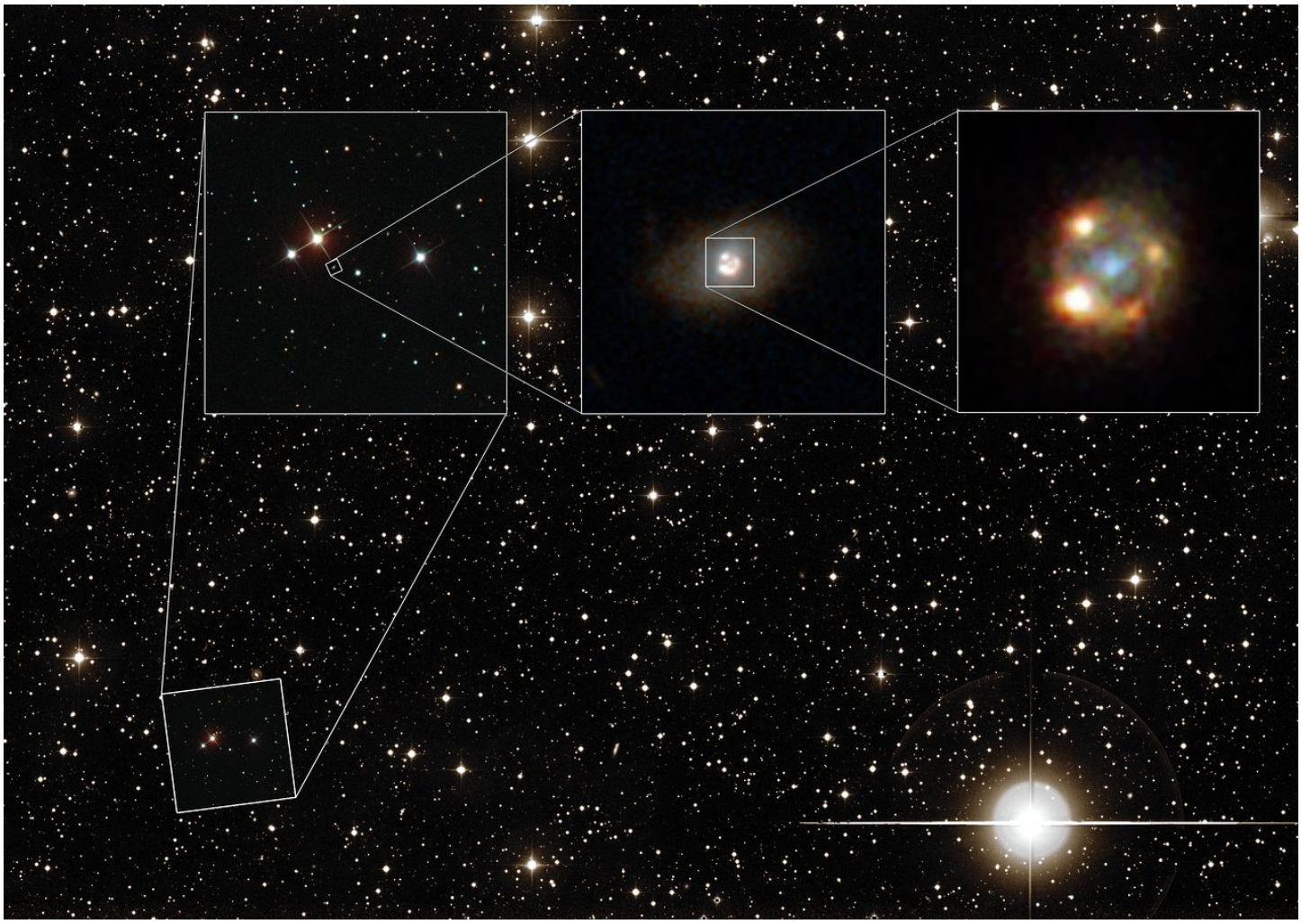
Space News Update

— April 21, 2017 —

Contents

1. Hubble Observes First Multiple Images of Explosive Distance Indicator



A Swedish-led team of astronomers used the NASA/ESA Hubble Space Telescope to analyse the multiple images of a gravitationally lensed type Ia supernova for the first time. The four images of the exploding star will be used to measure the expansion of the Universe. This can be done without any theoretical assumptions about the cosmological model, giving further clues about how fast the Universe is really expanding. The results are published in the journal Science.

An international team, led by astronomers from the Stockholm University, Sweden, has discovered a distant type Ia supernova, called iPTF16geu [1] — it took the light 4.3 billion years to travel to Earth [2]. The light from this particular supernova was bent and magnified by the effect of gravitational lensing so that it was split into four separate images on the sky [3]. The four images lie on a circle with a radius of only about 3000 light-years around the lensing foreground galaxy, making it one of the smallest extragalactic gravitational lenses discovered so far. Its appearance resembles the famous Refsdal supernova, which astronomers detected in 2015 (heic1525). Refsdal, however, was a core-collapse supernova.

Type Ia supernovae always have the same intrinsic brightness, so by measuring how bright they appear astronomers can determine how far away they are. They are therefore known as standard candles. These supernovae have been used for decades to measure distances across the Universe, and were also used to discover its accelerated expansion and infer the existence of dark energy. Now the supernova iPTF16geu allows scientists to explore new territory, testing the theories of the warping of spacetime on smaller extragalactic scales than ever before.

"Resolving, for the first time, multiple images of a strongly lensed standard candle supernova is a major breakthrough. We can measure the light-focusing power of gravity more accurately than ever before, and probe physical scales that may have seemed out of reach until now," says Ariel Goobar, Professor at the Oskar Klein Centre at Stockholm University and lead author of the study.

The critical importance of the object meant that the team instigated follow-up observations of the supernova less than two months after its discovery. This involved some of the world's leading telescopes in addition to Hubble: the Keck telescope on Mauna Kea, Hawaii, and ESO's Very Large Telescope in Chile. Using the data gathered, the team calculated the magnification power of the lens to be a factor of 52. Because of the standard candle nature of iPTF16geu, this is the first time this measurement could be made without any prior assumptions about the form of the lens or cosmological parameters.

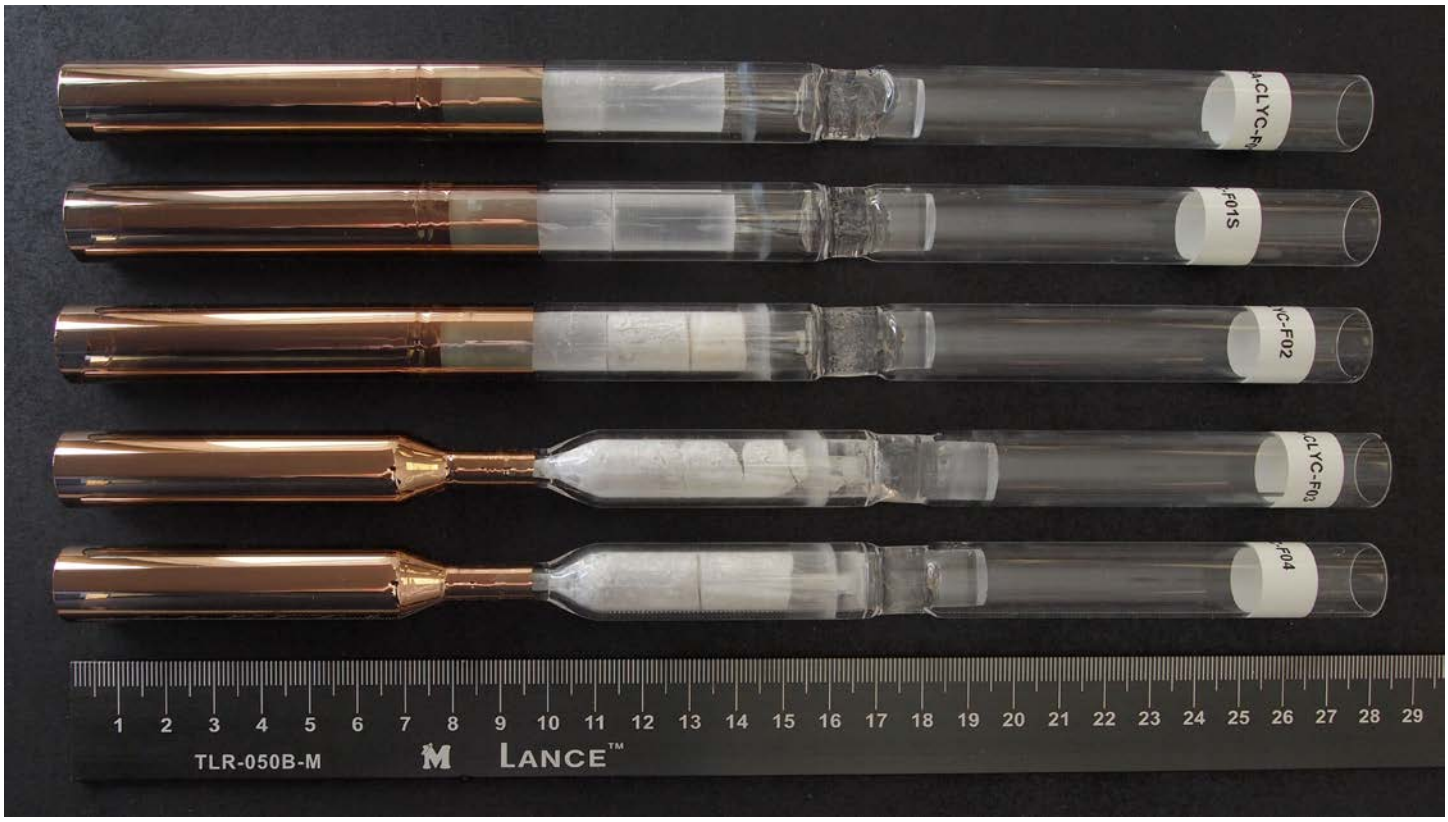
Currently the team is in the process of accurately measuring how long it took for the light to reach us from each of the four images of the supernova. The differences in the times of arrival can then be used to calculate the Hubble constant — the expansion rate of the Universe — with high precision [4]. This is particularly crucial in light of the recent discrepancy between the measurements of its value in the local and the early Universe (heic1702).

As important as lensed supernovae are for cosmology, it is extremely difficult to find them. Not only does their discovery rely on a very particular and precise alignment of objects in the sky, but they are also only visible for a short time. *"The discovery of iPTF16geu is truly like finding a somewhat weird needle in a haystack,"* remarks Rahman Amanullah, co-author and research scientist at Stockholm University. *"It reveals to us a bit more about the Universe, but mostly triggers a wealth of new scientific questions."*

Studying more similarly lensed supernovae will help shape our understanding of just how fast the Universe is expanding. The chances of finding such supernovae will improve with the installation of new survey telescopes in the near future.

Source: ESA Return to Contents

2. Crystals Grown Aboard Space Station Provide Radiation Detecting Technology



Research into crystal growth in microgravity was one of the earliest investigations conducted aboard the International Space Station and is continued to this day. The unique microgravity environment of space provides an ideal setting for producing crystals that are more perfect than their terrestrial-grown counterparts. The Crystal Growth of Cs2LiYCl6:Ce Scintillators in Microgravity (**CLYC-Crystal Growth**), a Center for the Advancement of Science in Space (**CASIS**)-sponsored investigation, will study the potential benefits of growing the CYLC crystal in microgravity.

The CLYC crystal is a special kind of multicomponent crystal system used to make scintillator radiation detectors, a device that is sensitive to both gamma rays and neutrons.

“It’s a spectroscopic crystal, which means, using this crystal, we can detect the presence and intensity of radiation, as well as identify which isotopes emit radiation by measuring the energy,” said Dr. Alexei Churilov, primary investigator and senior scientist at Radiation Monitoring Devices Inc. (RMD).

The CLYC crystal is produced as a commercial product by RMD and is largely used to detect and differentiate both harmful and harmless levels of radiation. The crystal’s main application is homeland security as a method of detected smuggled nuclear materials, but may also be used for oil and gas exploration, medical imaging, particle and space physics and scientific instruments.

However, the Earth-grown crystals have shown defects such as cracks, grain boundaries and inclusions, incidents which scientists like Churilov hope to eliminate by using the space station’s microgravity environment as a growth habitat.

Research has shown that many, **though not all**, crystals benefit from growth in microgravity. Although the reasoning behind this phenomena is still being **investigated**, research points to the lack of buoyancy-induced convection, which affects transport of molecules in the crystal.

“Our ultimate goal is to study the growth of CLYC in microgravity without the interference of convection and to improve the production of the crystal on Earth,” said Churilov.

The research for the CLYC Crystal Growth investigation will be conducted within the Solidification Using a Baffle in Sealed Ampoules Furnaces and Inserts (**SUBSA** Furnaces and Inserts). SUBSA helps researchers advance the understanding of processes involved in semiconductor crystal growth. It offers a gradient freeze furnace for materials science investigations. SUBSA was originally operated aboard the space station in 2002, the SUBSA hardware has been modernized and updated with data acquisition, high resolution video and communication interfaces.

During the investigation, four crystal growth runs will be conducted aboard the space station and then in the ground-based SUBSA furnaces, giving researchers a view into the gravitational effect on their growth. Once the investigation is complete, the space-grown crystals will be compared against their counterparts on Earth and tested for imperfections and effectiveness as radiation detectors.

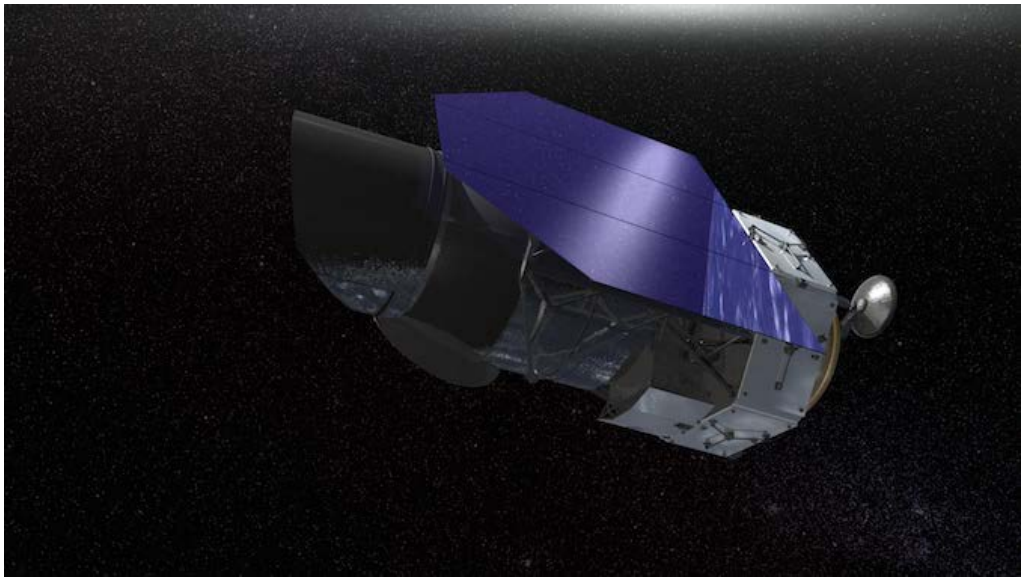
Although microgravity can’t be mimicked or reproduced on the ground, results from the investigation will provide information about which crystal methods to use on Earth, how to improve ampoule and furnace design and which crystal growth parameters to change in pursuit of a more perfect crystallization process.

Though the total weight of the CLYC Crystal Growth investigation is small, only a few kilograms together with packaging, the benefits can be immense as the data gathered during the investigation will be put to immediate use in the production of CLYC crystals.

Follow **@ISS_Research** for more information about the science happening on the space station.

Source: NASA Return to Contents

3. With an Eye on Growing Cost, NASA Aims for 2025 Launch of Next 'Great Observatory'



NASA managers say the WFIRST mission, the next in the agency's line of powerful observatories after the Hubble and James Webb telescopes, could cost around $3.2 billion after budgeting for a novel first-of-its-kind instrument to probe the make-up of planets around nearby stars and a bigger-than-expected launch vehicle.

The observatory will be stationed at the L2 Lagrange point, a gravitational balance point about a million miles (1.5 million kilometers) from Earth, to survey the cosmos for dark energy and detect the the faint starlight reflected off of planets in other solar systems, allowing scientists to measure the composition of their atmospheres and surfaces.

WFIRST could help cosmologists and astronomers get closer to answering two fundamental questions: What is driving the expansion of the universe, and where might scientists find an Earth analog around another star?

The space agency formally kicked off development of WFIRST in February 2016, a year ahead of schedule, after several years of technological research and mission concept studies. Congress approved extra money for the project, allowing NASA to press ahead with the mission on a faster schedule than expected.

The Wide Field Infrared Survey Telescope, or WFIRST, is scheduled to be ready for launch by September 2025, employing one of two primary mirrors donated to NASA by the National Reconnaissance Office, the U.S. government's spy satellite agency.

The NRO no longer needed the mirrors, which were developed for a cancelled surveillance mission that would have carried a downward-looking telescope to capture detailed images of military and strategic targets around the world.

WFIRST's repurposed primary mirror, made by Harris Corp., did not come with the detectors and instrument needed to make it a functional telescope. Engineers are also making changes to the mirror for WFIRST's astronomical mission.

After the NRO gifted NASA the two excess mirrors in 2012, the space agency revamped its plans for the WFIRST mission, doubling the size of the mission's telescope to accommodate the spy assets.

The mirror measures 7.9 feet (2.4 meters) in diameter, the same size as Hubble's, giving WFIRST the same sensitivity as NASA's flagship space observatory. But WFIRST will see a swath of the sky 100 times bigger than Hubble's field-of-view, allowing it to extend Hubble's deep vision across the cosmos.

NASA officials originally planned for WFIRST to have a telescope half the size of Hubble, and the observatory was to be placed into a geostationary orbit around 22,000 miles (nearly 36,000 kilometers) above Earth.

That would have allowed WFIRST to fit on a rocket like United Launch Alliance's Atlas 5.

But the bigger spacecraft, coupled with a decision to station WFIRST at the more distant L2 Lagrange point, will mean the observatory must launch aboard a more powerful — and perhaps more expensive — rocket.

NASA is currently looking at ULA's Delta 4-Heavy or SpaceX's Falcon Heavy rocket to send WFIRST into space, according to Dominic Bedford, the mission's program scientist at NASA Headquarters.

The James Webb Space Telescope, a partnership between NASA, the European Space Agency and Canada, is set for launch in October 2018 with an even bigger primary mirror — more than 21 feet (6.5 meters) in diameter — comprised of 18 hexagonal segments. But JWST is like Hubble, crafted to peer deep into the universe, not a wide field surveyor like WFIRST.

"WFIRST is like 100 Hubbles, relative to the field-of-view, and it's going after science that is really compelling," said Thomas Zurbuchen, associate administrator of NASA's science mission directorate.

The high-resolution maps created by WFIRST will require a huge data archive and software to pick out the most promising data.

"This is the first astrophysics mission that I would say brings us into the big data era," said Jeff Kruk, WFIRST's acting project scientist at NASA's Goddard Space Flight Center in Maryland. "This is the first NASA mission that's going to be undertaking large-scale data mining like this."

Fitted with two science instruments, WFIRST will observe the universe for more than six years. A wide field imager and spectrometer will survey the cosmos in near-infrared for dark energy research and planet searches, and a coronagraph aboard WFIRST is designed to blot out bright starlight to directly image their planetary systems.

Astronomers using WFIRST's wide field-of-view will detect thousands of bright supernovae — a giant explosion at the end of a star's life — to measure how the rate of the universe's expansion has changed over time, according to NASA.

Dark energy is a mysterious force accelerating the expansion of the universe.

Scientists expect WFIRST to find up to 20,000 exoplanets orbiting other stars, building on the planet-hunting capabilities of NASA's Kepler telescope.

While Kepler detects planets that pass between the telescope and a host star, WFIRST will use a technique called microlensing, which is the gravitational effect caused when one star passes in front of another.

When such an event occurs, the light rays coming from the background star are bent by the gravity of the foreground star, called the lens star. Planets around the lens star can also distort the brightness of the background star, allowing astronomers to use microlensing to search for alien worlds.

The coronagraph on WFIRST is an experimental addition to the observatory. Engineers want to check the device's performance before building a coronagraph for a much larger future telescope that could find another planet like Earth.

"In the long run, for finding Earths, you need a much bigger telescope, but this is proof the technology will actually work in space, and it gives you confidence that when you actually go up to a larger telescope, that it will work," Kruk said April 13 in a presentation to the NASA Advisory Council's science committee.

Direct imaging is a key step toward measuring the structure and composition of exoplanets, and in determining whether the worlds are habitable.

The James Webb Space Telescope will be capable imaging giant planets several times the size and mass of Jupiter, hot young worlds that are unlikely to harbor life.

WFIRST will see smaller planets the size of Saturn and Neptune that lie closer to their parent stars, and perhaps even rocky "super-Earths" that are somewhat bigger than our own planet.

Project managers are preparing for WFIRST's systems requirements review in July, followed by the start of the next phase of development — called Phase B — around Oct. 1.

NASA officials want to keep WFIRST's total cost around $3.2 billion — in current-year economic conditions — and Bedford said the space agency could "descope" the mission by removing the coronagraph instrument if it looks like it will bust the budget cap.

"The coronagraph is not required for mission success, so we can back off the coronagraph if necessary," Bedford said in the April 13 meeting of the NASA science advisory committee.

Multiple internal and external cost assessments will be completed in the coming months to inform NASA decision-makers on whether WFIRST should remain intact.

An cost assessment by the Aerospace Corp. in 2015 put WFIRST's project cost between $2 billion and $2.3 billion. A report issued by the National Academy of Sciences last year said the cost of WFIRST had increased by $550 million since the Aerospace Corp. study, and the review panel recommended NASA slash the observatory's capabilities, such as removing the coronagraph, if costs continued to grow.

NASA does not want to repeat its experience with JWST.

When astronomers first conceived of the once-in-a-generation mission in the late 1990s, they expected it could launch as soon as 2007 and cost around $1 billion. Its launch is now set for late next year, with a cost nearly nine times the initial estimate, carving money out of NASA's budget that could have gone to other projects.

"Budget is a big concern," Bedford said. "The concern I'm mostly recognizing now is the overall mission cost of $3.2 billion. We have to make sure that we make the right choices to keep the science capability while keeping under that cost.

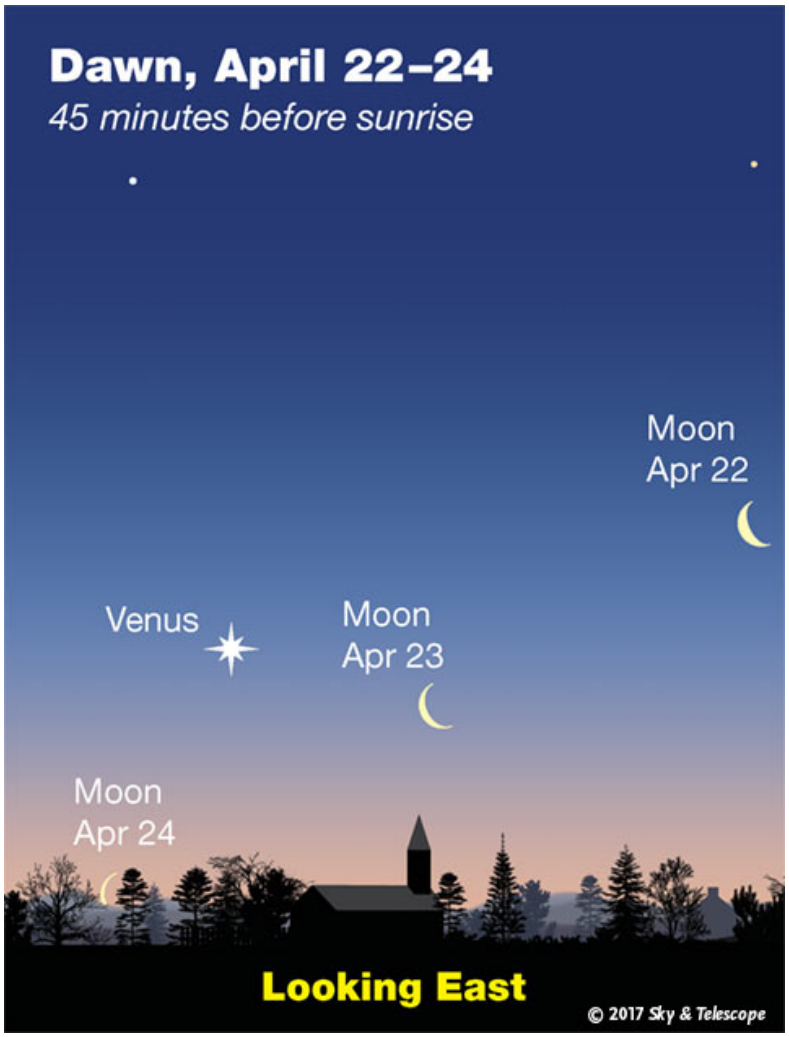
"The problem with mission design is you tend to have a function of science vs. cost that is steep," Bedford said. "You lose more science than you lose cost."

Source: Spaceflight Now Return to Contents

The Night Sky

Friday, April 21
• As night descends, look high in the west for Pollux and Castor lined up almost horizontally (depending on your latitude). These two stars, the heads of the Gemini twins, form the top of the enormous Arch of Spring. To their lower left is Procyon, the left end of the Arch. Farther to their lower right is the other end, formed by Menkalinan (Beta Aurigae) and then brilliant Capella. The whole thing sinks in the west through the evening.

• The weak Lyrid meteor shower should peak in the hours before Saturday's dawn. The Moon will be only a waning crescent. The shower's peak usually lasts just a few hours, but this year the predicted timing (12h Universal Time April 22) is good for North America, especially the West. But don't expect more than one meteor every several minutes, at best.



Saturday, April 22
• The spring constellation Corvus, the Crow, perches in the southeast these evenings, about a fist and a half at arm's length to the right of Spica as shown here. But above Spica this year is brilliant Jupiter, hogging the show. Corvus is traditionally seen as ready to snatch sparkling Spica out of Virgo's hand. This year he has a brighter shiny to go for.

• As dawn begins to brighten Sunday morning, catch Venus and the waning crescent Moon low in the east.

Sunday, April 23
• Face north after nightfall, look very high, and you'll find the Pointers, the end stars of the Big Dipper's bowl. They're on the meridian pointing toward Polaris straight down below. From the Pointers to Polaris is about three fists at arm's length.

Monday, April 24
• Bright Arcturus is climbing high in the east these evenings. Equally bright Capella is descending high in the northwest. They stand at exactly the same height above your horizon at some moment between about 8:30 and 10:00 p.m. daylight-saving time, depending mostly on how far east or west you live in your time zone. Can you time this event? Like everything star-related, it happens 4 minutes earlier every night.

Tuesday, April 25
• Jupiter's moon Europa reappears from eclipse out of Jupiter's shadow around 10:28 p.m. EDT. Then at 11:17 p.m. EDT, Io starts crossing Jupiter’s face. And at 11:42 p.m. EDT, Io’s shadow comes following behind.

Source: Sky & Telescope

Return to Contents

ISS Sighting Opportunities

For Denver:

No sightings through April 30th.

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

NASA-TV Highlights

(all times Eastern Daylight Time)

- **8 p.m., Friday, April 21 -** Replay of SpaceCast Weekly (all channels)
- **4:30 a.m., Saturday, April 22 -** Coverage of the Rendezvous and Capture of the Orbital ATK Cygnus Cargo Craft at the ISS (Capture time is scheduled at 6:05 a.m.) (all channels)
- **7:30 a.m., Saturday, April 22 -** Coverage of the Installation of the Orbital ATK Cygnus Cargo Craft to the ISS (all channels)
- **10 a.m., 6 p.m., Saturday, April 22 -** Replay of SpaceCast Weekly (all channels)
- **2 p.m., 9 p.m., Saturday, April 22 -** Replay of the NASA Television Video File Feed of ISS Expedition 51-52/Soyuz MS-04 Docking, Hatch Opening and Other Activities (all channels)
- **4 p.m., 8 p.m., Saturday, April 22 -** Replay of "What's New in Aerospace?" Series – Celebrating Earth Day with Former NASA Astronaut Kathy Sullivan (NTV-1 (Public))
- **9 a.m., 7 p.m., Sunday, April 23 -** Replay of the NASA Television Video File Feed of ISS Expedition 51-52/Soyuz MS-04 Docking, Hatch Opening and Other Activities (all channels)
- **10 a.m., 6 p.m., Sunday, April 23 -** Replay of "What's New in Aerospace?" Series – Celebrating Earth Day with Former NASA Astronaut Kathy Sullivan (NTV-1 (Public))
- **4 p.m., 8 p.m., Sunday, April 23 -** Replay of SpaceCast Weekly (all channels)
- **10 a.m., 3 p.m., 7 p.m., 11 p.m., Monday, April 24 -** ISS Expedition 51 In-Flight Event with President Trump, Ivanka Trump and NASA Astronaut Kate Rubins from the Oval Office at the White House with Commander Peggy Whitson and Flight Engineer Jack Fischer of NASA (all channels)

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

Return to Contents

Space Calendar

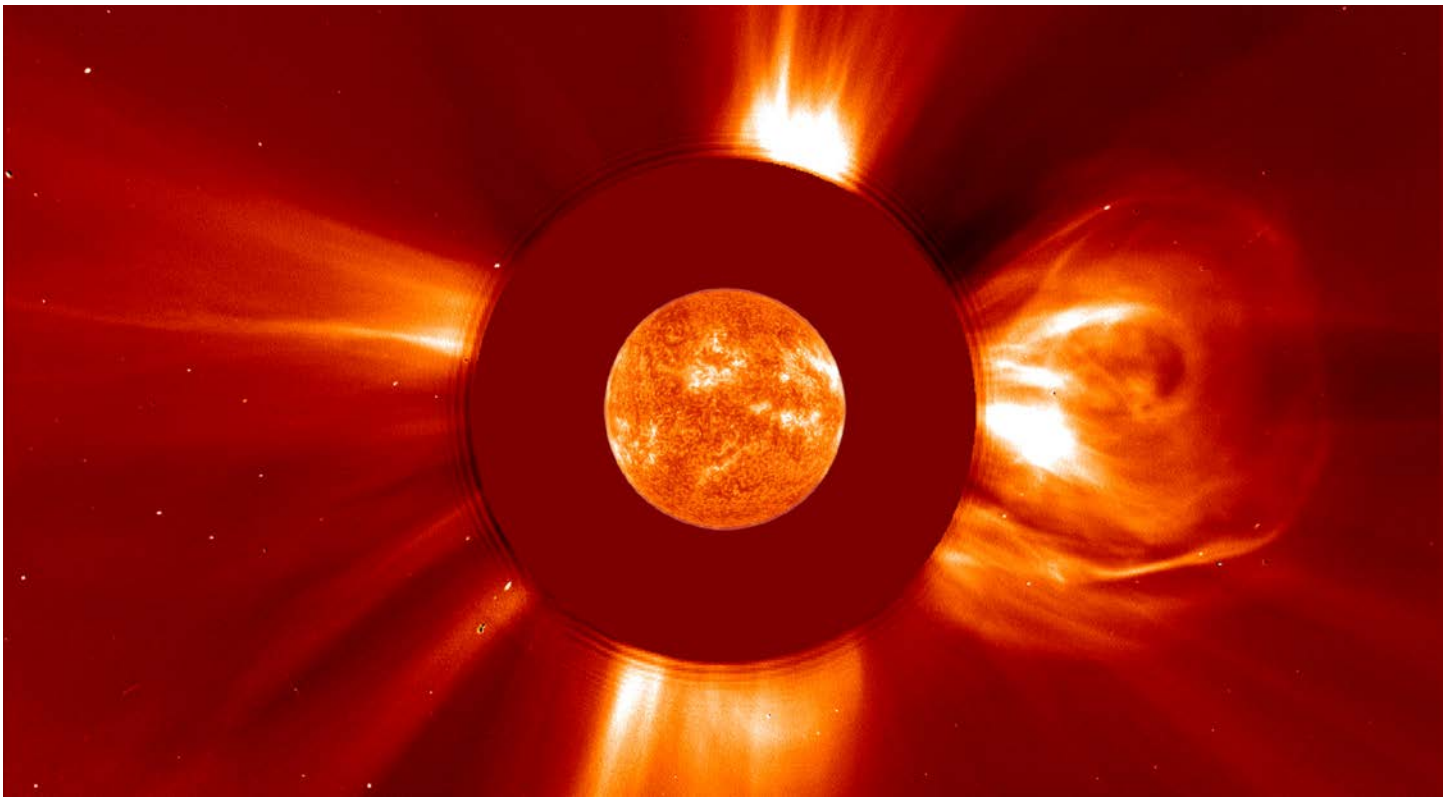
- Apr 21 - Comet 73P-AC/Schwassmann-Wachmann Perihelion (0.968 AU)
- Apr 21 - Comet C/2013 X1 (PANSTARRS) At Opposition (3.709 AU)
- Apr 21 - Apollo Asteroid 2016 UW80 Near-Earth Flyby (0.072 AU)
- Apr 21 - Asteroid 1704 Wachmann Closest Approach To Earth (1.049 AU)
- Apr 21 - Asteroid 5799 Brewington Closest Approach To Earth (1.931 AU)
- Apr 21 - 20th Anniversary (1997), Cremated Remains of 24 People Launched into Space
- Apr 21 - 315th Anniversary (1702) - Maria Margarethe Kirch Becomes 1st Woman to Discover a Comet (C/1702 H1)
- Apr 22 - HOT [Apr 15] Earth Day
- Apr 22 - HOT [Apr 15] March For Science
- Apr 22 - HOT [Apr 20] Cassini, Final Titan Flyby
- Apr 22 - Lyrids Meteor Shower Peak
- Apr 22 - Moon Occults Neptune
- Apr 22 - Comet 94P/Russell Closest Approach To Earth (1.540 AU)
- Apr 22 - Comet 157P/Tritton At Opposition (2.190 AU)
- Apr 22 - Comet 107P/Wilson-Harrington At Opposition (2.510 AU)
- Apr 22 - Comet P/2014 U2 (Kowalski) At Opposition (3.706 AU)
- Apr 22 - Comet 119P/Parker-Hartley At Opposition (4.201 AU)
- Apr 22 - NEW [Apr 19] Apollo Asteroid 2017 HD Near-Earth Flyby (0.010 AU)
- Apr 22 - Aten Asteroid 2016 JP Near-Earth Flyby (0.065 AU)
- Apr 22 - Asteroid 10051 Albee Closest Approach To Earth (2.137 AU)
- Apr 22 - 5th Anniversary (2012), Sutter's Mill Meteorite Fall in California
- Apr 23 - HOT [Apr 17] 50th Anniversary (1967), Soyuz 1 Launch
- Apr 23 - Max Valier Sat/ Venta 1/PSLV Launch
- Apr 23 - Comet C/2017 E4 (Lovejoy) Perihelion (0.494 AU)
- Apr 23 - Comet C/2017 E3 (PANSTARRS) At Opposition (5.057 AU)
- Apr 23 - Apollo Asteroid 2017 GK4 Near-Earth Flyby (0.092 AU)
- Apr 23 - NEW [Apr 20] Asteroid 10063 Erinleeryan Closest Approach To Earth (2.877 AU)
- Apr 23 - 55th Anniversary (1962), Ranger 4 Launch (Moon Impact Mission)
- Apr 24 - HOT 50th Anniversary (1967), 1st Person To Die On A Space Mission - Vladimir Komarov
- Apr 24 - Moon Occults Asteroid 2 Pallas
- Apr 24 - Comet 267P/LONEOS Closest Approach To Earth (2.943 AU)
- Apr 24 - NEW [Apr 21] Apollo Asteroid 2017 HY Near-Earth Flyby (0.008 AU)
- Apr 24 - NEW [Apr 21] Apollo Asteroid 2017 HB1 Near-Earth Flyby (0.009 AU)
- Apr 24 - Apollo Asteroid 2017 FH101 Near-Earth Flyby (0.048 AU)
- Apr 24 - Asteroid 951 Gaspra Closest Approach To Earth (1.583 AU)
- Apr 24 - Asteroid 4226 Damiaan Closest Approach To Earth (2.289 AU)
- Apr 24-30 - HOT [Apr 20] Astronomy Week
- Apr 25 - Comet C/2015 TQ209 (LINEAR) Closest Approach To Earth (2.581 AU)
- Apr 25 - Comet 104P/Kowal At Opposition (2.678 AU)
- Apr 25 - Comet 21P/Giacobini-Zinner At Opposition (3.502 AU)
- Apr 25 - Comet 11P/Tempel-Swift-LINEAR At Opposition (4.183 AU)
- Apr 25 - UPDATED [Apr 17] Comet C/2017 E3 (PANSTARRS) Closest Approach To Earth (5.056 AU)
- Apr 25 - Apollo Asteroid 11066 Sigurd Closest Approach To Earth (1.008 AU)
- Apr 25 - Asteroid 15131 Alanalda Closest Approach To Earth (1.506 AU)
- Apr 25 - Asteroid 7231 Porco Closest Approach To Earth (2.302 AU)
- Apr 25 - 40th Anniversary (1977), Inaugural Flight of Stratospheric Observatory for Infrared Astronomy (SOFIA)

Source: JPL Space Calendar

Return to Contents

Food for Thought

NASA and Partners Survey Space Weather Science



NASA has long been a leader in understanding the science of space weather, including research into the potential for induced electrical currents to disrupt our power systems.

Last year, NASA scientists worked with scientists and engineers from research institutions and industry during a pair of intensive week-long workshops in order to assess the state of science surrounding this type of space weather. This summary was published Jan. 30, 2017, in the journal Space Weather.

Storms from the sun can affect our power grids, railway systems and underground pipelines through a phenomenon called geomagnetically induced currents, or GICs. The sun regularly releases a constant stream of magnetic solar material called the solar wind, along with occasional huge clouds of solar material called coronal mass ejections. This material interacts with Earth's magnetic field, causing temporary changes. That temporary change to the magnetic field can create electric currents just under Earth's surface. These are GICs.

Long, thin, metal structures near Earth's surface -- such as underground pipelines, railroads and power lines -- can act as giant wires for these currents, causing electricity to flow long distances underground. This electric current can cause problems for all three structures, and it's especially difficult to manage in power systems, where controlling the amount of electric current is key for keeping the lights on. Under extreme conditions, GICs can cause temporary blackouts, which means that studying space weather is a crucial component for emergency management.

"We already had a pretty good grasp of the key moving pieces that can affect power systems," said Antti Pulkkinen, a space weather researcher at NASA's Goddard Space Flight Center in Greenbelt, Maryland. "But this was the first we had solar experts, heliospheric scientists, magnetospheric physicists, power engineers and emergency management officials all in a room together."

Though GICs can primarily cause problems for power systems, railroads and pipelines aren't immune.

"Researchers have found a positive correlation between geomagnetic storms and mis-operation of railway signaling systems," said Pulkkinen, who is also a member of the space weather research-focused Community Coordinated Modeling Center based at Goddard.

This is because railway signals, which typically control traffic at junctures between tracks or at intersections with roads, operate on an automated closed/open circuit system. If a train's metal wheels are on the track near the signal, they close the electrical circuit, allowing electrical current to flow to the signal and turn it on.

"Geomagnetically induced currents could close that loop and make the system signal that there's a train when there isn't," said Pulkkinen.

Similarly, current flowing in oil pipelines could create false alarms, prompting operators to inspect pipelines that aren't damaged or malfunctioning.

In power systems, the GICs from a strong space weather event can cause something called voltage collapse. Voltage collapse is a temporary state in which the voltage of a segment of a power system goes to zero. Because voltage is required for current to flow, voltage collapse can cause blackouts in affected areas.

Though blackouts caused by voltage collapse can have huge effects on transportation, healthcare and commerce, GICs are unlikely to cause permanent damage to large sections of power systems.

"For permanent transformer damage to occur, there needs to be sustained levels of GICs going through the transformer," said Pulkkinen. "We know that's not how GICs work. GICs tend to be much more noisy and short-lived, so widespread physical damage of transformers is unlikely even during major storms."

The scientists who worked on the survey, part of the NASA Living With a Star Institute, also created a list of the key unanswered questions in GIC science, mostly related to computer modeling and prediction. The group members' previous work on GIC science and preparedness has already been used to shape new standards for power companies to guard against blackouts. In September 2016, the Federal Energy Regulatory Commission, or FERC, released new standards that require power companies to assess and prepare for potential GIC disruptions.

"We're really proud that our team members made major contributions to the updated FERC standards," said Pulkkinen. "It also shows that the U.S. is actively working to address GIC risk."

Source: SpaceRef.com Return to Contents

Space Image of the Week

Spiral Galaxy Pair NGC 4302 and NGC 4298

In celebration of the 27th anniversary of the launch of NASA's Hubble Space Telescope on April 24, 1990, astronomers used the legendary telescope to take a portrait of a stunning pair of spiral galaxies.

The edge-on galaxy is called NGC 4302, and the tilted galaxy is NGC 4298. These galaxies look quite different because we see them angled at different positions on the sky. They are actually very similar in terms of their structure and contents.

Both galaxies are approximately 55 million light-years away. They reside in the constellation Coma Berenices in the Virgo Cluster of nearly 2,000 galaxies. Both were discovered in 1784 by astronomer William Herschel. Such objects were first simply called "spiral nebulas," because it wasn't known how far away they were. In the early 20th century, Edwin Hubble discovered that galaxies are other island cities of stars far outside our Milky Way.

Source: HubbleSite.org

Return to Contents