Space News Update

— April 13, 2018 —

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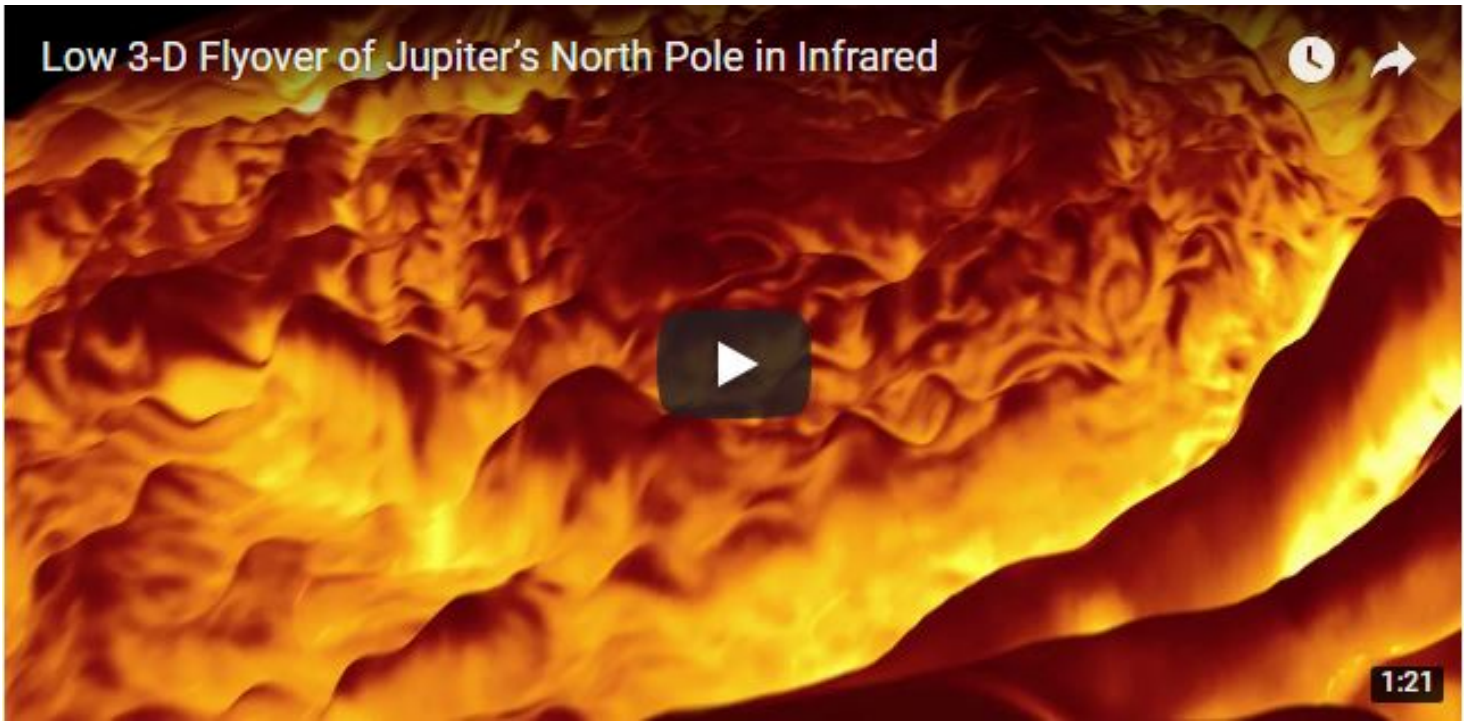
1. Juno Mission Provides Infrared Tour of Jupiter's North Pole

Scientists working on NASA's Juno mission to Jupiter shared a 3-D infrared movie depicting densely packed cyclones and anticyclones that permeate the planet's polar regions, and the first detailed view of a dynamo, or engine, powering the magnetic field for any planet beyond Earth. Those are among the items unveiled during the European Geosciences Union General Assembly in Vienna, Austria, on Wednesday, April 11.



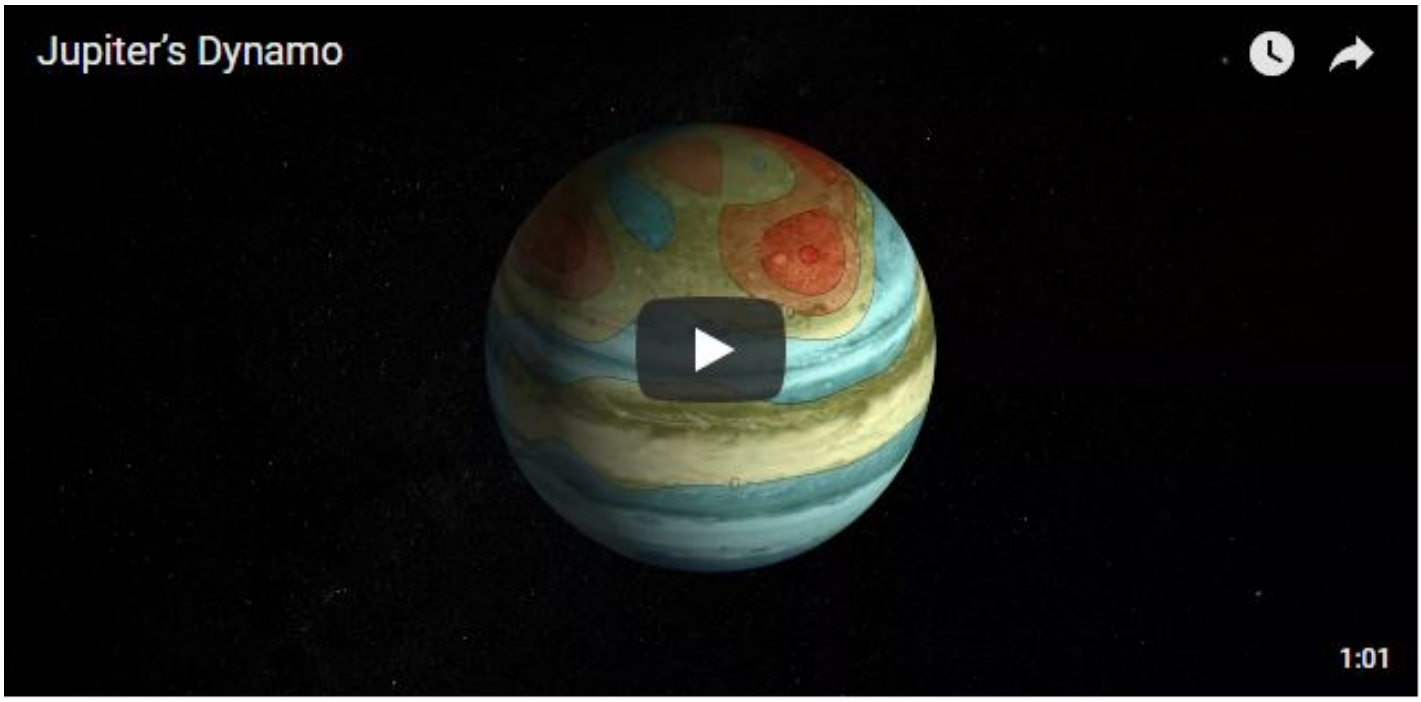
Juno mission scientists have taken data collected by the spacecraft's Jovian InfraRed Auroral Mapper (JIRAM) instrument and generated the 3-D fly-around of the Jovian world's north pole. Imaging in the infrared part of the spectrum, JIRAM captures light emerging from deep inside Jupiter equally well, night or day. The instrument probes the weather layer down to 30 to 45 miles (50 to 70 kilometers) below Jupiter's cloud tops. The imagery will help the team understand the forces at work in the animation - a north pole dominated by a central cyclone surrounded by eight circumpolar cyclones with diameters ranging from 2,500 to 2,900 miles (4,000 to 4,600 kilometers).

"Before Juno, we could only guess what Jupiter's poles would look like," said Alberto Adriani, Juno co-investigator from the Institute for Space Astrophysics and Planetology, Rome. "Now, with Juno flying over the poles at a close distance it permits the collection of infrared imagery on Jupiter's polar weather patterns and its massive cyclones in unprecedented spatial resolution."

Another Juno investigation discussed during the media briefing was the team's latest pursuit of the interior composition of the gas giant. One of the biggest pieces in its discovery has been understanding how Jupiter's deep interior rotates.

"Prior to Juno, we could not distinguish between extreme models of Jupiter's interior rotation, which all fitted the data collected by Earth-based observations and other deep space missions," said Tristan Guillot, a Juno co-investigator from the Université Côte d'Azur, Nice, France. "But Juno is different -- it orbits the planet from pole-to-pole and gets closer to Jupiter than any spacecraft ever before. Thanks to the amazing increase in accuracy brought by Juno's gravity data, we have essentially solved the issue of how Jupiter's interior rotates:

The zones and belts that we see in the atmosphere rotating at different speeds extend to about 1,900 miles (3,000 kilometers).



"At this point, hydrogen becomes conductive enough to be dragged into near-uniform rotation by the planet's powerful magnetic field."

The same data used to analyze Jupiter's rotation contain information on the planet's interior structure and composition. Not knowing the interior rotation was severely limiting the ability to probe the deep interior. "Now our work can really begin in earnest -- determining the interior composition of the solar system's largest planet," said Guillot.

At the meeting, the mission's deputy-principal investigator, Jack Connerney of the Space Research Corporation, Annapolis, Maryland, presented the first detailed view of the dynamo, or engine, powering the magnetic field of Jupiter.

Connerney and colleagues produced the new magnetic field model from measurements made during eight orbits of Jupiter. From those, they derived maps of the magnetic field at the surface and in the region below the surface where the dynamo is thought to originate. Because Jupiter is a gas giant, "surface" is defined as one Jupiter radius, which is about 44,400 miles (71,450 kilometers).

These maps provide an extraordinary advancement in current knowledge and will guide the science team in planning the spacecraft's remaining observations.

"We're finding that Jupiter's magnetic field is unlike anything previously imagined,"said Connerney. "Juno's investigations of the magnetic environment at Jupiter represent the beginning of a new era in the studies of planetary dynamos."

The map Connerney's team made of the dynamo source region revealed unexpected irregularities, regions of surprising magnetic field intensity, and that Jupiter's magnetic field is more complex in the northern hemisphere than in the southern hemisphere. About halfway between the equator and the north pole lies an area where the magnetic field is intense and positive. It is flanked by areas that are less intense and negative.

In the southern hemisphere, however, the magnetic field is consistently negative, becoming more and more intense from the equator to the pole.

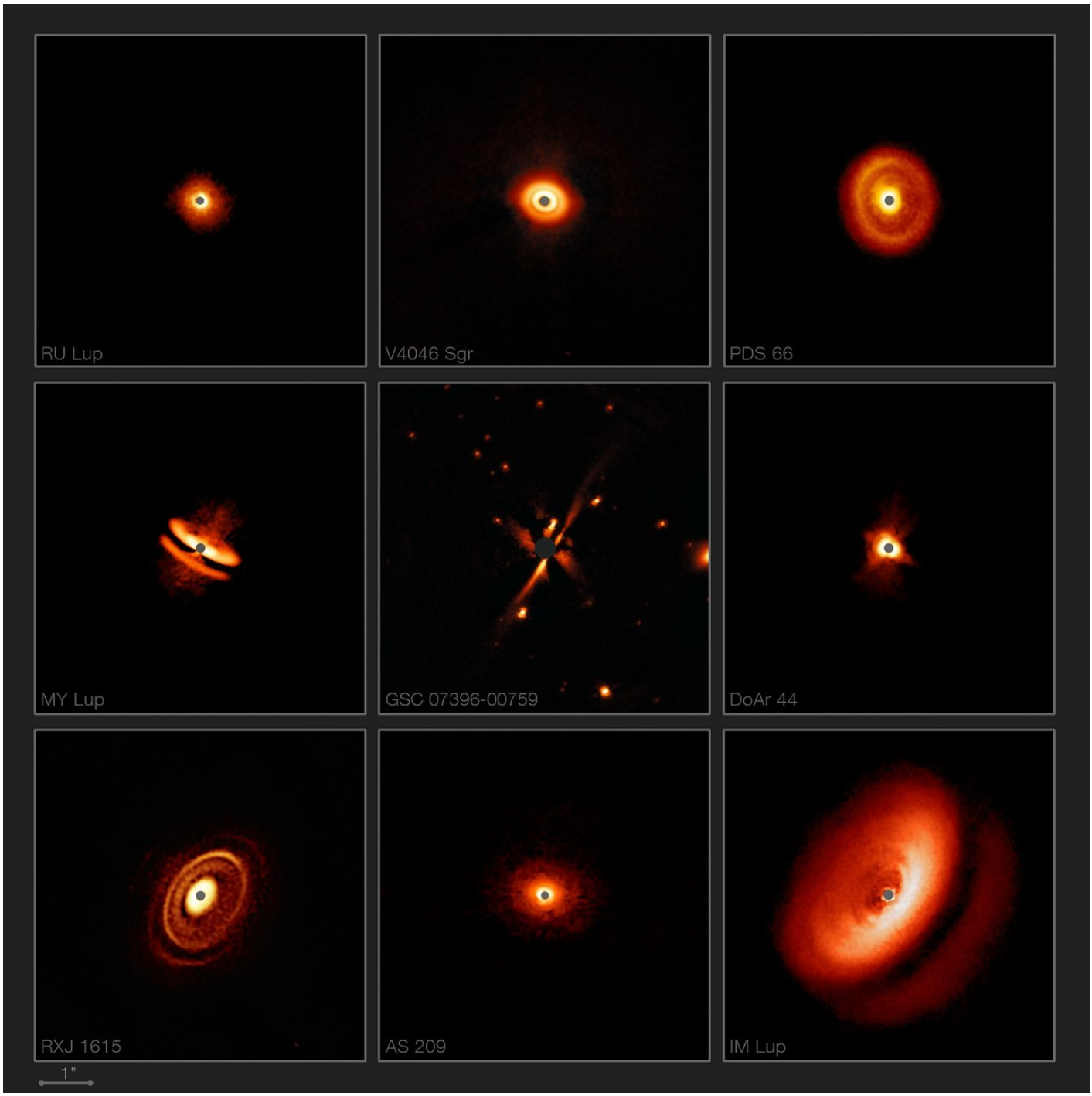
The researchers are still figuring out why they would see these differences in a rotating planet that's generally thought of as more-or-less fluid.

"Juno is only about one third the way through its planed mapping mission and already we are beginning to discover hints on how Jupiter's dynamo works," said Connerney. "The team is really anxious to see the data from our remaining orbits."

Juno has logged nearly 122 million miles (200 million kilometers) to complete those 11 science passes since entering Jupiter's orbit on July 4, 2016. Juno's 12th science pass will be on May 24.

Source: JPL Return to Contents

2. SPHERE reveals fascinating zoo of discs around young stars



The SPHERE instrument on ESO's Very Large Telescope (VLT) in Chile allows astronomers to suppress the brilliant light of nearby stars in order to obtain a better view of the regions surrounding them. This collection of new SPHERE images is just a sample of the wide variety of dusty discs being found around young stars.

These discs are wildly different in size and shape—some contain bright rings, some dark rings, and some even resemble hamburgers. They also differ dramatically in appearance depending on their orientation in the sky—from circular face-on discs to narrow discs seen almost edge-on.

SPHERE's primary task is to discover and study giant exoplanets orbiting nearby stars using direct imaging . But the instrument is also one of the best tools in existence to obtain images of the discs around young stars—

regions where planets may be forming. Studying such discs is critical to investigating the link between disc properties and the formation and presence of planets.

Many of the young stars shown here come from a new study of T Tauri stars, a class of stars that are very young (less than 10 million years old) and vary in brightness. The discs around these stars contain gas, dust, and planetesimals—the building blocks of planets and the progenitors of planetary systems.

These images also show what our own Solar System may have looked like in the early stages of its formation, more than four billion years ago.

Most of the images presented were obtained as part of the DARTTS-S (Discs ARound T Tauri Stars with SPHERE) survey. The distances of the targets ranged from 230 to 550 light-years away from Earth. For comparison, the Milky Way is roughly 100 000 light-years across, so these stars are, relatively speaking, very close to Earth. But even at this distance, it is very challenging to obtain good images of the faint reflected light from discs, since they are outshone by the dazzling light of their parent stars.

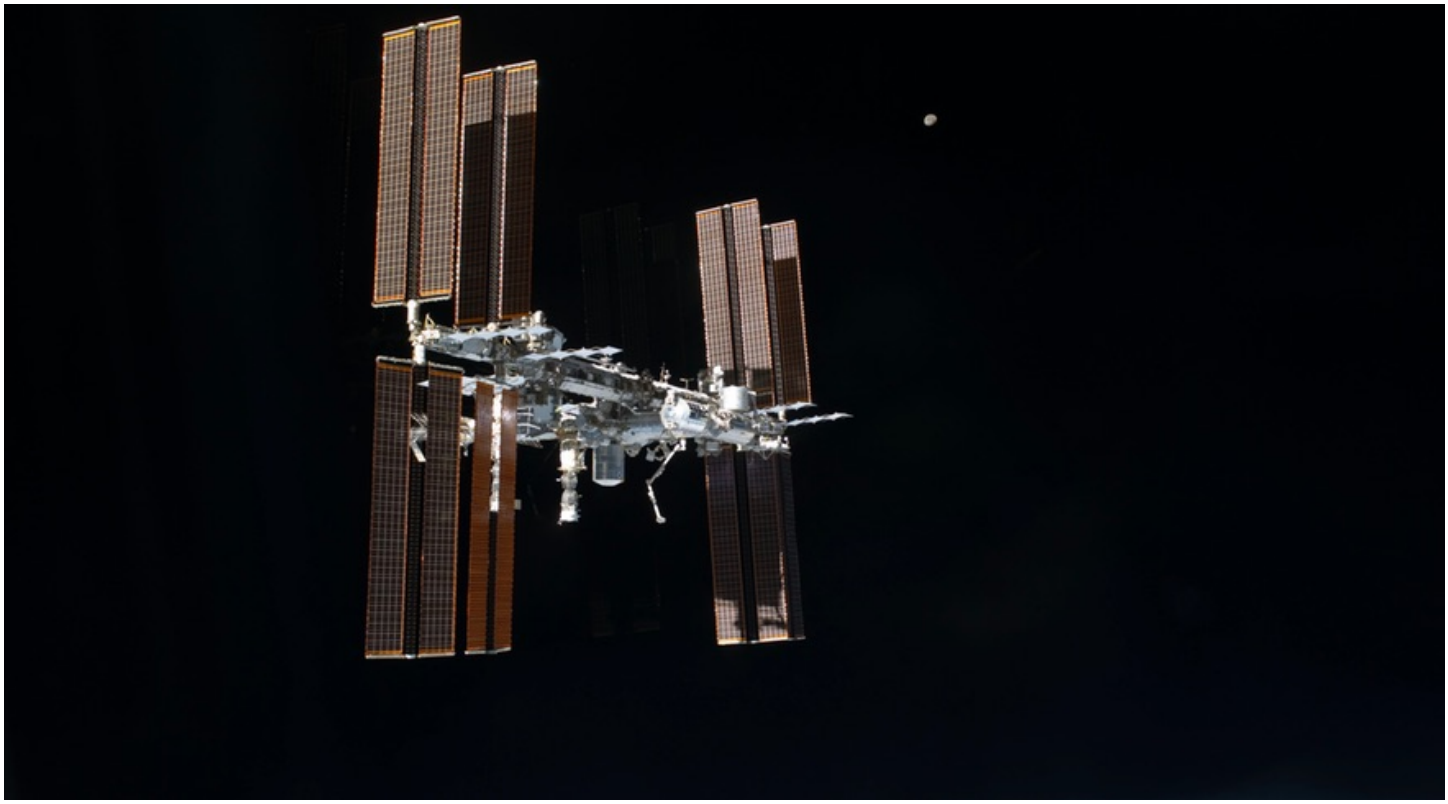
Another new SPHERE observation is the discovery of an edge-on disc around the star GSC 07396-00759, found by the SHINE (SpHere INfrared survey for Exoplanets) survey. This red star is a member of a multiple star system also included in the DARTTS-S sample but, oddly, this new disc appears to be more evolved than the gas-rich disc around the T Tauri star in the same system, although they are the same age. This puzzling difference in the evolutionary timescales of discs around two stars of the same age is another reason why astronomers are keen to find out more about discs and their characteristics.

Astronomers have used SPHERE to obtain many other impressive images , as well as for other studies including the interaction of a planet with a disc , the orbital motions within a system, and the time evolution of a disc.

The new results from SPHERE, along with data from other telescopes such as ALMA, are revolutionising astronomers' understanding of the environments around young stars and the complex mechanisms of planetary formation.

Source: Phys.org Return to Contents

3. NASA may extend space station missions to address potential commercial crew delays



NASA is in discussions with its Russian counterparts about extending some upcoming space station missions as a way to buy more time for development of commercial crew vehicles.

During an April 12 hearing by the commerce, justice and science subcommittee of the House Appropriations Committee on the agency's fiscal year 2019 budget proposal, NASA Acting Administrator Robert Lightfoot said longer "increments" of crews on the ISS could be one way to provide more schedule margin in the event of additional delays by Boeing and SpaceX in the development of their crewed spacecraft.

"Right now we don't show a gap" in U.S. access to the International Space Station, Lightfoot said in response to a question posed by subcommittee chairman Rep. John Culberson (R-Texas). "But we're looking at options at what can we do to not have a gap."

"We're working with our partners, our Russian partners, on if we can have longer increments for crew members that go up," he said.

He revisited that later in the hearing. "One thing we have is a great relationship with our Russians partners, and we're looking at other alternatives about potentially extending mission duration for the current missions that are there so that we don't gap the ability to get there," he said.

NASA's current agreement with flying astronauts on Soyuz vehicles expires next year, after the agency purchased three seats on Soyuz flights launching in the spring of 2019 and returning in the fall. It's not clear what would be involved in extending ISS mission durations, such as any technical issues regarding how long a Soyuz spacecraft can remain docked to the ISS.

NASA announced April 5 it had updated its existing commercial crew contract with Boeing to study modifications to the crewed test flight for the company's CST-100 Starliner. Those modifications would include

adding a third astronaut and extending the spacecraft's stay at the ISS from two weeks to as long as six months. Those changes, Lightfoot noted at the hearing, were another way to mitigate the effects of additional development delays.

At the hearing, Lightfoot said there was still schedule margin for the development of Starliner and SpaceX's Crew Dragon to be ready by the fall of 2019. Schedules last updated in January call for both companies to make uncrewed test flights of their vehicles in August. Boeing would then make a crewed test flight in November, followed by SpaceX in December.

Lightfoot, though, hinted that those schedules would be delayed again. "We still expect to see the first test flights at the end of this year," he said, later elaborating that these were the uncrewed test flights for both companies.

Culberson asked when the crewed test flights would take place, and Lightfoot said he would take that for the record. "I'm focused on the uncrewed one right now," he said.

Juggling the SLS launch schedule

Lightfoot also said at the hearing that NASA was revisiting the schedule for Space Launch System missions based on the unexpected windfall it received in the final 2018 omnibus appropriations bill.

That bill, signed into law March 23, provided $350 million for NASA to build a second mobile launch platform for the SLS. NASA officials said last year a second platform could help shorten the gap between the first and second SLS launches, but did not include funding for it in its 2019 budget proposal, citing competing priorities.

That second launch platform, which would be designed for the Block 1B version of the SLS with the larger Exploration Upper Stage, would reduce the 33-month "iron bar" in the schedule between the first two SLS missions created by the time needed to modify the current platform. That platform has been built to support the Block 1 version of SLS, which uses the Interim Cryogenic Propulsion Stage (ICPS).

Lightfoot said that having a second launch platform opens the door to launching a second SLS mission with the ICPS. That could be used, he said, to launch the Europa Clipper mission, which could be ready for launch as soon as 2022. NASA's 2019 budget proposal, though, plans a 2025 launch of Europa Clipper using a commercially-procured launch vehicle rather than SLS.

Another option would be to fly the first crewed Orion mission, known as Exploration Mission (EM) 2, on that second SLS Block 1. "If EM-2 flies that way, we would have to change the mission profile because we can't do what we would do if we had the Exploration Upper Stage," he said. "But that still gets humans in orbit and still allows us to check out all the systems that we wouldn't check out on EM-1."

He indicated that the funding for the second mobile launch platform took the agency by surprise. "You're going to have to give us a little time, because that was just a couple weeks ago that we found out that we were getting that," he said.

Defending budget cuts

The two-hour hearing by the subcommittee was largely cordial, with members thanking Lightfoot for his record-setting service as acting administrator. Lightfoot announced last month he will retire from the agency at the end of April.

He was called on by some members, though, to defend cuts in the 2019 proposal. That included NASA's education office as well as four Earth science missions, all of which the administration sought to cut in 2018 but which Congress ultimately funded.

Lightfoot said it was continuing to work on those programs funded in 2018 despite the administration's new effort to cancel them. "We are ready to execute as we were asked to do in 2018," he said.

He added that NASA has looked at ways to make its education office more effective. That office, he said, will soon be renamed the "Next-Gen STEM Office" to focus on science, technology, engineering and mathematics education activities for the next generation. But, should the administration's proposal to defund the office be approved, he said the agency would focus its education activities through its missions. "That's going to be how were going to try to inspire the next generation as we go forward," he said.

"Admittedly, that's going to be a concern whether that can actually fill the void or not," he said later in the hearing. "As long as we're getting appropriated the money, we will have an education office that executes what you guys have asked us to do."

Committee members also questioned plans to cancel the Wide-Field Infrared Survey Telescope (WFIRST) in the 2019 budget proposal, citing its inclusion as the top-priority large mission in the 2010 astrophysics decadal. Lightfoot said that, should WFIRST be cancelled, NASA would look at ways instrument technology developed for it could be applied to future missions.

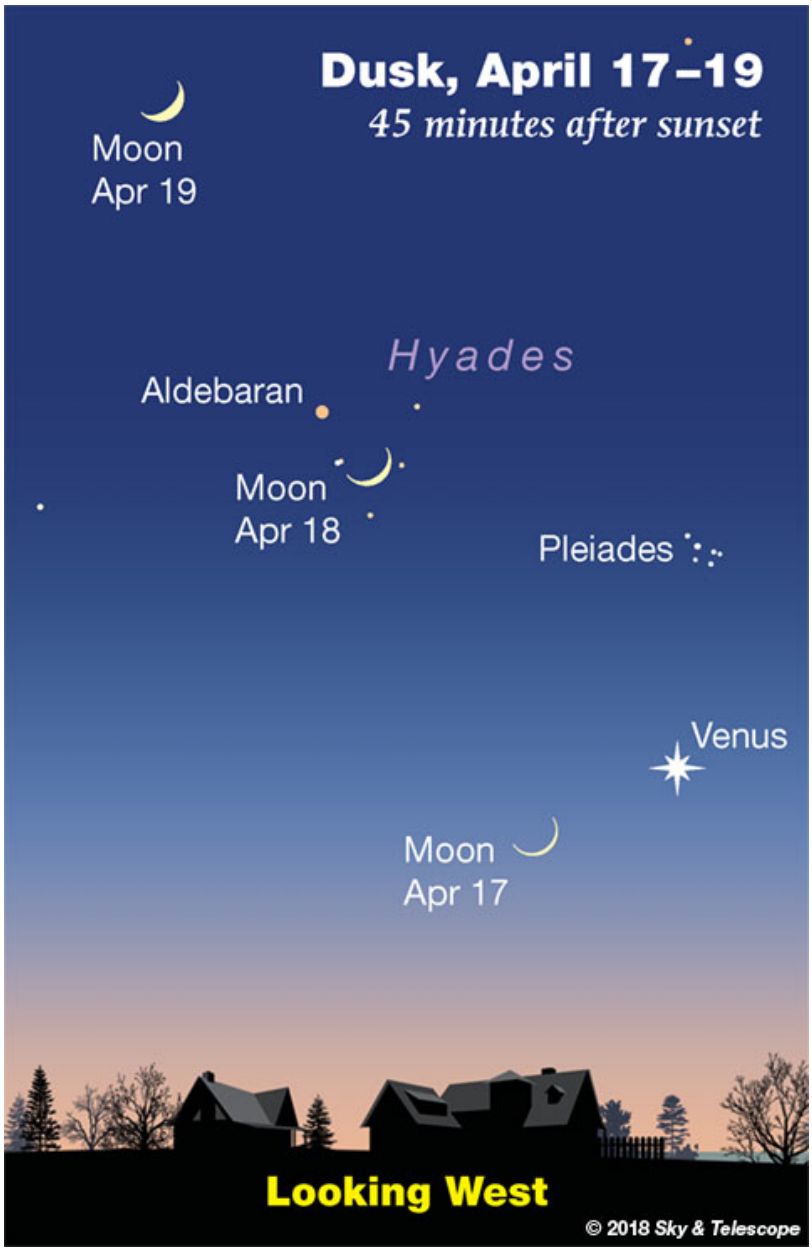
Culberson said his subcommittee planned to hold a hearing on issues with both WFIRST and the James Webb Space Telescope, whose launch NASA said last month would be delayed by about a year to May 2020. That hearing is tentatively scheduled for May 9, although Lightfoot said that ongoing reviews of JWST, including one by an independent review board established by NASA after the latest delay, will not be ready in time to support that hearing.

Culberson also offered advice to members concerned about cuts to education or science programs in the administration's proposal. "The budget, again, is just a recommendation," he said. "We don't get too worked up over the budget."

Source: SpaceNews Return to Contents

The Night Sky

Friday, April 13



• **Confirm the satellite of an asteroid?!** In the early-morning hours of Saturday April 14th, telescope users from the eastern Great Lakes through New England have a chance to catch the asteroid 113 Amalthea occulting an 11th-magnitude star, clouds permitting — and possibly to confirm and characterize Amalthea's small moon, tentatively discovered by amateurs during an occultation last year. Full details, and get finder charts and other helpful materials from the top line here. Good luck!

• This is the time of year when, as the last of twilight fades away, the bowl of the dim Little Dipper extends straight to the right of Polaris. High above the end stars of the Little Dipper's bowl, you'll find the end stars of the Big Dipper's bowl.

Saturday, April 14

• After dark, Leo walks horizontally across the meridian high in the south. His brightest star is Regulus, the bottom star of Leo's Sickle. The Sickle forms his front leg, chest, mane, and part of his head.

Not far from Regulus, the red long-period variable star R Leonis this week should still be near its maximum brightness, magnitude 5.4 or so. There's also the tiny Frosty Leo Nebula nearby to hunt out, and galaxy groups to explore. Make a night of it with your scope using Bob King's Put a Little Bit of Leo in Your Life, with finder charts and photos.

Sunday, April 15

• Right after dark, Orion is still in the southwest in his spring orientation: striding down to the right, with his belt horizontal. The belt points left toward Sirius and right toward Aldebaran and, farther on, the Pleiades.

• New Moon (exact at 9:57 p.m. EDT).

Monday, April 16

• Vega, the bright "Summer Star," rises in the northeast shortly after dark these evenings, depending on your latitude. Exactly where should you watch for it? Spot the Big Dipper very high in the northeast. Look at Mizar

at the bend of its handle. If you can see Mizar's tiny, close companion Alcor (binoculars make it easy), follow a line from Mizar through Alcor all the way down to the horizon. That's where Vega will be.

Tuesday, April 17

• Venus and a super-thin crescent Moon form a lovely pair low in the west as twilight fades, as shown here. They're about 5° apart at the time of twilight for the longitudes of the Americas.

• Saturn is at aphelion and the in fact farthest it's been from the Sun (by a trace) since 1959.

Source: Sky & Telescope Return to Contents

ISS Sighting Opportunities

For Denver:

Date	Visible	Max Height	Appears	Disappears
Wed Apr 11, 8:54 PM	3 min	27°	21° above W	17° above S
Thu Apr 12, 8:02 PM	4 min	56°	40° above W	10° above SE
Fri Apr 13, 8:46 PM	2 min	11°	10° above WSW	10° above SW

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

NASA-TV Highlights

(all times Eastern Daylight Time)

- **6 p.m., 10 p.m., Friday, April 13 -** Replay of The von Kármán Lecture Series: Planning Cassini's Grand Finale: A Retrospective (NTV-1 (Public))
- **6 p.m., 10 p.m., Friday, April 13 -** Replay of SpaceCast Weekly (all channels)
- **10 a.m., 4 p.m., 8 p.m., Saturday, April 14 -** Replay of SpaceCast Weekly (all channels)
- **9 a.m., 5 p.m., Sunday, April 15 -** Replay of The von Kármán Lecture Series: Planning Cassini's Grand Finale: A Retrospective (NTV-1 (Public))
- **10 a.m., 10 p.m., Sunday, April 15 -** Replay of SpaceCast Weekly (all channels)
- **11 a.m., Sunday, April 15 -** TESS (Transiting Exoplanet Survey Satellite) NASA Social (all channels)
- **1 p.m., 6 p.m., Sunday, April 15 -** TESS (Transiting Exoplanet Survey Satellite) Prelaunch News Briefing (all channels)
- **3 p.m., 8 p.m., Sunday, April 15** - TESS (Transiting Exoplanet Survey Satellite) Science Briefing (all channels)
- **10 a.m., Monday, April 16 -** NASA Edge: TESS (Transiting Exoplanet Survey Satellite) Live Broadcast (all channels)
- **1 p.m., Monday, April 16 -** ISS Expedition 55 In-Flight Facebook Live Event with Flight Engineer Drew Feustel of NASA (all channels)
- **2 p.m., Monday, April 16 -** Replay of the TESS (Transiting Exoplanet Survey Satellite) Prelaunch News Briefing (all channels)
- **4 p.m., Monday, April 16 -** Replay of the TESS (Transiting Exoplanet Survey Satellite) Science Briefing (all channels)
- **6 p.m., Monday, April 16 -** TESS (Transiting Exoplanet Survey Satellite) Launch Coverage (launch scheduled for 6:32 p.m.) (all channels)

- **9 p.m., 11 p.m., Monday, April 16 -** Replay of the TESS (Transiting Exoplanet Survey Satellite) Launch (all channels)
- **10 a.m., Tuesday, April 17** - ISS Expedition 55 Educational In-Flight Event with the Lake Orion High School and the Oakland Community College in Lake Orion, Michigan and Flight Engineers Drew Feustel and Ricky Arnold of NASA (starts at 10:25 a.m.) (all channels)

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

Space Calendar

- Apr 13 - Comet 105P/Singer Brewster Closest Approach To Earth (1.254 AU)
- Apr 13 - Comet P/2007 R2 (Gibbs) At Opposition (4.187 AU)
- Apr 13 - NEW [Apr 11] Apollo Asteroid 2018 GP Near-Earth Flyby (0.011 AU)
- Apr 13 - NEW [Apr 13] Apollo Asteroid 2018 GV1 Near-Earth Flyby (0.012 AU)
- Apr 13 - Aten Asteroid 2005 GZ128 Near-Earth Flyby (0.074 AU)
- Apr 13 - Apollo Asteroid 2013 GF84 Near-Earth Flyby (0.077 AU)
- Apr 13 - Asteroid 17024 Costello Closest Approach To Earth (1.404 AU)
- Apr 13 - Asteroid 27363 Alvanclark Closest Approach To Earth (1.793 AU)
- Apr 13 - Asteroid 1958 Chandra Closest Approach To Earth (2.167 AU)
- Apr 13 - Thomas Jefferson's 275th Birthday (1743)
- Apr 14 - UPDATED [Apr 13] AFSPC 11/ EAGLE/ MYCROFT Atlas 5 Launch
- Apr 14 - Comet 186P/Garradd At Opposition (3.634 AU)
- Apr 14 - Comet 158P/Kowal-LINEAR At Opposition (3.892 AU)
- Apr 14 - Aten Asteroid 2014 UR Near-Earth Flyby (0.024 AU)
- Apr 14 - NEW [Apr 09] Apollo Asteroid 2018 GM Near-Earth Flyby (0.096 AU)
- Apr 14 - Asteroid 3061 Cook Closest Approach To Earth (2.513 AU)
- Apr 14 - Asteroid 4169 Celsius Closest Approach To Earth (2.974 AU)
- Apr 15 - Comet 30P/Reinmuth Closest Approach To Earth (1.769 AU)
- Apr 15 - Comet C/2018 F1 (Grauer) Closest Approach To Earth (2.881 AU)
- Apr 15 - Comet P/2017 D1 (Fuls) At Opposition (3.734 AU)
- Apr 15 - Comet 158P/Kowal-LINEAR Closest Approach To Earth (3.892 AU)
- Apr 15 - Comet C/2016 A3 (PANSTARRS) At Opposition (4.097 AU)
- Apr 15 - Apollo Asteroid 2016 GB222 Near-Earth Flyby (0.074 AU)
- Apr 15 - Asteroid 1997 Leverrier Closest Approach To Earth (1.590 AU)
- Apr 15 - Asteroid 4342 Freud Closest Approach To Earth (1.850 AU)
- Apr 15 - Dwarf Planet 136108 Haumea At Opposition (49.618 AU)
- Apr 15 - Hermann Kohl's 130th Birthday (1888)
- Apr 16 - UPDATED [Apr 12] Transiting Expoplanet Survyey Satellite (TESS) Falcon 9 Launch
- Apr 16 - Apollo Asteroid 2018 FJ29 Near-Earth Flyby (0.078 AU)
- Apr 16 - Asteroid 2712 Keaton Closest Approach To Earth (1.120 AU)
- Apr 16 - Asteroid 1001 Gaussia Closest Approach To Earth (2.603 AU)
- Apr 17 - Comet C/2018 E1 (ATLAS) Perihelion (2.705 AU)
- Apr 17 - NEW [Apr 13] Amor Asteroid 2018 GC2 Near-Earth Flyby (0.023 AU)
- Apr 17 - Asteroid 21 Lutetia Closest Approach To Earth (1.644 AU)
- Apr 17 - 20th Anniversary (1998), STS-90 Launch (Space Shuttle Columbia, Spacelab)

Source: JPL Space Calendar

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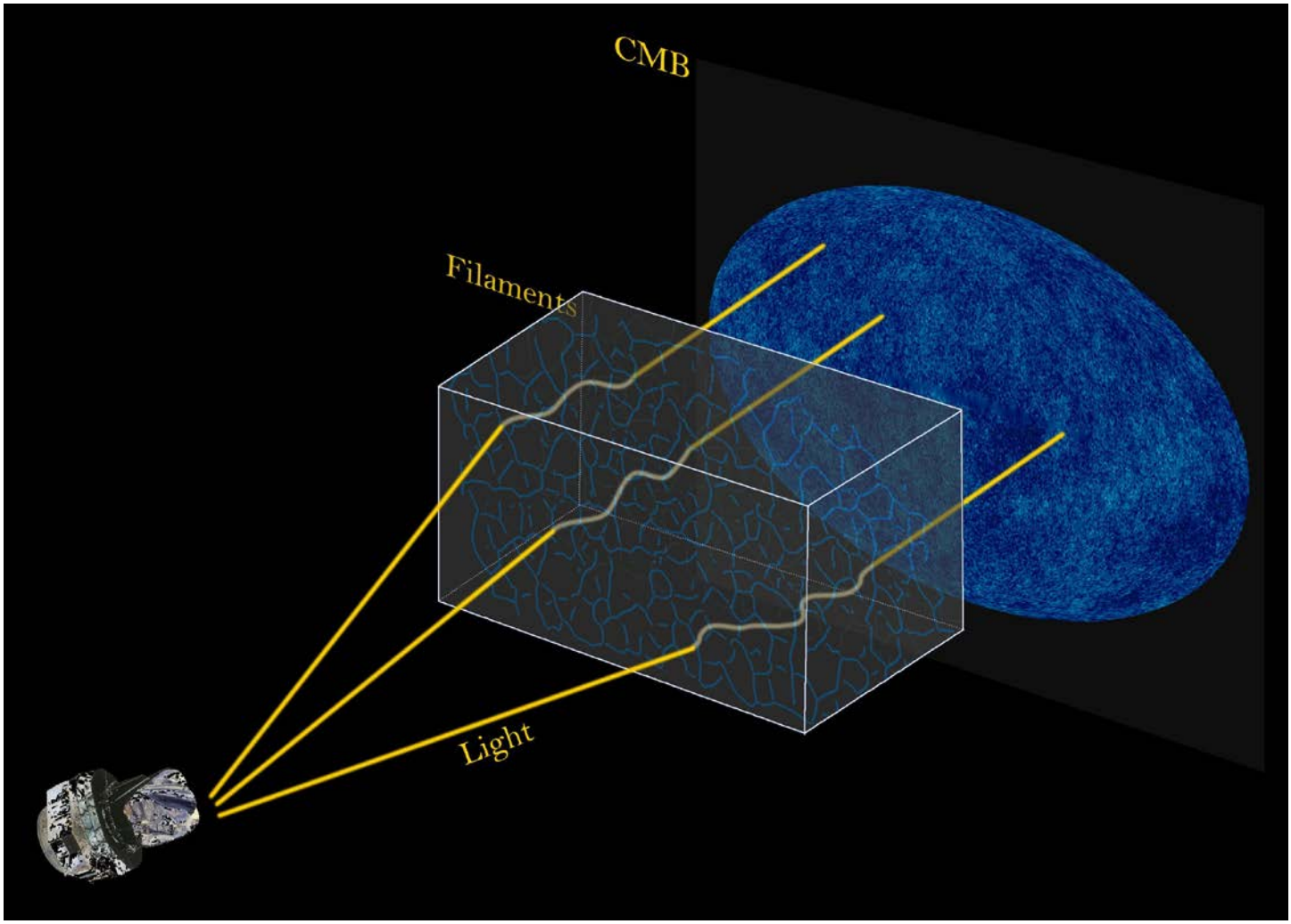
Food for Thought

Tiny distortions in universe's oldest light reveal clearer picture of strands in cosmic web



Scientists have decoded faint distortions in the patterns of the universe's earliest light to map huge tubelike structures invisible to our eyes – known as filaments – that serve as superhighways for delivering matter to dense hubs such as galaxy clusters.

The international science team, which included researchers from the Department of Energy's Lawrence Berkeley National Laboratory (Berkeley Lab) and UC Berkeley, analyzed data from past sky surveys using sophisticated image-recognition technology to home in on the gravity-based effects that identify the shapes of these filaments. They also used models and theories about the filaments to help guide and interpret their analysis.

Published April 9 in the journal *Nature Astronomy*, the detailed exploration of filaments will help researchers to better understand the formation and evolution of the cosmic web – the large-scale structure of matter in the universe – including the mysterious, unseen stuff known as dark matter that makes up about 85 percent of the total mass of the universe.

Dark matter constitutes the filaments – which researchers learned typically stretch and bend across hundreds of millions of light years – and the so-called halos that host clusters of galaxies are fed by the universal

network of filaments. More studies of these filaments could provide new insights about dark energy, another mystery of the universe that drives its accelerating expansion.

Filament properties could also put gravity theories to the test, including Einstein's theory of general relativity, and lend important clues to help solve an apparent mismatch in the amount of visible matter predicted to exist in the universe – the "missing baryon problem."

"Usually researchers don't study these filaments directly – they look at galaxies in observations," said Shirley Ho, a senior scientist at Berkeley Lab and Cooper-Siegel associate professor of physics at Carnegie Mellon University who led the study. "We used the same methods to find the filaments that Yahoo and Google use for image recognition, like recognizing the names of street signs or finding cats in photographs."

The study used data from the Baryon Oscillation Spectroscopic Survey, or BOSS, an Earth-based sky survey that captured light from about 1.5 million galaxies to study the universe's expansion and the patterned distribution of matter in the universe set in motion by the propagation of sound waves, or "baryonic acoustic oscillations," rippling in the early universe.

The BOSS survey team, which featured Berkeley Lab scientists in key roles, produced a catalog of likely filament structures that connected clusters of matter that researchers drew from in the latest study.

Researchers also relied on precise, space-based measurements of the cosmic microwave background, or CMB, which is the nearly uniform remnant signal from the first light of the universe. While this light signature is very similar across the universe, there are regular fluctuations that have been mapped in previous surveys.

In the latest study, researchers focused on patterned fluctuations in the CMB. They used sophisticated computer algorithms to seek out the imprint of filaments from gravity-based distortions in the CMB, known as weak lensing effects, that are caused by the CMB light passing through matter.

Since galaxies live in the densest regions of the universe, the weak lensing signal from the deflection of CMB light is strongest from those parts. Dark matter resides in the halos around those galaxies, and was also known to spread from those denser areas in filaments.

"We knew that these filaments should also cause a deflection of CMB and would also produce a measurable weak gravitational lensing signal," said Siyu He, the study's lead author who is a Ph.D. researcher from Carnegie Mellon University – she is now at Berkeley Lab and is also affiliated with UC Berkeley. The research team used statistical techniques to identify and compare the "ridges," or points of higher density that theories informed them would point to the presence of filaments.

"We were not just trying to 'connect the dots' – we were trying to find these ridges in the density, the local maximum points in density," she said. They checked their findings with other filament and galaxy cluster data, and with "mocks," or simulated filaments based on observations and theories. The team used large cosmological simulations generated at Berkeley Lab's National Energy Research Scientific Computing Center (NERSC), for example, to check for errors in their measurements.

The filaments and their connections can change shape and connections over time scales of hundreds of millions of years. The competing forces of the pull of gravity and the expansion of the universe can shorten or lengthen the filaments.

"Filaments are this integral part of the cosmic web, though it's unclear what is the relationship between the underlying dark matter and the filaments," and that was a primary motivation for the study, said Simone Ferraro, one of the study's authors who is a Miller postdoctoral fellow at UC Berkeley's Center for Cosmological Physics.

New data from existing experiments, and next-generation sky surveys such as the Berkeley Lab-led Dark Energy Spectroscopic Instrument (DESI) now under construction at Kitt Peak National Observatory in Arizona should provide even more detailed data about these filaments, he added.

Researchers noted that this important step in sleuthing the shapes and locations of filaments should also be useful for focused studies that seek to identify what types of gases inhabit the filaments, the temperatures of these gases, and the mechanisms for how particles enter and move around in the filaments. The study also allowed them to determine the length of filaments.

Siyu He said that resolving the filament structure can also provide clues to the properties and contents of the voids in space around the filaments, and "help with other theories that are modifications of general relativity," she said.

Ho added, "We can also maybe use these filaments to constrain dark energy – their length and width may tell us something about dark energy's parameters."

Source: Phys.org Return to Contents

Space Image of the Week

New NASA 4K Tour Of The Moon

Take a virtual tour of the Moon in all-new 4K resolution, thanks to data provided by NASA's Lunar Reconnaissance Orbiter spacecraft.

As the visualization moves around the near side, far side, north and south poles, we highlight interesting features, sites, and information gathered on the lunar terrain.

Click the image above to watch the video on YouTube.

Music Provided By Killer Tracks: "Never Looking Back" - Frederick Wiedmann. "Flying over Turmoil" - Benjamin Krause & Scott Goodman.

Source: SpaceRef

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