Space News Update

— July 13, 2018 —

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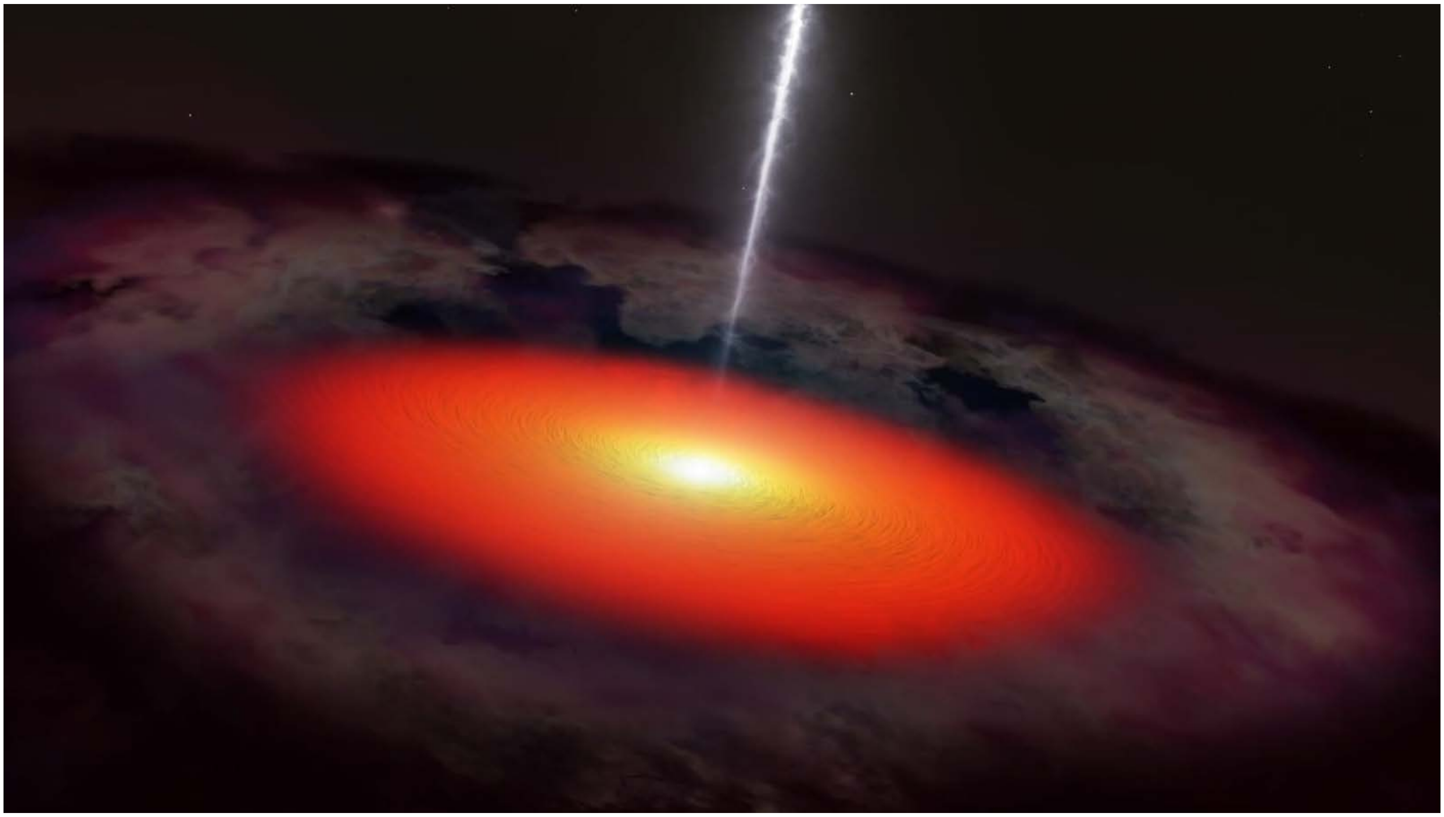
1. Fermi Traces Source of Cosmic Neutrino to Monster Black Hole



For the first time ever, scientists using NASA's Fermi Gamma-ray Space Telescope have found the source of a high-energy neutrino from outside our galaxy. This neutrino traveled 3.7 billion years at almost the speed of light before being detected on Earth. This is farther than any other neutrino whose origin scientists can identify.

High-energy neutrinos are hard-to-catch particles that scientists think are created by the most powerful events in the cosmos, such as galaxy mergers and material falling onto supermassive black holes. They travel at speeds just shy of the speed of light and rarely interact with other matter, allowing them to travel unimpeded across distances of billions of light-years.

The neutrino was discovered by an international team of scientists using the National Science Foundation's IceCube Neutrino Observatory at the Amundsen–Scott South Pole Station. Fermi found the source of the neutrino by tracing its path back to a blast of gamma-ray light from a distant supermassive black hole in the constellation Orion.

"Again, Fermi has helped make another giant leap in a growing field we call multimessenger astronomy," said Paul Hertz, director of the Astrophysics Division at NASA Headquarters in Washington. "Neutrinos and gravitational waves deliver new kinds of information about the most extreme environments in the universe. But to best understand what they're telling us, we need to connect them to the 'messenger' astronomers know best—light."

Scientists study neutrinos, as well as cosmic rays and gamma rays, to understand what is going on in turbulent cosmic environments such as supernovas, black holes and stars. Neutrinos show the complex processes that occur inside the environment, and cosmic rays show the force and speed of violent activity. But, scientists rely on gamma rays, the most energetic form of light, to brightly flag what cosmic source is producing these neutrinos and cosmic rays.

“The most extreme cosmic explosions produce gravitational waves, and the most extreme cosmic accelerators produce high-energy neutrinos and cosmic rays,” says Regina Caputo of NASA’s Goddard Space Flight Center in Greenbelt, Maryland, the analysis coordinator for the Fermi Large Area Telescope Collaboration. “Through Fermi, gamma rays are providing a bridge to each of these new cosmic signals.”

The discovery is the subject of two papers published Thursday in the journal Science. The source identification paper also includes important follow-up observations by the Major Atmospheric Gamma Imaging Cherenkov Telescopes and additional data from NASA’s Neil Gehrels Swift Observatory and many other facilities.

On Sept. 22, 2017, scientists using IceCube detected signs of a neutrino striking the Antarctic ice with energy of about 300 trillion electron volts—more than 45 times the energy achievable in the most powerful particle accelerator on Earth. This high energy strongly suggested that the neutrino had to be from beyond our solar system. Backtracking the path through IceCube indicated where in the sky the neutrino came from, and automated alerts notified astronomers around the globe to search this region for flares or outbursts that could be associated with the event.

Data from Fermi’s Large Area Telescope revealed enhanced gamma-ray emission from a well-known active galaxy at the time the neutrino arrived. This is a type of active galaxy called a blazar, with a supermassive black hole with millions to billions of times the Sun’s mass that blasts jets of particles outward in opposite directions at nearly the speed of light. Blazars are especially bright and active because one of these jets happens to point almost directly toward Earth.

Fermi scientist Yasuyuki Tanaka at Hiroshima University in Japan was the first to associate the neutrino event with the blazar designated TXS 0506+056 (TXS 0506 for short).

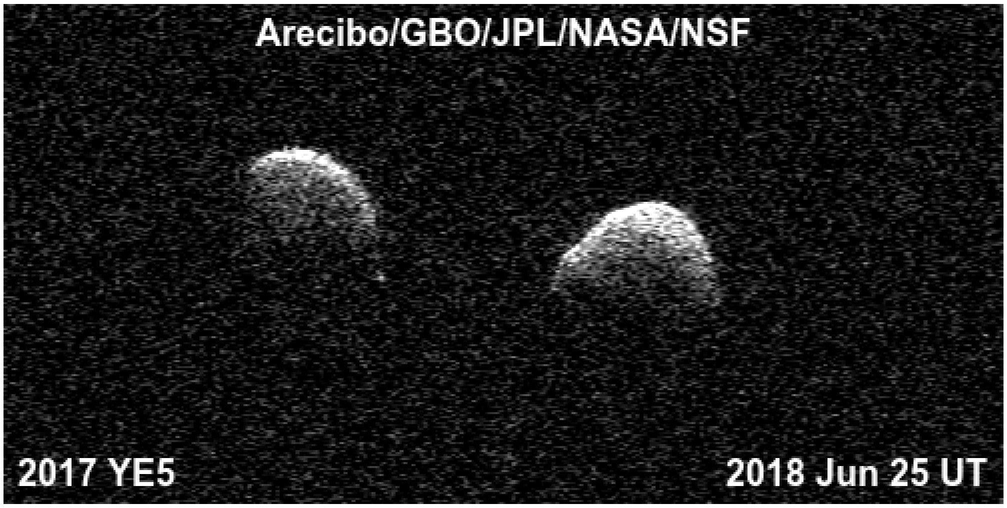
“Fermi’s LAT monitors the entire sky in gamma rays and keeps tabs on the activity of some 2,000 blazars, yet TXS 0506 really stood out,” said Sara Buson, a NASA Postdoctoral Fellow at Goddard who performed the data analysis with Anna Franckowiak, a scientist at the Deutsches Elektronen-Synchrotron research center in Zeuthen, Germany. “This blazar is located near the center of the sky position determined by IceCube and, at the time of the neutrino detection, was the most active Fermi had seen it in a decade.”

NASA's Fermi Gamma-ray Space Telescope is an astrophysics and particle physics partnership, developed in collaboration with the U.S. Department of Energy and with important contributions from academic institutions and partners in France, Germany, Italy, Japan, Sweden and the United States. The NASA Postdoctoral Fellow program is administered by Universities Space Research Association under contract with NASA.

For more about NASA’s Fermi mission, visit: **https://www.nasa.gov/fermi**

Source: NASA Return to Contents

2. Observatories Team Up to Reveal Rare Double Asteroid



New observations by three of the world's largest radio telescopes have revealed that an asteroid discovered last year is actually two objects, each about 3,000 feet (900 meters) in size, orbiting each other.

Near-Earth asteroid 2017 YE5 was discovered with observations provided by the Morocco Oukaimeden Sky Survey on Dec. 21, 2017, but no details about the asteroid's physical properties were known until the end of June. This is only the fourth "equal mass" binary near-Earth asteroid ever detected, consisting of two objects nearly identical in size, orbiting each other. The new observations provide the most detailed images ever obtained of this type of binary asteroid.

On June 21, the asteroid 2017 YE5 made its closest approach to Earth for at least the next 170 years, coming to within 3.7 million miles (6 million kilometers) of Earth, or about 16 times the distance between Earth and the Moon. On June 21 and 22, observations by NASA's Goldstone Solar System Radar (GSSR) in California showed the first signs that 2017 YE5 could be a binary system. The observations revealed two distinct lobes, but the asteroid's orientation was such that scientists could not see if the two bodies were separate or joined. Eventually, the two objects rotated to expose a distinct gap between them.

Scientists at the Arecibo Observatory in Puerto Rico had already planned to observe 2017 YE5, and they were alerted by their colleagues at Goldstone of the asteroid's unique properties. On June 24, the scientists teamed up with researchers at the Green Bank Observatory (GBO) in West Virginia and used the two observatories together in a bi-static radar configuration (in which Arecibo transmits the radar signal and Green Bank receives the return signal). Together, they were able to confirm that 2017 YE5 consists of two separated objects. By June 26, both Goldstone and Arecibo had independently confirmed the asteroid's binary nature.

The new observations obtained between June 21 and 26 indicate that the two objects revolve around each other once every 20 to 24 hours. This was confirmed with visible-light observations of brightness variations by Brian Warner at the Center for Solar System Studies in Rancho Cucamonga, California.

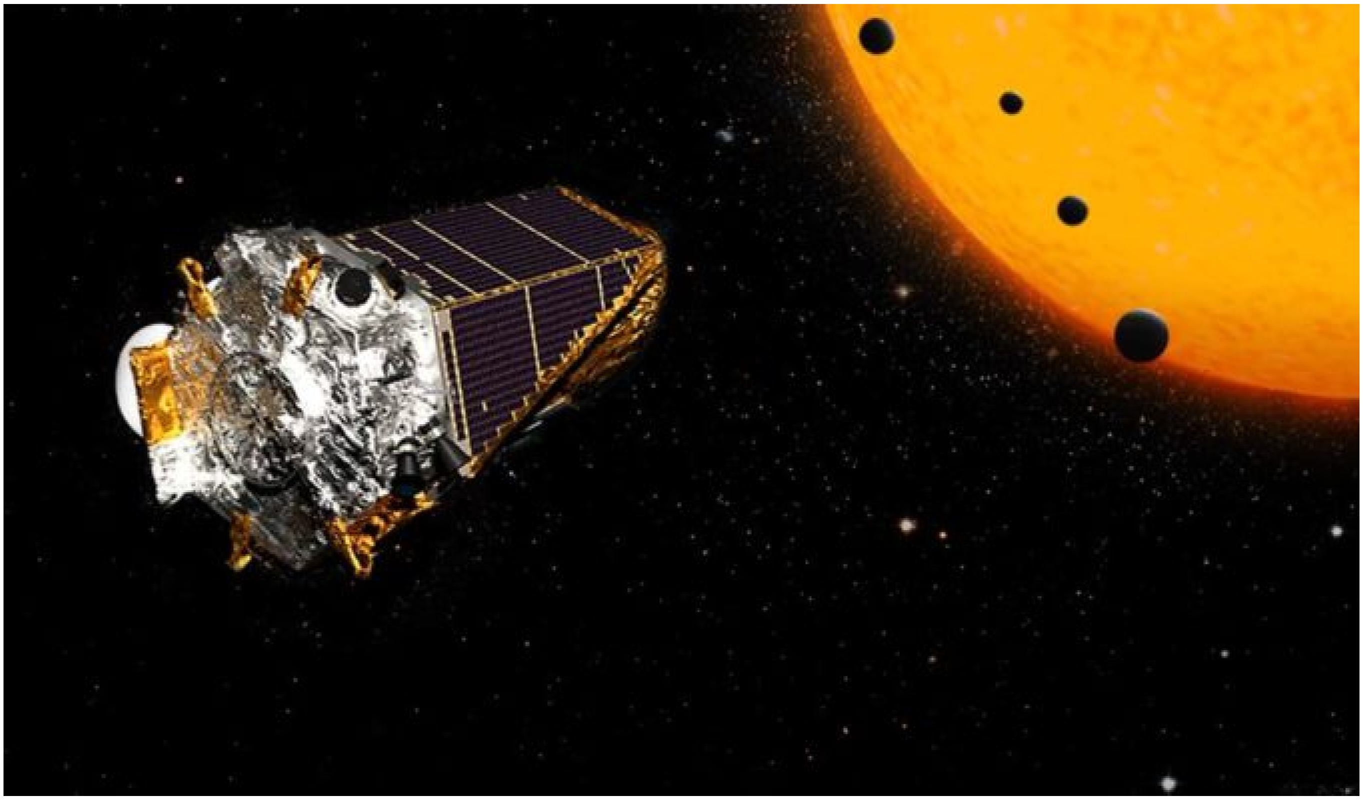
Radar imaging shows that the two objects are larger than their combined optical brightness originally suggested, indicating that the two rocks do not reflect as much sunlight as a typical rocky asteroid. 2017 YE5 is likely as dark as charcoal. The Goldstone images taken on June 21 also show a striking difference in the radar reflectivity of the two objects, a phenomenon not seen previously among more than 50 other binary asteroid systems studied by radar since 2000. (However, the majority of those binary asteroids consist of one large object and a much smaller satellite.) The reflectivity differences also appear in the Arecibo images and hint that the two objects may have different densities, compositions near their surfaces, or different surface roughnesses.

Scientists estimate that among near-Earth asteroids larger than 650 feet (200 meters) in size, about 15 percent are binaries with one larger object and a much smaller satellite. Equal-mass binaries like 2017 YE5 are much rarer. Contact binaries, in which two similarly sized objects are in contact, are thought to make up another 15 percent of near-Earth asteroids larger than 650 feet (200 meters) in size.

The discovery of the binary nature of 2017 YE5 provides scientists with an important opportunity to improve understanding of different types of binaries and to study the formation mechanisms between binaries and contact binaries, which may be related. Analysis of the combined radar and optical observations may allow scientists to estimate the densities of the 2017 YE5 objects, which will improve understanding of their composition and internal structure, and of how they formed.

Source: JPL Return to Contents

3. NASA’s Kepler telescope nears end of mission



Nearly a decade after launching from Cape Canaveral on a planet-hunting quest that has netted 2,650 new confirmed worlds beyond our solar system, NASA’s Kepler telescope has paused its observations after on-board sensors detected it is running low on fuel.

Kepler’s dwindling fuel supply was not a surprise to mission managers, and engineers previously projected the spacecraft would run out of propellant this year. The observatory uses the fuel to point toward new star fields in search of planets, and to orient its radio transmitter toward Earth.

Ground controllers interrupted Kepler’s current observing campaign July 2 after sensors inside the spacecraft’s propulsion system detected “an anomalous drop in fuel pressure,” according to a status update posted on the mission’s website.

Such a telemetry signature is one sign of low fuel, and officials decided to pause its current science observations, known as Campaign 18, until all of the telescope’s recorded scene data can be downlinked to Earth during a four-day pre-arranged period booked with the Deep Space Network starting Aug. 2.

Until then, Kepler will remain in a fuel-conserving hibernation-like mode with no science observations planned. NASA officials said they decided to put Kepler into safe mode to preserve 51 days of “high-quality” science data stored on the spacecraft’s solid state recorder, guarding against the risk of running out of fuel before the information can be transmitted to Earth.

Once Kepler empties its fuel tank, the spacecraft will no longer be able to point its antenna toward Earth, cutting off communications with the observatory. Kepler orbits the sun, and is currently located around 100 million miles from Earth.

Assuming the data downlink in early August is successful, Kepler will resume its science mission Aug. 6 by aiming its 37-inch (95-centimeter) telescope toward a new field of stars to begin a new observing period known as Campaign 19. Kepler's 95-megapixel camera is designed to sense the telltale dips in starlight caused by a passing planet.

Kepler launched March 6, 2009, from Cape Canaveral aboard a Delta 2 rocket. The mission's primary science phase ended in 2013 after the failure of two of the spacecraft's four reaction wheels, which kept the telescope steadily pointed at its stellar targets.

Managers devised a new way of using Kepler with only two operating reaction wheels, and the mission is currently in an extended phase known as K2. Scientists have confirmed the discovery of 2,650 planets around other stars using Kepler data, and there are more than 2,700 planet candidates detected by Kepler that require follow-up observations.

NASA officials cautioned that Kepler's next planet-hunting season starting in August may not be completed if the spacecraft is running on its final bits of fuel.

Kepler launched with 12 kilograms, or a little over 3 gallons, of hydrazine fuel, but it does not carry a fuel gauge. Instead, engineers must monitor data on fuel pressure and catalog fuel consumption to estimate how much propellant remains for the spacecraft's thrusters.

When the spacecraft runs out of fuel, controllers hope to send commands to turn off Kepler's radio transmitters and disable on-board software that would automatically turn them back on, a measure to ensure the telescope does not interfere with radio traffic on future space missions.

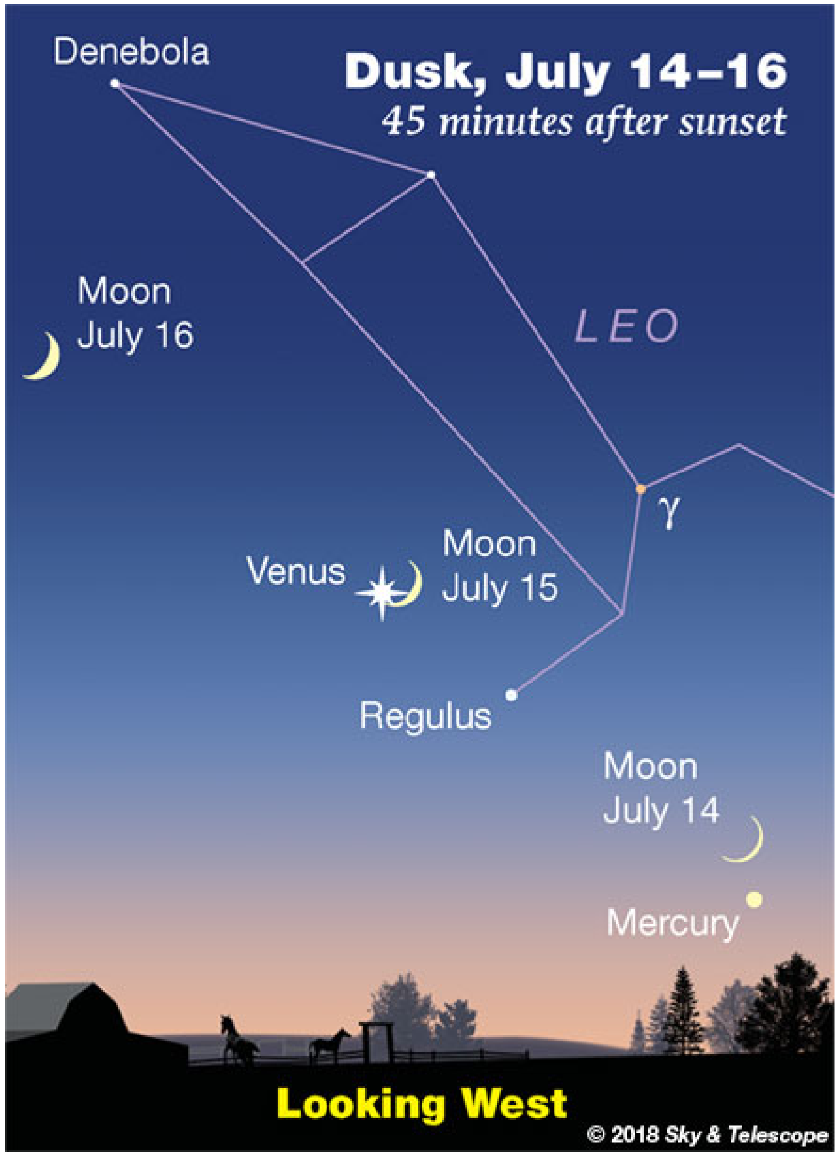
NASA's newest mission dedicated to the search for planets, the Transiting Exoplanet Survey Satellite, launched in April. It is designed to look for planets around bright, nearby stars, while Kepler sought more distant exoplanets.

Source: Spaceflight Now Return to Contents

The Night Sky

Friday, July 13
• Cassiopeia is now well past its annual bottoming out due north. Look for its W pattern climbing low in the north-northeast after dark. The farther north you live, the higher it will be.

Saturday, July 14
• As twilight fades, see if you can catch the Moon over Mercury very low in the west, well to the lower right of Venus as shown here. Your best view may be about 45 minutes after sunset.



• One hour after sunset, as twilight fades further and the stars are coming out, you'll find the two brightest stars of summer, Vega and Arcturus, about equally near the zenith: Vega toward the east, shining very pale bluish white, and Arcturus toward the southwest, pale yellow-orange.

Sunday, July 15
• **Moon and Venus: a lovely couple!** Hanging dramatically in the west during twilight will be quite the eye-catcher: Venus and the crescent Moon closely paired. *How* closely depends on where you are. Seen at the time of dusk in North America's eastern time zone, they'll appear about 2° apart. Seen from the West, they'll be less than 1° apart.

Also, look carefully a little to their lower right for Regulus twinkling away. It's slightly less than 1% as bright as Venus. You may also be able to catch Mercury much farther lower right. A line from Venus through Regulus points straight to Mercury; binoculars will help.

Monday, July 16
• Now the crescent Moon in twilight shines upper left of Venus. Its sunlit bulge points down *almost* straight toward Venus — and, as always, exactly straight toward the Sun.

Tuesday, July 17
• Starry Scorpius is sometimes called "the Orion of Summer" for its brightness and its prominent red supergiant (Antares in the case of Scorpius, Betelgeuse for Orion). But Scorpius passes a lot lower across the southern sky on July nights than Orion does in winter (for those of us at mid-northern latitudes.) That means it has only one really good evening month: July.

Catch Scorpius due south just after dark now, before it starts to tilt lower toward the southwest. It's full of deep-sky objects to hunt out with a good sky atlas and binoculars or a telescope.

Source: Sky & Telescope

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ISS Sighting Opportunities

For Denver:

Date	Visible	Max Height	Appears	Disappears
Fri Jul 13, 1:41 AM	1 min	17°	17° above NNE	10° above NE
Fri Jul 13, 3:15 AM	2 min	12°	10° above NNW	11° above N
Fri Jul 13, 4:53 AM	1 min	11°	10° above NNW	11° above N
Sat Jul 14, 2:23 AM	1 min	14°	13° above NNW	14° above N
Sat Jul 14, 4:01 AM	< 1 min	10°	10° above N	10° above N
Sun Jul 15, 1:33 AM	< 1 min	17°	17° above N	17° above N
Sun Jul 15, 3:08 AM	< 1 min	10°	10° above NNW	10° above N
Sun Jul 15, 4:45 AM	2 min	15°	10° above NNW	15° above N
Mon Jul 16, 00:42 AM	< 1 min	11°	11° above NNE	11° above NNE
Mon Jul 16, 2:16 AM	1 min	11°	10° above NNW	11° above N
Mon Jul 16, 3:53 AM	1 min	12°	10° above NNW	12° above N
Tue Jul 17, 1:24 AM	< 1 min	13°	12° above NNW	13° above NNW
Tue Jul 17, 3:01 AM	< 1 min	10°	10° above N	10° above N
Tue Jul 17, 4:37 AM	2 min	24°	11° above NNW	24° above NNE

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

NASA-TV Highlights

(all times Eastern Daylight Time)

July 13, Friday

12 p.m. – Station astronaut Ricky Arnold talks with the Sea Education Association in Falmouth, Massachusetts (All Channels)
2 p.m., 6 p.m., 10 p.m. - Replay of SpaceCast Weekly (All Channels)

July 14, Saturday

8 a.m., 2p.m., 10 p.m. - Replay of SpaceCast Weekly (All Channels)
10 a.m., 4 p.m., 7 p.m. - Replay of National Science Foundation Press Conference on astrophysics findings led by NSF's IceCube Neutrino Observatory (All Channels)
1 p.m., 6 p.m., 9 p.m. - Replay of The New Space Age: A Conversation with NASA Administrator Jim Bridenstine and Politico Live (All Channels)

July 15, Sunday

8:15 a.m. – Coverage of the Departure of the Northrop Grumman Cygnus CRS-9 Cargo Craft from the International Space Station (Release scheduled at 8:35 a.m. ET) (All Channels)
9 a.m., 4 p.m., 10 p.m. - Replay of The New Space Age: A Conversation with NASA Administrator Jim Bridenstine and Politico Live (All Channels)
11 a.m., 2 p.m., 8 p.m. - Replay of National Science Foundation Press Conference on astrophysics findings led by NSF's IceCube Neutrino Observatory (All Channels)
1 p.m., 6 p.m., 11 p.m. - Replay of SpaceCast Weekly (All Channels)

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

Space Calendar

- Jul 13 - [Jul 09] Partial Solar Eclipse
- Jul 13 - Asteroid 3768 Monroe Closest Approach To Earth (1.953 AU)
- Jul 13 - Dwarf Planet 134340 Pluto At Opposition (32.584 AU)
- Jul 13 - Lecture: Walking on Mars, Pasadena, California
- Jul 14 - [Jul 13] Amor Asteroid 2018 NW1 Near-Earth Flyby (0.025 AU)
- Jul 14 - Asteroid 84882 Table Mountain Closest Approach To Earth (1.439 AU)
- Jul 14 - George Green's 225th Birthday (1793)
- Jul 15 - Asteroid 6779 Perrine Closest Approach To Earth (1.417 AU)
- Jul 15 - Neptune Trojan 2011 HM102 At Opposition (27.204 AU)
- Jul 15 - Jane Luu's 55th Birthday (1963)
- Jul 15 - Jocelyn Bell's 75th Birthday (1943)
- Jul 15 - Carl Woese's 90th Birthday (1928)
- Jul 15 - Henri Buisson's 145th Birthday (1873)
- Jul 16 - Comet 49P/Arend-Rigaux Perihelion (1.430 AU)
- Jul 16 - Comet C/2017 M4 (ATLAS) Closest Approach To Earth (3.231 AU)
- Jul 16 - Asteroid 7672 Hawking Closest Approach To Earth (1.319 AU)
- Jul 16 - Asteroid 1790 Volkov Closest Approach To Earth (1.406 AU)
- Jul 16 - Asteroid 20469 Dudleymoore Closest Approach To Earth (1.494 AU)
- Jul 16 - Asteroid 5760 Mittlefehldt Closest Approach To Earth (1.715 AU)
- Jul 16 - Asteroid 7231 Porco Closest Approach To Earth (2.024 AU)
- Jul 16 - Asteroid 5816 Potsdam Closest Approach To Earth (2.162 AU)
- Jul 17 - Comet P/2018 L4 (PANSTARRS) Closest Approach To Earth (0.859 AU)
- Jul 17 - Comet 216P/LINEAR At Opposition (3.787 AU)
- Jul 17 - Centaur Object 10199 Chariklo Occults 2UCAC 20033219 (13.7 Magnitude Star)
- Jul 17 - [Jul 08] Apollo Asteroid 2018 NM Near-Earth Flyby (0.004 AU)
- Jul 17 - Apollo Asteroid 9162 Kwiila Closest Approach To Earth (0.831 AU)
- Jul 17 - Asteroid 2362 Mark Twain Closest Approach To Earth (0.991 AU)
- Jul 17 - Asteroid 7984 Marius Closest Approach To Earth (1.458 AU)
- Jul 17 - Asteroid 9941 Iguanodon Closest Approach To Earth (1.564 AU)

Source: JPL Space Calendar

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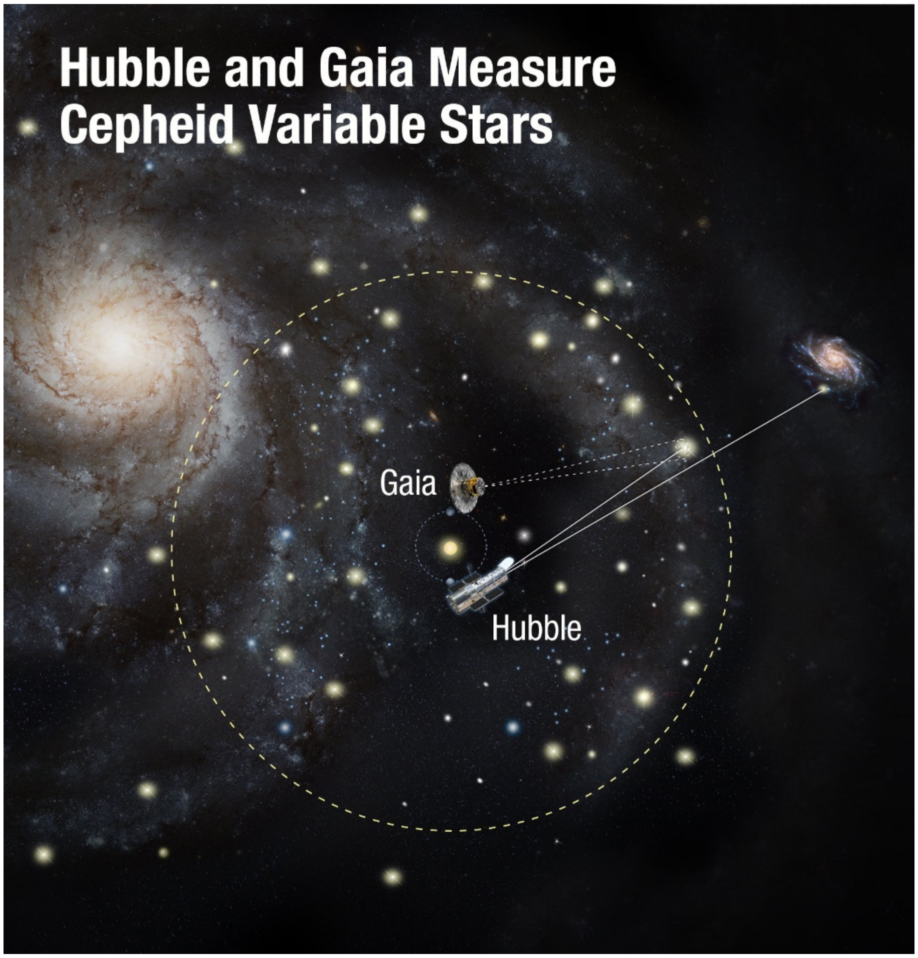
Food for Thought

Hubble and Gaia team up to fuel cosmic conundrum



Using the power and synergy of two space telescopes, astronomers have made the most precise measurement to date of the universe's expansion rate.

The results further fuel the mismatch between measurements for the expansion rate of the nearby universe, and those of the distant, primeval universe—before stars and galaxies even existed.

This so-called "tension" implies that there could be new physics underlying the foundations of the universe. Possibilities include the interaction strength of dark matter, dark energy being even more exotic than previously thought, or an unknown new particle in the tapestry of space.

Combining observations from NASA's Hubble Space Telescope and the European Space Agency's (ESA) Gaia space observatory, astronomers further refined the previous value for the Hubble constant, the rate at which the universe is expanding from the big bang 13.8 billion years ago.

But as the measurements have become more precise, the team's determination of the Hubble constant has become more and more at odds with the measurements from another space observatory, ESA's Planck mission, which is coming up with a different predicted value for the Hubble constant.

Planck mapped the primeval universe as it appeared only 360,000 years after the big bang. The entire sky is imprinted with the signature of the big bang encoded in microwaves. Planck measured the sizes of the ripples in this Cosmic Microwave Background (CMB) that were produced by slight irregularities in the big bang fireball.

The fine details of these ripples encode how much dark matter and normal matter there is, the trajectory of the universe at that time, and other cosmological parameters.

These measurements, still being assessed, allow scientists to predict how the early universe would likely have evolved into the expansion rate we can measure today. However, those predictions don't seem to match the new measurements of our nearby contemporary universe.

"With the addition of this new Gaia and Hubble Space Telescope data, we now have a serious tension with the Cosmic Microwave Background data," said Planck team member and lead analyst George Efstathiou of the Kavli Institute for Cosmology in Cambridge, England, who was not involved with the new work.

"The tension seems to have grown into a full-blown incompatibility between our views of the early and late time universe," said team leader and Nobel Laureate Adam Riess of the Space Telescope Science Institute and the Johns Hopkins University in Baltimore, Maryland. "At this point, clearly it's not simply some gross error in any one measurement. It's as though you predicted how tall a child would become from a growth chart and then found the adult he or she became greatly exceeded the prediction. We are very perplexed."

In 2005, Riess and members of the SHOES (Supernova H0 for the Equation of State) team set out to measure the universe's expansion rate with unprecedented accuracy. In the following years, by refining their techniques, this team shaved down the rate measurement's uncertainty to unprecedented levels. Now, with the power of Hubble and Gaia combined, they have reduced that uncertainty to just 2.2 percent.

Because the Hubble constant is needed to estimate the age of the universe, the long-sought answer is one of the most important numbers in cosmology. It is named after astronomer Edwin Hubble, who nearly a century ago discovered that the universe was uniformly expanding in all directions—a finding that gave birth to modern cosmology.

Galaxies appear to recede from Earth proportional to their distances, meaning that the farther away they are, the faster they appear to be moving away. This is a consequence of expanding space, and not a value of true space velocity. By measuring the value of the Hubble constant over time, astronomers can construct a picture of our cosmic evolution, infer the make-up of the universe, and uncover clues concerning its ultimate fate.

The two major methods of measuring this number give incompatible results. One method is direct, building a cosmic "distance ladder" from measurements of stars in our local universe. The other method uses the CMB to measure the trajectory of the universe shortly after the big bang and then uses physics to describe the universe and extrapolate to the present expansion rate. Together, the measurements should provide an end-to-end test of our basic understanding of the so-called "Standard Model" of the universe. However, the pieces don't fit.

Using Hubble and newly released data from Gaia, Riess' team measured the present rate of expansion to be 73.5 kilometers (45.6 miles) per second per megaparsec. This means that for every 3.3 million light-years farther away a galaxy is from us, it appears to be moving 73.5 kilometers per second faster. However, the Planck results predict the universe should be expanding today at only 67.0 kilometers (41.6 miles) per second per megaparsec. As the teams' measurements have become more and more precise, the chasm between them has continued to widen, and is now about four times the size of their combined uncertainty.

Over the years, Riess' team has refined the Hubble constant value by streamlining and strengthening the "cosmic distance ladder," used to measure precise distances to nearby and far-off galaxies. They compared those distances with the expansion of space, measured by the stretching of light from nearby galaxies. Using the apparent outward velocity at each distance, they then calculated the Hubble constant.

To gauge the distances between nearby galaxies, his team used a special type of star as cosmic yardsticks or milepost markers. These pulsating stars, called Cepheid variables, brighten and dim at rates that correspond to their intrinsic brightness. By comparing their intrinsic brightness with their apparent brightness as seen from Earth, scientists can calculate their distances.

Gaia further refined this yardstick by geometrically measuring the distance to 50 Cepheid variables in the Milky Way. These measurements were combined with precise measurements of their brightnesses from Hubble. This allowed the astronomers to more accurately calibrate the Cepheids and then use those seen outside the Milky Way as milepost markers.

"When you use Cepheids, you need both distance and brightness," explained Riess. Hubble provided the information on brightness, and Gaia provided the parallax information needed to accurately determine the distances. Parallax is the apparent change in an object's position due to a shift in the observer's point of view. Ancient Greeks first used this technique to measure the distance from Earth to the Moon.

"Hubble is really amazing as a general-purpose observatory, but Gaia is the new gold standard for calibrating distance. It is purpose-built for measuring parallax—this is what it was designed to do," Stefano Casertano of the Space Telescope Science Institute and a member of the SHOES team added. "Gaia brings a new ability to recalibrate all past distance measures, and it seems to confirm our previous work. We get the same answer for the Hubble constant if we replace all previous calibrations of the distance ladder with just the Gaia parallaxes. It's a crosscheck between two very powerful and precise observatories."

The goal of Riess' team is to work with Gaia to cross the threshold of refining the Hubble constant to a value of only one percent by the early 2020s. Meanwhile, astrophysicists will likely continue to grapple with revisiting their ideas about the physics of the early universe.

The Riess team's latest results are published in the July 12 issue of the *Astrophysical Journal*.

Source: Phys.org Return to Contents

Space Image of the Week

Centaurus A
Image Credit & Copyright: CEDIC Team at Chilescope, *Processing* - Bernhard Hubl

Explanation: Only 11 million light-years away, Centaurus A is the closest active galaxy to planet Earth. Spanning over 60,000 light-years, the peculiar elliptical galaxy also known as NGC 5128, is featured in this sharp telescopic view. Centaurus A is apparently the result of a collision of two otherwise normal galaxies resulting in a fantastic jumble of star clusters and imposing dark dust lanes. Near the galaxy's center, left over cosmic debris is steadily being consumed by a central black hole with a billion times the mass of the Sun. As in other active galaxies, that process likely generates the radio, X-ray, and gamma-ray energy radiated by Centaurus A.

Source: APOD

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