests a huge asteroid that struck the Earth approximately 66 million years ago caused the planet to warm up for approximately 100,000 years. In their paper published in the journal *Science*, the group describes their study of oxygen ratios in ancient fish bones and what it revealed.

Prior research has shown that approximately 66 million years ago, a massive asteroid struck the Earth at a point near what is now Chicxulub, Mexico. Other studies have suggested the sudden change in climate that resulted is what caused the dinosaurs to go extinct. The belief has been that the smoke and particles thrust into the atmosphere blocked out the sun causing the planet to cool for a long period of time. In this new effort, the researchers suggest the cooling period likely was shorter than thought and that it was followed by a lengthy hot spell. The researchers came to this conclusion by studying the bones and teeth of ancient fish.

The fish remains were sifted from sediment samples collected at a site in El Kef, Tunisia. During the time before and long after the asteroid strike, the area was covered by the Tethys Sea. The researchers looked at oxygen ratios in the fish remains as a means of determining the temperature of the water at the time that the fish died. Collecting samples from different layers allowed for building a temperature timeline that began before the asteroid strike and lasting hundreds of thousands of years thereafter. In looking at their timeline the group found that sea temperatures had risen approximately 5°C not long after the asteroid struck and had stayed at that temperature for approximately 100,000 years.

The researchers suggest the strike by the asteroid very likely released a lot of carbon dioxide into the atmosphere because the ground area where it struck was rich in carbonates. The strike very likely would have also ignited large long-burning forest fires which would have also released a lot of carbon into the air. The

evidence suggests that the cooling after the impact was short-lived as massive amounts of carbon dioxide were released into the atmosphere setting off global warming.

The researchers note that a lot more work will need to be done to confirm their findings. Another site will have to be found with similar evidence, for example, to prove that the warming was not localized.

Explore further: New analysis of Chicxulub asteroid suggests it may have struck in vulnerable spot

More information: K. G. MacLeod et al. Postimpact earliest Paleogene warming shown by fish debris oxygen isotopes (El Kef, Tunisia), *Science* (2018). DOI: 10.1126/science.aap8525

Source: Phys.org

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2. Twin Spacecraft Launch to Track Earth’s Water Movement

A joint U.S./German space mission to track the continuous movement of water and other changes in Earth’s mass on and beneath the planet’s surface successfully launched at 12:47 p.m. PDT Tuesday from the California coast.

The twin spacecraft of the Gravity Recovery and Climate Experiment Follow-On (GRACE-FO), a joint NASA/German Research Centre for Geosciences (GFZ) mission, lifted off on a SpaceX Falcon 9 rocket from Space Launch Complex 4E at Vandenberg Air Force Base in California, sharing their ride into space with five Iridium NEXT communications satellites.

Ground stations have acquired signals from both GRACE-FO spacecraft. Initial telemetry shows the satellites are performing as expected. The GRACE-FO satellites are at an altitude of about 305 miles (490 kilometers), traveling about 16,800 mph (7.5 kilometers per second). They are in a near-polar orbit, circling Earth once every 90 minutes.

“GRACE-FO will provide unique insights into how our complex planet operates,” said Thomas Zurbuchen, associate administrator of NASA’s Science Mission Directorate at NASA Headquarters. “Just as important, because the mission monitors many key aspects of the Earth’s water cycle, GRACE-FO data will be used throughout the world to improve people’s lives – from better predictions of drought impacts to higher quality information on use and management of water from underground aquifers.”

Over its five-year mission, GRACE-FO will monitor the movement of mass around our planet by measuring where and how the moving mass changes Earth's gravitational pull. The gravity changes cause the distance

between the two satellites to vary slightly. Although the two satellites orbit 137 miles (220 kilometers) apart, advanced instruments continuously measure their separation to within the width of a human red blood cell.

GRACE-FO continues the U.S./German partnership of the original GRACE mission, which operated from 2002 through 2017. “This mission continues and advances an amazing achievement of science and technology pioneered by the United States and Germany,” said Zurbuchen.

For 15 years, GRACE’s monthly maps of regional gravity variations provided new insights into how the Earth system functions and responds to change.

Among its innovations, GRACE was the first mission to measure the amount of ice being lost from the Greenland and Antarctic ice sheets. The mission improved our understanding of the processes responsible for sea level rise and ocean circulation, provided insights into where global groundwater resources are shrinking or growing, showed where dry soils are contributing to drought, and monitored changes in the solid Earth, such as from earthquakes.

Frank Webb, GRACE-FO project scientist at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California, notes that to understand changes taking place in the climate system, scientists need data records several decades long.

"Extending the data record from GRACE will allow us to better distinguish short-term variability from longer-term trends," he said.

The GRACE-FO satellites will spend their first few days in space moving to the separation distance needed to perform their mission. When they reach this distance, the mission begins an 85-day, in-orbit checkout phase. Mission managers will evaluate the instruments and satellite systems and perform calibration and alignment procedures. Then the satellites will begin gathering and processing science data. The first science data are expected to be released in about seven months.

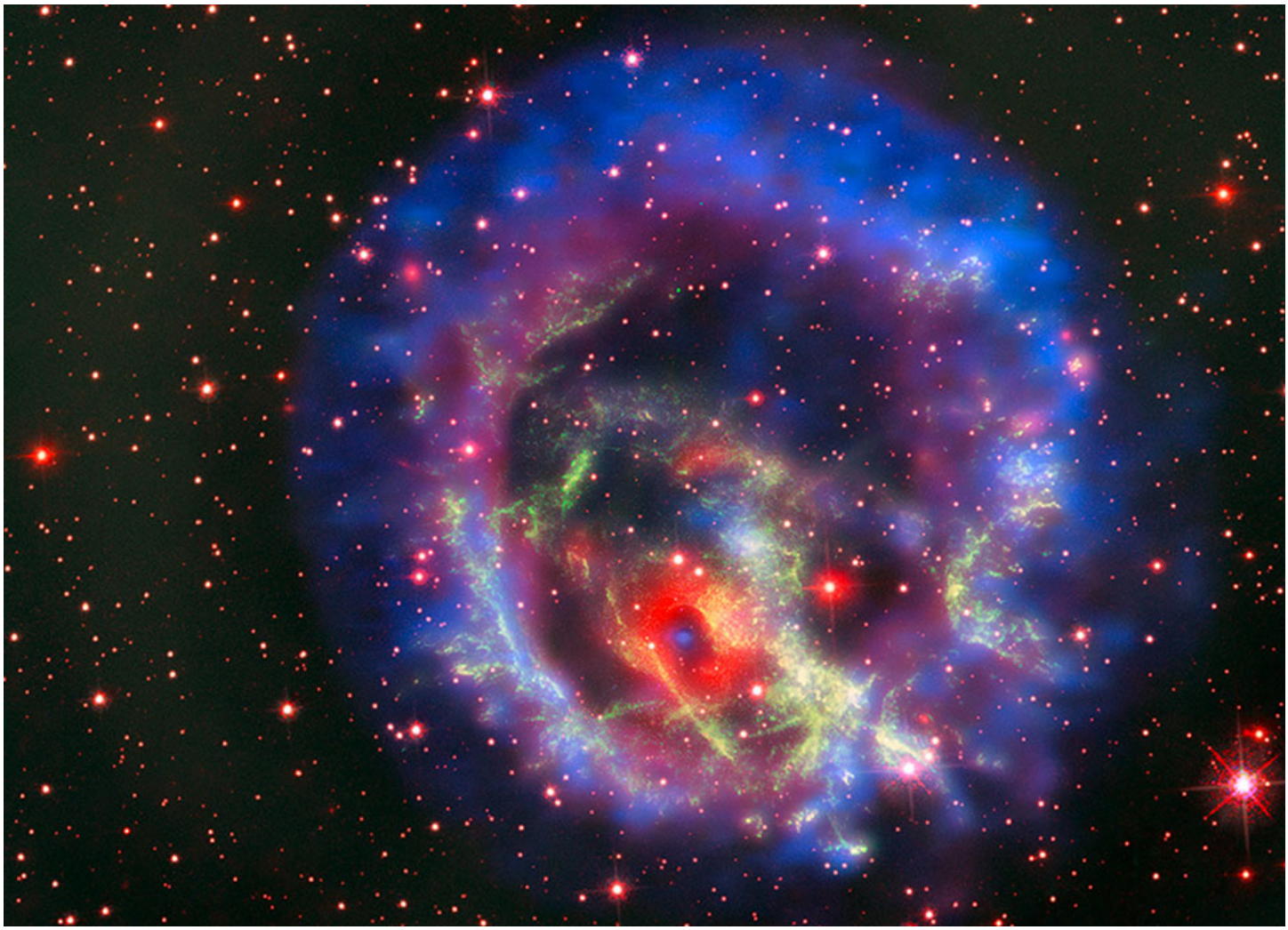
JPL manages the GRACE-FO mission for NASA’s Science Mission Directorate in Washington, under the direction of the Earth Systematic Missions Program Office at NASA’s Goddard Space Flight Center in Greenbelt, Maryland. The spacecraft were built by Airbus Defence and Space in Friedrichshafen, Germany, under subcontract to JPL. GFZ contracted GRACE-FO launch services from Iridium. GFZ subcontracted mission operations to the German Aerospace Center (DLR), which operates the German Space Operations Center in Oberpfaffenhofen, Germany.

For more information about GRACE-FO, visit:

https://www.nasa.gov/gracefo

Source: NASA Return to Contents

3. Astronomers Spot a Distant and Lonely Neutron Star



Astronomers have discovered a special kind of neutron star for the first time outside of the Milky Way galaxy, using data from NASA's Chandra X-ray Observatory and the European Southern Observatory's Very Large Telescope (VLT) in Chile.

Neutron stars are the ultra dense cores of massive stars that collapse and undergo a supernova explosion. This newly identified neutron star is a rare variety that has both a low magnetic field and no stellar companion.

The neutron star is located within the remains of a supernova -- known as 1E 0102.2-7219 (E0102 for short) -- in the Small Magellanic Cloud, located 200,000 light-years from Earth.

This new composite image of E0102 allows astronomers to learn new details about this object that was discovered more than three decades ago. In this image, X-rays from Chandra are blue and purple, and visible light data from VLT's Multi Unit Spectroscopic Explorer (MUSE) instrument are bright red. Additional data from the Hubble Space Telescope are dark red and green.

Oxygen-rich supernova remnants like E0102 are important for understanding how massive stars fuse lighter elements into heavier ones before they explode. Seen up to a few thousand years after the original explosion, oxygen-rich remnants contain the debris ejected from the dead star's interior. This debris (visible as a green filamentary structure in the combined image) is observed today hurtling through space after being expelled at millions of miles per hour.

Chandra observations of E0102 show that the supernova remnant is dominated by a large ring-shaped structure in X-rays, associated with the blast wave of the supernova. The new MUSE data revealed a smaller ring of gas (in bright red) that is expanding more slowly than the blast wave. At the center of this ring is a blue point-like source of X-rays. Together, the small ring and point source act like a celestial bull's eye.

The combined Chandra and MUSE data suggest that this source is an isolated neutron star, created in the supernova explosion about two millennia ago. The X-ray energy signature, or "spectrum," of this source is very similar to that of the neutron stars located at the center of two other famous oxygen-rich supernova remnants: Cassiopeia A (Cas A) and Puppis A. These two neutron stars also do not have companion stars.

The lack of evidence for extended radio emission or pulsed X-ray radiation, typically associated with rapidly rotating highly-magnetized neutron stars, indicates that the astronomers have detected the X-radiation from the hot surface of an isolated neutron star with low magnetic fields. About ten such objects have been detected in the Milky Way galaxy, but this is the first one detected outside our galaxy.

But how did this neutron star end up in its current position, seemingly offset from the center of the circular shell of X-ray emission produced by the blast wave of the supernova? One possibility is that the supernova explosion did occur near the middle of the remnant, but the neutron star was kicked away from the site in an asymmetric explosion, at a high speed of about two million miles per hour. However, in this scenario, it is difficult to explain why the neutron star is, today, so neatly encircled by the recently discovered ring of gas seen at optical wavelengths.

Another possible explanation is that the neutron star is moving slowly and its current position is roughly where the supernova explosion happened. In this case, the material in the optical ring may have been ejected either during the supernova explosion, or by the doomed progenitor star up to a few thousand years before.

A challenge for this second scenario is that the explosion site would be located well away from the center of the remnant as determined by the extended X-ray emission. This would imply a special set of circumstances for the surroundings of E0102: for example, a cavity carved by winds from the progenitor star before the supernova explosion, and variations in the density of the interstellar gas and dust surrounding the remnant.

Future observations of E0102 at X-ray, optical, and radio wavelengths should help astronomers solve this exciting new puzzle posed by the lonely neutron star.

Reference: "Identification of the Central Compact Object in the Young Supernova Remnant 1E 0102.2-7219," Frédéric P. A. Vogt et al., 2018 Apr. 2, Nature Astronomy [https://www.nature.com/articles/s41550-018-0433-0, preprint: https://arxiv.org/abs/1803.01006].

Source: Spaceref.com Return to Contents

The Night Sky

Friday, May 25

• As the waxing gibbous Moon crosses the sky tonight, Spica hangs below it, as shown in early twilight here.

• The Arch of Spring spans the western sky in late twilight, arching over Venus. Pollux and Castor form the Arch's top; they're lined up over Venus roughly horizontally. Look well to Venus's left to find Procyon, the left end of the Arch. Look farther to Venus's right for Capella, the Arch's right end.

Saturday, May 26

• Tonight the Moon forms a flat triangle with Spica and brighter Jupiter, which are more or less on opposite sides of it, as shown here. This is their arrangement in bright twilight. The whole scene rotates clockwise as it moves westward through the night.

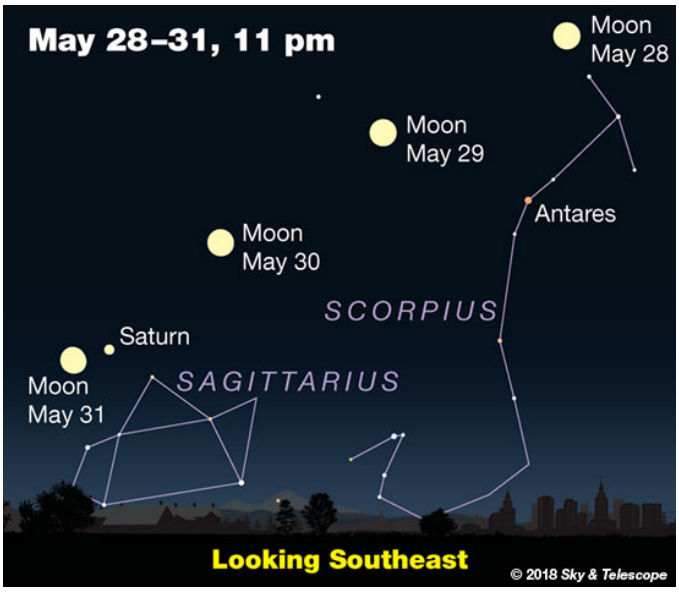
Sunday, May 27

• Now Jupiter shines to the Moon's right in the evening. They may look like companions, but Jupiter is 1,700 times farther away.

And very high above them shines bright Arcturus, 530,000 times more distant than Jupiter.

Monday, May 28

• Jupiter's moon Europa emerges out of eclipse from Jupiter's shadow around 11:13 p.m. Eastern Daylight Time. A small telescope will show Europa gradually swelling into view just off the planet's eastern limb.



Source: Sky & Telescope

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ISS Sighting Opportunities

For Denver:

Date	Visible	Max Height	Appears	Disappears
Fri May 25, 9:47 PM	2 min	16°	16° above N	10° above NNE
Fri May 25, 11:24 PM	< 1 min	10°	10° above N	10° above N
Sat May 26, 00:59 AM	1 min	15°	10° above NNW	15° above N
Sat May 26, 8:54 PM	2 min	22°	22° above NNW	10° above NNE
Sat May 26, 10:31 PM	< 1 min	10°	10° above N	10° above N
Sun May 27, 00:08 AM	< 1 min	14°	14° above N	14° above NNE
Sun May 27, 9:39 PM	1 min	12°	12° above N	10° above N
Sun May 27, 11:16 PM	1 min	11°	11° above N	10° above NNE
Mon May 28, 00:51 AM	< 1 min	12°	10° above NW	12° above NNW
Mon May 28, 8:46 PM	2 min	14°	14° above NNW	10° above NNE
Mon May 28, 10:23 PM	1 min	10°	10° above N	10° above NNE

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

NASA-TV Highlights

(all times Eastern Daylight Time)

Friday, May 25

2 p.m., Replay of SpaceCast Weekly (all channels)

6 p.m., Replay of SpaceCast Weekly (all channels)

10 p.m., Replay of SpaceCast Weekly (NTV-1 (Public))

Tuesday, May 29

7:30 a.m., ISS Expedition 55 In-Flight Event for JAXA with the Gifu Prefecture and Flight Engineer Norishige Kanai of the Japan Aerospace Exploration Agency (JAXA) (English interpretation on Public, native language on Media) (all channels)

4 p.m., Video File of the ISS Expedition 56-57 Crew's Pre-Launch Activities at the Baikonur Cosmodrome in Kazakhstan (Prokopyev, Aunon-Chancellor, Gerst; includes material recorded from May 19-29) (all channels)

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

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Space Calendar

- May 25 -  [May 23] Towel Day - Annual Tribute to Douglas Adams
- May 25 - GSAT 11/ Azerspace 2 (Intelsat 38) Ariane 5 Launch
- May 25 - Comet 5D/Brorsen Closest Approach To Earth (2.295 AU)
- May 25 - Comet P/2012 SB6 (Lemmon) At Opposition (3.601 AU)
- May 25 - Comet P/2011 U2 (Bressi) At Opposition (4.583 AU)
- May 25 - Apollo Asteroid 2018 JG2 Near-Earth Flyby (0.047 AU)
- May 25 -  [May 21] Amor Asteroid 2018 KC1 Near-Earth Flyby (0.059 AU)
- May 25 - Apollo Asteroid 2018 FS3 Near-Earth Flyby (0.074 AU)
- May 25 - Asteroid 17059 Elvis Closest Approach To Earth (1.555 AU)
- May 25 - Asteroid 2169 Taiwan Closest Approach To Earth (1.912 AU)
- May 25 - Asteroid 157064 Sedona Closest Approach To Earth (2.108 AU)
- May 25 - 10th Anniversary (2008), Phoenix, Mars Landing
- May 26 - Comet 234P/LINEAR Closest Approach To Earth (2.354 AU)
- May 26 - Comet 187P/LINEAR Closest Approach To Earth (2.888 AU)
- May 26 - Comet 187P/LINEAR At Opposition (2.888 AU)
- May 26 - Comet P/2011 U2 (Bressi) Closest Approach To Earth (4.583 AU)
- May 26 - Apollo Asteroid 2017 LF Near-Earth Flyby (0.085 AU)
- May 26 - Asteroid 5738 Billpickering Closest Approach To Earth (2.120 AU)
- May 26 - Plutino 2006 HJ123 At Opposition (33.096 AU)
- May 27 - Moon Occults Asteroid 16 Psyche
- May 27 - Comet 255P/Levy At Opposition (2.698 AU)
- May 27 - Comet P/2017 G2 (PANSTARRS) Closest Approach To Earth (2.954 AU)
- May 27 - Comet 315P/LONEOS At Opposition (3.368 AU)
- May 27 - Comet 187P/LINEAR Perihelion (3.881 AU)
- May 27 -  [May 18] Aten Asteroid 2018 JK3 Near-Earth Flyby (0.050 AU)
- May 27 - Aten Asteroid 66391 (1999 KW4) Near-Earth Flyby (0.078 AU)
- May 27 - Atira Asteroid 481817 (2008 UL90) Closest Approach To Earth (0.580 AU)
- May 27 - Asteroid 11335 Santiago Closest Approach To Earth (1.457 AU)
- May 27 - Asteroid 2197 Shanghai Closest Approach To Earth (2.306 AU)
- May 27 - Plutino 38628 Huya At Opposition (27.633 AU)
- May 27 - Alexander Volkov's 70th Birthday (1948)
- May 28 - Comet P/1999 RO28 (LONEOS) Closest Approach To Earth (2.877 AU)
- May 28 - Comet C/2015 VL62 Closest Approach To Earth (2.895 AU)
- May 28 - Comet 215P/NEAT Closest Approach To Earth (3.051 AU)
- May 28 - Comet 157P/Tritton At Opposition (3.884 AU)
- May 28 - Asteroid 4 Vesta Occults TYC 6268-00905-1 (10.3 Magnitude Star)
- May 28 -  [May 20] Aten Asteroid 2018 KR Near-Earth Flyby (0.040 AU)
- May 28 - Apollo Asteroid 2018 JA Near-Earth Flyby (0.052 AU)
- May 28 - Amor Asteroid 2018 ER4 Near-Earth Flyby (0.066 AU)
- May 28 - Asteroid 17744 Jodiefoster Closest Approach To Earth (1.379 AU)
- May 28 - Asteroid 6117 Brevardastro Closest Approach To Earth (1.480 AU)
- May 28 - Asteroid 6714 Montreal Closest Approach To Earth (1.657 AU)
- May 28 - Asteroid 4099 Wiggins Closest Approach To Earth (1.805 AU)
- May 28 - Asteroid 3780 Maury Closest Approach To Earth (1.827 AU)
- May 28 - Asteroid 2044 Wirt Closest Approach To Earth (1.998 AU)
- May 28 - Asteroid 1042 Amazone Closest Approach To Earth (2.279 AU)

Source: JPL Space Calendar

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Food for Thought

Fifty-five Years Ago, Faith 7 Closes Out Project Mercury

Project Mercury was America's first human space flight program. The Space Task Group at Langley Research Center in Virginia initiated the project in 1958 with three goals: orbiting a human spacecraft, investigating an astronaut's ability to function in space, and safely recovering both spacecraft and crew.

After some early launch failures, the first successful test of the single-seat spacecraft without an astronaut on board took place in December 1960, launched into a suborbital flight atop a Redstone rocket. A similar flight a month later carried Ham, a chimpanzee. Two crewed 16-minute suborbital flights flew in May and August 1961, with Alan B. Shepard and Virgil I. Grissom aboard, respectively. The first successful uncrewed Mercury orbital flight using the more powerful Atlas rocket launched in September 1961, followed by the orbital flight of Enos, another chimpanzee, in November.

John H. Glenn flew the first human orbital flight in February 1962, followed by M. Scott Carpenter in May and Walter M. Schirra in October. Glenn and Carpenter each orbited the Earth three times, Schirra six.

The final flight of Project Mercury launched May 15, 1963, from Pad 14 at Cape Canaveral Air Force Station in Florida. L. Gordon Cooper, the pilot of Mercury 9, named his capsule Faith 7. The number 7 recognized his status as one of the Original 7 astronauts. During a flight that was longer than all previous Mercury missions combined, Cooper conducted 11 experiments that included monitoring radiation levels, deploying a strobe beacon to see how well Cooper could track it, observing zodiacal lights, and taking photographs of the Earth. During his 17th orbit, Cooper transmitted slow-scan black and white television images back to the Mercury Control Center (MCC) at Cape Canaveral, the first TV transmission from an American crewed spacecraft.

Although plans called for Cooper to sleep as much as eight hours, he slept only intermittently during portions of the flight.

Faith 7 performed well until the 19th orbit, when a faulty sensor erroneously indicated that the spacecraft was starting reentry. Two orbits later, a short circuit knocked out the automatic stabilization and control system. When the carbon dioxide level began to rise in the cabin and in his spacesuit, Cooper reported to MCC in his usual understated manner, "Things are beginning to stack up a little." Despite these malfunctions, he managed to make a perfect manual reentry concluding a highly successful mission. Faith 7 splashed down about 80 miles southeast of Midway Island in the Pacific Ocean, just four miles from the recovery ship USS *Kearsarge*. Cooper orbited the Earth 22 times and logged 34 hours and 20 minutes in space, the longest US space flight at that time. Project Mercury gave NASA the confidence to move on to Project Gemini during which the critical techniques required to achieve a lunar landing before the end of the decade were mastered by two-person crews.

Enjoy Gordon Cooper's oral history with the JSC History Office.

The Mercury 9 capsule is currently on display at Space Center Houston. A recreation of the MCC is on display inside the Kurt Debus Center at the Kennedy Space Center Visitor Complex.

Source: NASA Return to Contents

Space Image of the Week

VIMOS's Last Embrace

Explanation Two spiral galaxies are locked in a spellbinding, swirling dance in this image from the VIMOS instrument on ESO's Very Large Telescope (VLT). The two interacting galaxies — NGC 5426 and NGC 5427 — together form an intriguing astronomical object named Arp 271, the subject of this, the final image captured by VIMOS before it was decommissioned on 24 March 2018.

VIMOS — or, in full, the VIsible Multi-Object Spectrograph — was active on the VLT for an impressive 16 years. During that time it helped scientists to uncover the wild early lives of massive galaxies, observe awe-inspiring triple-galaxy interactions, and explore deep cosmic questions such as how the Universe's most massive galaxies grew so large. Instead of focusing on single objects, VIMOS was able to capture detailed information about hundreds of galaxies at once. This sensitive instrument collected the spectra of tens of thousands of galaxies throughout the Universe, showing how they formed, grew, and evolved.

Arp 271 is framed against a backdrop of distant galaxies in this view, and wisps of bluish gas, dust and young stars can be seen bridging the gap between the two galaxies — a result of their mutual gravitational interaction. Like many astronomical observations, this image looks back in time. Thanks to the vast gulf of space separating the Earth and Arp 271, this image shows how the galaxies looked over 110 million years ago: the amount of time it has taken their light to reach us. This kind of collision and merger is also thought to be the eventual fate of the Milky Way, which scientists believe will undergo a similar interaction with our neighbouring galaxy Andromeda.

Credit: ESO/Juan Carlos Muñoz

Source: European Southern Observatory

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