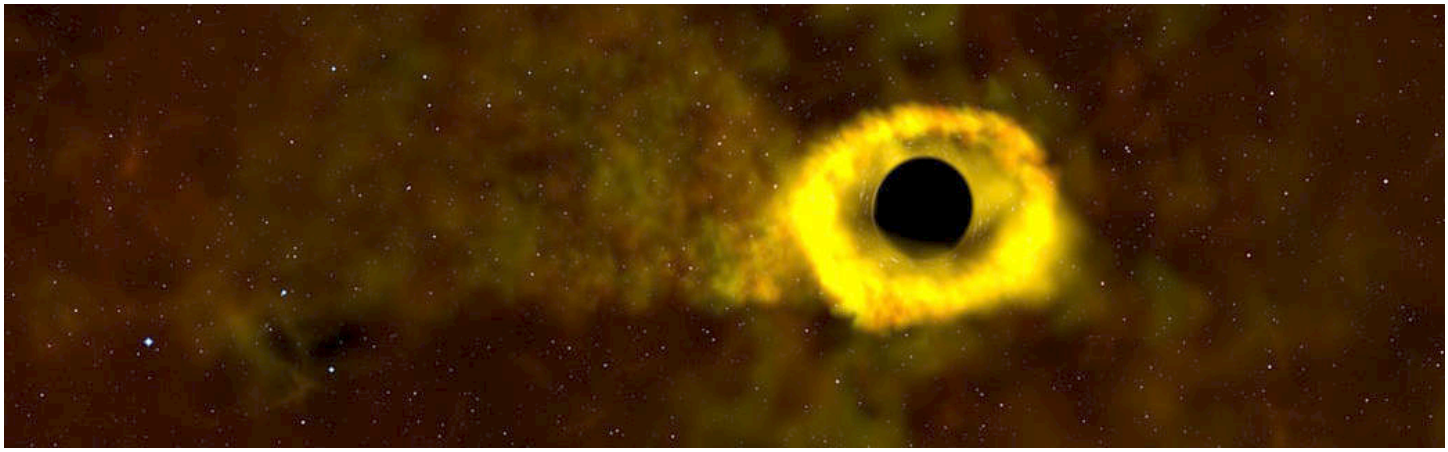
Space News Update

— September 6, 2019 —

Contents

1. **NASA's TESS Mission Spots Its 1st Star-shredding Black Hole**



For the first time, NASA's planet-hunting Transiting Exoplanet Survey Satellite (TESS) watched a black hole tear apart a star in a cataclysmic phenomenon called a tidal disruption event. Follow-up observations by NASA's Neil Gehrels Swift Observatory and other facilities have produced the most detailed look yet at the early moments of one of these star-destroying occurrences.

"TESS data let us see exactly when this destructive event, named ASASSN-19bt, started to get brighter, which we've never been able to do before," said Thomas Holoien, a Carnegie Fellow at the Carnegie Observatories in Pasadena, California. "Because we identified the tidal disruption quickly with the ground-based All-Sky Automated Survey for Supernovae (ASAS-SN), we were able to trigger multiwavelength follow-up observations in the first few days. The early data will be incredibly helpful for modeling the physics of these outbursts."

A paper describing the findings, led by Holoien, was published in the Sept. 27, 2019, issue of The Astrophysical Journal and is now available online.

ASAS-SN, a worldwide network of 20 robotic telescopes headquartered at Ohio State University (OSU) in Columbus, discovered the event on Jan. 29. Holoien was working at the Las Campanas Observatory in Chile when he received the alert from the project's South Africa instrument. Holoien quickly trained two Las Campanas telescopes on ASASSN-19bt and then requested follow-up observations by Swift, ESA's (European Space Agency's) XMM-Newton and ground-based 1-meter telescopes in the global Las Cumbres Observatory network.

TESS, however, didn't need a call to action because it was already looking at the same area. The planet hunter monitors large swaths of the sky, called sectors, for 27 days at a time. This lengthy view allows TESS to observe transits, periodic dips in a star's brightness that may indicate orbiting planets.

ASAS-SN began spending more time looking at TESS sectors when the satellite started science operations in July 2018. Astronomers anticipated TESS could catch the earliest light from short-lived stellar outbursts, including supernovae and tidal disruptions. TESS first saw ASASSN-19bt on Jan. 21, over a week before the event was bright enough for ASAS-SN to detect it. However, the satellite only transmits data to Earth every two weeks, and once received they must be processed at NASA's Ames Research Center in Silicon Valley, California. So the first TESS data on the tidal disruption were not available until March 13. This is why obtaining early follow-up observations of these events depends on coordination by ground-based surveys like ASAS-SN.

Fortunately, the disruption also occurred in TESS's southern continuous viewing zone, which was always in sight of one of the satellite's four cameras. (TESS shifted to monitoring the northern sky at the end of July.)

ASASSN-19bt's location allowed Holoien and his colleagues to follow the event across several sectors. If it had occurred outside this zone, TESS might have missed the beginning of the outburst.

"The early TESS data allow us to see light very close to the black hole, much closer than we've been able to see before," said Patrick Vallely, a co-author and National Science Foundation Graduate Research Fellow at OSU. "They also show us that ASASSN-19bt's rise in brightness was very smooth, which helps us tell that the event was a tidal disruption and not another type of outburst, like from the center of a galaxy or a supernova."

Holoien's team used UV data from Swift — the earliest yet seen from a tidal disruption — to determine that the temperature dropped by about 50%, from around 71,500 to 35,500 degrees Fahrenheit (40,000 to 20,000 degrees Celsius), over a few days. It's the first time such an early temperature decrease has been seen in a tidal disruption before, although a few theories have predicted it, Holoien said.

More typical for these kinds of events was the low level of X-ray emission seen by both Swift and XMM-Newton. Scientists don't fully understand why tidal disruptions produce so much UV emission and so few X-rays.

"People have suggested multiple theories — perhaps the light bounces through the newly created debris and loses energy, or maybe the disk forms further from the black hole than we originally thought and the light isn't so affected by the object's extreme gravity," said S. Bradley Cenko, Swift's principal investigator at NASA's Goddard Space Flight Center in Greenbelt, Maryland. "More early-time observations of these events may help us answer some of these lingering questions."

Astronomers think the supermassive black hole that generated ASASSN-19bt weighs around 6 million times the Sun's mass. It sits at the center of a galaxy called 2MASX J07001137-6602251 located around 375 million light-years away in the constellation Volans. The destroyed star may have been similar in size to our Sun.

Tidal disruptions are incredibly rare, occurring once every 10,000 to 100,000 years in a galaxy the size of our own Milky Way. Supernovae, by comparison, happen every 100 years or so. In total, astronomers have observed only about 40 tidal disruptions so far, and scientists predicted TESS would see only one or two in its initial two-year mission.

"For TESS to observe ASASSN-19bt so early in its tenure, and in the continuous viewing zone where we could watch it for so long, is really quite extraordinary," said Padi Boyd, the TESS project scientist at Goddard. "Future collaborations with observatories around the world and in orbit will help us learn even more about the different outbursts that light up the cosmos."

TESS is a NASA Astrophysics Explorer mission led and operated by MIT in Cambridge, Massachusetts, and managed by NASA's Goddard Space Flight Center. Additional partners include Northrop Grumman, based in Falls Church, Virginia; NASA's Ames Research Center in California's Silicon Valley; the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts; MIT's Lincoln Laboratory; and the Space Telescope Science Institute in Baltimore. More than a dozen universities, research institutes and observatories worldwide are participants in the mission.

NASA's Goddard Space Flight Center manages the Swift mission in collaboration with Penn State in University Park, the Los Alamos National Laboratory in New Mexico and Northrop Grumman Innovation Systems in Dulles, Virginia. Other partners include the University of Leicester and Mullard Space Science Laboratory of the University College London in the United Kingdom, Brera Observatory and ASI.

Source: NASA Return to Contents

2. New Frontier for Science as Astronomers Detect Gas Molecules in Comet from Another Star

An international team of astronomers, including Queen's University Belfast researchers, have made a historic discovery, detecting gas molecules in a comet which has tumbled into our solar system from another star.

It is the first time that astronomers have been able to detect this type of material in an interstellar object.

The discovery marks an important step forward for science as it will now allow scientists to begin deciphering exactly what these objects are made of and how our home solar system compares with others in our galaxy.

"For the first time we are able to accurately measure what an interstellar visitor is made of, and compare it with our own Solar system," said Professor Alan Fitzsimmons of the Astrophysics Research Centre, Queen's University Belfast.

Comet Borisov was discovered by Crimean amateur astronomer Gennady Borisov in August. Observations over the following 12 days showed that it was not orbiting the Sun, but was just passing through the Solar system on its own path around our galaxy.

By 24 September it had been renamed 2I/Borisov, the second interstellar object ever discovered by astronomers. Unlike the first such object discovered two years ago, 1I/'Oumuamua, this object appeared as a faint comet, with a surrounding atmosphere of dust particles, and a short tail.

Alan Fitzsimmons and colleagues from Europe, the United States and Chile used the William Herschel Telescope on La Palma in the Canary Islands to detect the gas in the comet but doing so was tricky.

He said: "Our first attempt was on Friday 13 September, but we were unlucky and were thwarted by the brightness of the sky so close to the Sun. But the next attempt was successful."

Astronomers at the observatory pointed the giant telescope at the comet low down in the morning sky between 6am and 7am last Friday. Passing the faint comet light into a spectrograph, this enabled the astronomers to measure how much light the comet was emitting as a function of wavelength, or colour.

Professor Fitzsimmons explained: "A spectrum allows us to detect individual types of gas by their spectral fingerprints. We received the data at midday and by 5pm that evening we knew we had successfully detected gas for the first time."

The gas detected was cyanogen, made of a carbon atom and a nitrogen atom bonded together. It is a toxic gas if inhaled, but it is relatively common in comets.

Combining these spectra with filtered images of the comet obtained with the TRAPPIST-North telescope in Morocco, the team also measured the amount of dust being ejected by the comet, and placed limits on the size of the central nucleus.

Dr. Emmanuel Jehin is monitoring the comet using the TRAPPIST-North telescope in Morocco, and provided data crucial for measuring the amount of comet dust emitted by 2I. He said "We are used to seeing comet images, but this one is so special ! Looking at it nearly every morning for two weeks now, I'm fascinated by the fact this object is not like the many others I have been observing, but is truly coming from another star probably very far away."

Professor Karen Meech from the University of Hawai'i had previously imaged the comet, and used the new data to calculate the possible size of the comet.

She reported: "Our preliminary analysis using the amount of gas seen coming off the nucleus suggests that it is likely that much of the surface is active, in contrast to typical short period comets."

The team concluded that the most remarkable thing about the comet is that it appears ordinary in terms of the gas and dust it is emitting. It looks like it was born 4.6 billion years ago with the other comets in our Solar system, yet has come from an—as yet—unidentified star system.

As the comet approaches the Sun it will become brighter and more visible to astronomers. Dr. Oliver Hainaut from the European Southern Observatory said "The next year is going to be extremely exciting, as we will be able to follow 2I's evolution as it zooms through our Solar System. In comparison, we had only a few weeks to study `Oumuamua before it became too faint."

The European Space Agency approved a space mission earlier this year that may visit a future interstellar visitor. Dr. Colin Snodgrass in the team is also Deputy Principal Investigator on the ESA Comet Interceptor, due to be launched in 2028.

The research has been submitted to the *Astrophysical Journal Letters* for scientific peer review, and is available at arxiv.org/abs/1909.12144

Explore further

The visible spectrum of C/2019 Q4 (Borisov), the first confirmed interstellar comet

Source: Phys.org Return to Contents

3. **Still No Trace of Missing Indian Moon Lander: NASA**

A NASA satellite orbiting the Moon passed over the site where the Indian probe Vikram should have made touchdown earlier this month, but didn't see the missing lander, the US space agency said.

The announcement was made Thursday after NASA released photographs taken on September 17 by its Lunar Reconnaissance Orbiter (LRO) of the plains located about 370 miles (600 kilometers) from the Moon's south pole, which is where Vikram aimed to land. "So far the... team has not been able to locate or image the lander," NASA said.

"It was dusk when the landing area was imaged and thus large shadows covered much of the terrain; it is possible that the Vikram lander is hiding in a shadow," the space agency added, saying the LRO will pass over the site again in October, when the light will be better.

Blasting off in July, the emerging Asian giant had hoped with its Chandrayaan-2 ("Moon Vehicle 2") mission to become just the fourth country after the United States, Russia and regional rival China to make a successful moon landing, and the first on the lunar south pole.

The main spacecraft, which remains in orbit around the Moon, dropped the unmanned lander Vikram for a descent that would take five days, but the probe went silent just 2.1 kilometers above the surface. Vikram was traveling at a horizontal speed of 157 feet (48 meters) per second and descending 197 feet per second, just over half a mile from the landing point, according to US-based organization The Planetary Society.

Days after the failed landing, the Indian Space Research Organization said it had located the lander, but hadn't been able to establish communication. It has been trying to contact Vikram since.

However, NASA in its statement said "Vikram had a hard landing," which is aviation jargon meaning it crashed.

Explore further: India locates lander lost on final approach to moon

Source: Phys.org Return to Contents

The Night Sky

Friday, Sept. 27

• Arcturus shines in the west as twilight fades out. Capella, equally bright, is barely rising in the north-northeast (depending on your latitude; the farther north you are the higher it will be.) They're both magnitude 0. Later in the evening, Arcturus and Capella shine at the same height in their respective compass directions.

When will this happen? That depends on both your latitude and longitude. When it does, turn to look southwest. There will be Jupiter at about the same height (depending on your latitude).

Look south-southeast, and there will be 1st-magnitude Fomalhaut about equally high too.

Saturday, Sept. 28

• The starry W of Cassiopeia stands high in the northeast after dark. The right-hand side of the W, the brightest side, is tilted up.

Look along the second segment of the W counting down from the top. Notice the dim naked-eye stars along that segment (not counting its two ends). The brightest of these, on the right, is Eta Cassiopeiae, magnitude 3.4. It's a Sun-like star just 19 light-years away with an orange-dwarf companion, a lovely binary in a telescope.

The "one" on the left, fainter, is a naked-eye pair in a dark sky: Upsilon^1 and Upsilon^2 Cassiopeiae, 0.3° apart. They're orange giants unrelated to each other, 200 and 400 light-years away. Upsilon^1, slightly fainter, is the farther one.

• New Moon (exact at 2:26 p.m. Eastern Daylight Time).

Sunday, Sept. 29

• At this time of year the rich Cygnus Milky Way crosses the zenith soon after dark (for mid-northern latitudes). The Milky Way extends straight up from the southwest, like firelit smoke from some great dim campfire. It passes overhead, then runs straight down to the northeast — where it plummets through Cassiopeia, Perseus, and low Auriga.

• Algol in Perseus shines at its minimum brightness (magnitude 3.4 instead of its usual 2.3) for a couple hours centered on 12:34 a.m. tonight EDT, 9:34 p.m. PDT.

Monday, Sept. 30

• "My favorite observations allow me to make comparisons," writes Matt Wedel in the October *Sky & Telescope*: "similar objects at different distances, or objects of different sizes at the same distance." For binocular observers he offers some examples at the bowl of the Sagittarius Teaspoon, just above bright Saturn. See his Binocular Highlight column on page 43 of the October issue.

Source: Sky & Telescope

Return to Contents

ISS Sighting Opportunities

For Denver:

Date	Visible	Max Height	Appears	Disappears
Fri Sep 27, 8:22 PM	1 min	10°	10° above NNW	10° above N
Sat Sep 28, 7:33 PM	2 min	11°	10° above NNW	10° above NNE
Sat Sep 28, 9:10 PM	< 1 min	10°	10° above NNW	10° above NNW
Sun Sep 29, 8:22 PM	2 min	11°	10° above NNW	11° above NNE
Mon Sep 30, 7:33 PM	1 min	10°	10° above NNW	10° above NNE
Mon Sep 30, 9:10 PM	< 1 min	10°	10° above NNW	10° above NNW

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

NASA-TV Highlights

(all times Eastern Daylight Time)

No Special Programming

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

Return to Contents

Space Calendar

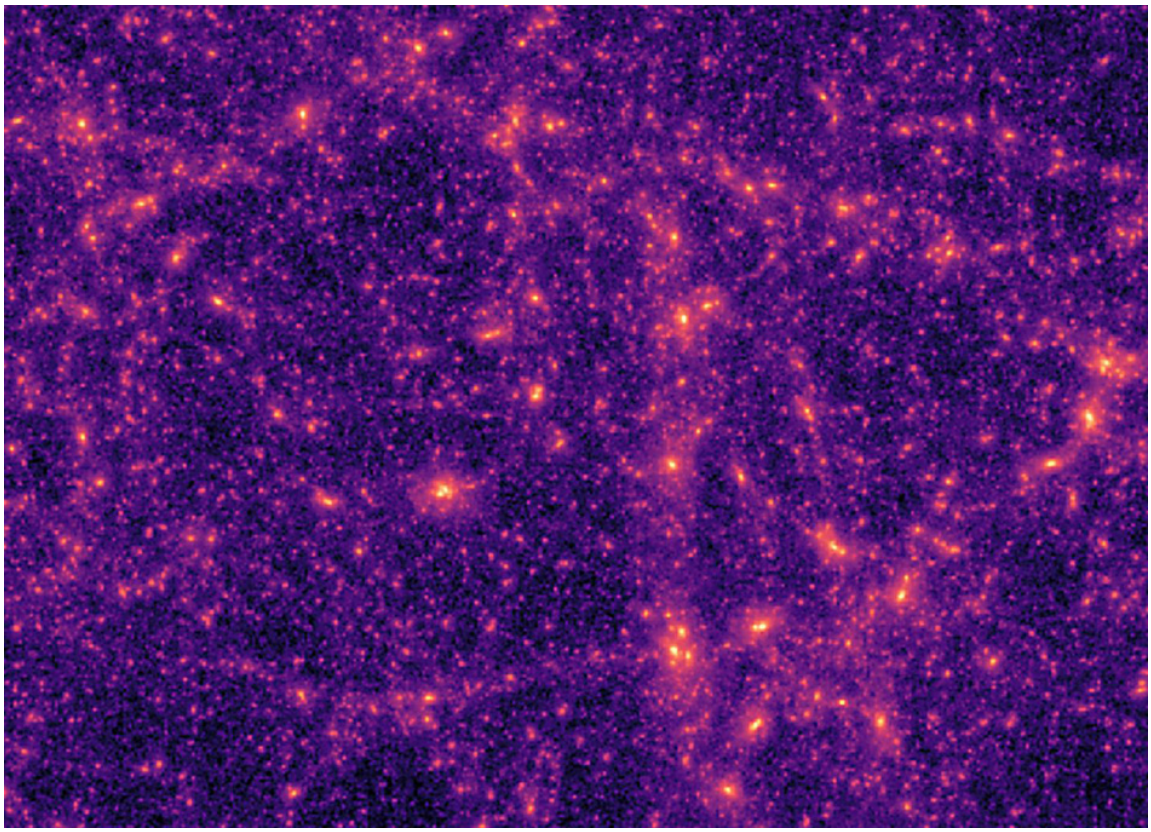
- Sep 27 - Comet C/2018 W2 (Africano) Closest Approach To Earth (0.494 AU)
- Sep 27 - Comet P/2019 M2 At Opposition (0.645 AU)
- Sep 27 - UPDATED [Sep 24] Comet 381P/LINEAR-Spacewatch Perihelion (2.265 AU)
- Sep 27 - Comet 95P/Chiron At Opposition (17.809 AU)
- Sep 27 - Apollo Asteroid 2006 QV89 Near-Earth Flyby (0.046 AU)
- Sep 27 - Asteroid 5905 Johnson Closest Approach To Earth (0.940 AU)
- Sep 27 - Asteroid 24102 Jacquecassini Closest Approach To Earth (1.267 AU)
- Sep 27 - Asteroid 17656 Hayabusa Closest Approach To Earth (1.661 AU)
- Sep 27 - Kuiper Belt Object 120347 Salacia At Opposition (43.975 AU)
- Sep 27 - Henry Holt's 90th Birthday (1929)
- Sep 27 - Benjamin Gould's 195th Birthday (1824)
- Sep 27 - Daniel Kirkwood's 205th Birthday (1814)
- Sep 28 - HOT [Sep 21] 50th Anniversay (1969), Murchison Meteorite Shower (Hit Barn in Australia)
- Sep 28 - Amor Asteroid 354030 (2001 RB18) Near-Earth Flyby (0.093 AU)
- Sep 28 - Asteroid 391257 Wilwheaton Closest Approach To Earth (1.210 AU)
- Sep 28 - Asteroid 2712 Keaton Closest Approach To Earth (1.220 AU)
- Sep 28 - Asteroid 30444 Shemp Closest Approach To Earth (1.351 AU)
- Sep 28 - Asteroid 2829 Bobhope Closest Approach To Earth (1.818 AU)
- Sep 28 - Binary Apollo Asteroid 2017 YE5 Closest Approach To Earth (3.229 AU)
- Sep 29 - Comet C/2018 W2 (Africano) At Opposition (0.497 AU)
- Sep 29 - Comet 112P/Urata-Niijima Closest Approach To Earth (1.238 AU)
- Sep 29 - Comet 376P/LONEOS Perihelion (2.831 AU)
- Sep 29 - NEW [Sep 23] Aten Asteroid 2019 SO1 Near-Earth Flyby (0.029 AU)
- Sep 29 - Asteroid 2118 Flagstaff Closest Approach To Earth (1.280 AU)
- Sep 29 - Asteroid 2511 Patterson Closest Approach To Earth (1.307 AU)
- Sep 29 - Asteroid 10189 Normanrockwell Closest Approach To Earth (1.444 AU)
- Sep 29 - Asteroid 16035 Sasandford Closest Approach To Earth (1.724 AU)
- Sep 29 - Asteroid 7367 Giotto Closest Approach To Earth (2.587 AU)
- Sep 29 - Asteroid 9767 Midsomer Norton Closest Approach To Earth (4.228 AU)
- Sep 29 - 10th Anniversary (2009), MESSENGER, 3rd Mercury Flyby
- Sep 29 - 15th Anniversary (2004), SpaceShipOne Launch F-2 (2nd Private Manned Space Flight)
- Sep 29 - Geoffrey Marcy's 65th Birthday (1954)
- Sep 29 - Michael Belton's 85th Birthday (1934)
- Sep 29 - 135th Anniversary (1884), Johann Palisa's Discovery of Asteroid 243 Ida
- Sep 30 - HOT [Sep 23] Deadline To Submit Names to Fly on NASA's Mars 2020 Rover
- Sep 30 - Comet 111P/Helin-Roman-Crockett At Opposition (3.063 AU)
- Sep 30 - Comet 349P/Lemmon At Opposition (3.195 AU)
- Sep 30 - NEW [Sep 27] Apollo Asteroid 2019 SN3 Near-Earth Flyby (0.006 AU)
- Sep 30 - NEW [Sep 26] Apollo Asteroid 2019 SH3 Near-Earth Flyby (0.008 AU)
- Sep 30 - NEW [Sep 21] Apollo Asteroid 2019 SP Near-Earth Flyby (0.017 AU)
- Sep 30 - 10th Anniversary (2009), 1st Clown is Launched into Space (Guy Lalibere)
- Sep 30 - 25th Anniversary (1994), STS-68 Launch (Space Shuttle Endeavour, Radar Imaging)
- Sep 30 - Phil Plait's 55th Birthday (1964)
- Sep 30 - 90th Anniversary (1929), Rocket-Powered Manned Flight by Fritz von Opel

Source: JPL Space Calendar

Return to Contents

Food for Thought

Artificial Intelligence Probes Dark Matter in the Universe



Understanding the how our universe came to be what it is today and what will be its final destiny is one of the biggest challenges in science.

The awe-inspiring display of countless stars on a clear night gives us some idea of the magnitude of the problem, and yet that is only part of the story. The deeper riddle lies in what we cannot see, at least not directly: dark matter and dark energy. With dark matter pulling the universe together and dark energy causing it to expand faster, cosmologists need to know exactly how much of those two is out there in order to refine their models.

At ETH Zurich, scientists from the Department of Physics and the Department of Computer Science have now joined forces to improve on standard methods for estimating the dark matter content of the universe through artificial intelligence. They used cutting-edge machine learning algorithms for cosmological data analysis that have a lot in common with those used for facial recognition by Facebook and other social media. Their results have recently been published in the scientific journal Physical Review D.

Facial recognition for cosmology

While there are no faces to be recognized in pictures taken of the night sky, cosmologists still look for something rather similar, as Tomasz Kacprzak, a researcher in the group of Alexandre Refregier at the Institute of Particle Physics and Astrophysics, explains: "Facebook uses its algorithms to find eyes, mouths or ears in images; we use ours to look for the tell-tale signs of dark matter and dark energy." As dark matter cannot be seen directly in telescope images, physicists rely on the fact that all matter - including the dark variety - slightly bends the path of light rays arriving at the Earth from distant galaxies. This effect, known as

"weak gravitational lensing", distorts the images of those galaxies very subtly, much like far-away objects appear blurred on a hot day as light passes through layers of air at different temperatures.

Cosmologists can use that distortion to work backwards and create mass maps of the sky showing where dark matter is located. Next, they compare those dark matter maps to theoretical predictions in order to find which cosmological model most closely matches the data. Traditionally, this is done using human-designed statistics such as so-called correlation functions that describe how different parts of the maps are related to each other. Such statistics, however, are limited as to how well they can find complex patterns in the matter maps.

Neural networks teach themselves

"In our recent work, we have used a completely new methodology", says Alexandre Refregier. "Instead of inventing the appropriate statistical analysis ourselves, we let computers do the job." This is where Aurelien Lucchi and his colleagues from the Data Analytics Lab at the Department of Computer Science come in. Together with Janis Fluri, a PhD student in Refregier's group and lead author of the study, they used machine learning algorithms called deep artificial neural networks and taught them to extract the largest possible amount of information from the dark matter maps.

In a first step, the scientists trained the neural networks by feeding them computer-generated data that simulates the universe. That way, they knew what the correct answer for a given cosmological parameter - for instance, the ratio between the total amount of dark matter and dark energy - should be for each simulated dark matter map. By repeatedly analysing the dark matter maps, the neural network taught itself to look for the right kind of features in them and to extract more and more of the desired information. In the Facebook analogy, it got better at distinguishing random oval shapes from eyes or mouths.

More accurate than human-made analysis

The results of that training were encouraging: the neural networks came up with values that were 30% more accurate than those obtained by traditional methods based on human-made statistical analysis. For cosmologists, that is a huge improvement as reaching the same accuracy by increasing the number of telescope images would require twice as much observation time - which is expensive.

Finally, the scientists used their fully trained neural network to analyse actual dark matter maps from the KiDS-450 dataset. "This is the first time such machine learning tools have been used in this context," says Fluri, "and we found that the deep artificial neural network enables us to extract more information from the data than previous approaches. We believe that this usage of machine learning in cosmology will have many future applications."

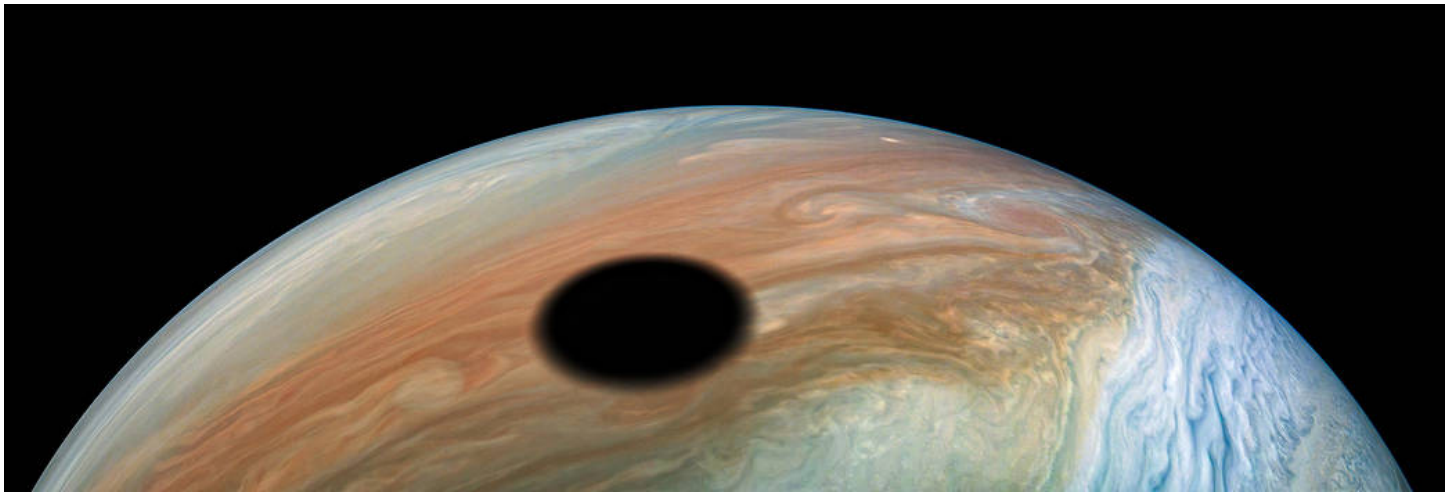
As a next step, he and his colleagues are planning to apply their method to bigger image sets such as the Dark Energy Survey. Also, more cosmological parameters and refinements such as details about the nature of dark energy will be fed to the neural networks.

Reference

Fluri J, Kacprzak T, Lucchi A, Refregier A, Amara A, Hofmann T, Schneider A: Cosmological constraints with deep learning from KiDS-450 weak lensing maps. Physical Review D. 100: 063514, doi: 10.1103/PhysRevD.100.063514

Source: Spaceref.com Return to Contents

Space Image of the Week



Moon Shadow

Explanation Jupiter's volcanically active moon Io casts its shadow on the planet in this dramatic image from NASA's Juno spacecraft. As with solar eclipses on the Earth, within the dark circle racing across Jupiter's cloud tops one would witness a full solar eclipse as Io passes in front of the Sun.

Such events occur frequently on Jupiter because it is a large planet with many moons. In addition, unlike most other planets in our solar system, Jupiter's axis is not highly tilted relative to its orbit, so the Sun never strays far from Jupiter's equatorial plane (+/- 3 degrees). This means Jupiter's moons regularly cast their shadows on the planet throughout its year.

Juno's close proximity to Jupiter provides an exceptional fish-eye view, showing a small fraction near the planet's equator. The shadow is about 2,200 miles (3,600 kilometers) wide, approximately the same width as Io, but appears much larger relative to Jupiter.

A little larger than Earth's Moon, Io is perhaps most famous for its many active volcanoes, often caught lofting fountains of ejecta well above its thin atmosphere.

Citizen scientist Kevin M. Gill created this enhanced-color image using data from the spacecraft's JunoCam imager. The raw image was taken on Sept. 11, 2019 at 8:41 p.m. PDT (11:41 p.m. EDT) as the Juno spacecraft performed its 22nd close flyby of Jupiter. At the time the image was taken, the spacecraft was about 4,885 miles (7,862 kilometers) from the cloud tops at a latitude of 21 degrees.

JunoCam's raw images are available for the public to peruse and process into image products at https://missionjuno.swri.edu/junocam/processing.

More information about Juno is at https://www.nasa.gov/juno and https://missionjuno.swri.edu.

Image credit:

Image data: NASA/JPL-Caltech/SwRI/MSSS

Image processing by Kevin M. Gill, © CC BY 3.0

Source: NASA

Return to Contents