THE YEAR IN SCIENCE

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SCIENCE FOR THE CURIOUS

January/February 2016

100 TOP STORIES OF 2015

PLUTO SHINES

A big year for the little world.

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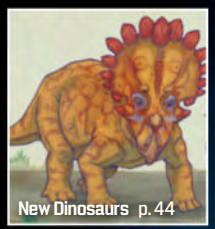
Kennewick Man p. 30



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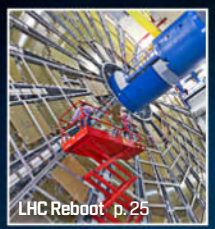

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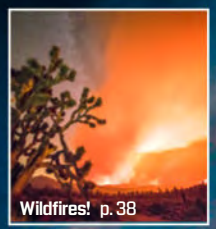

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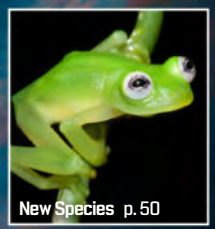

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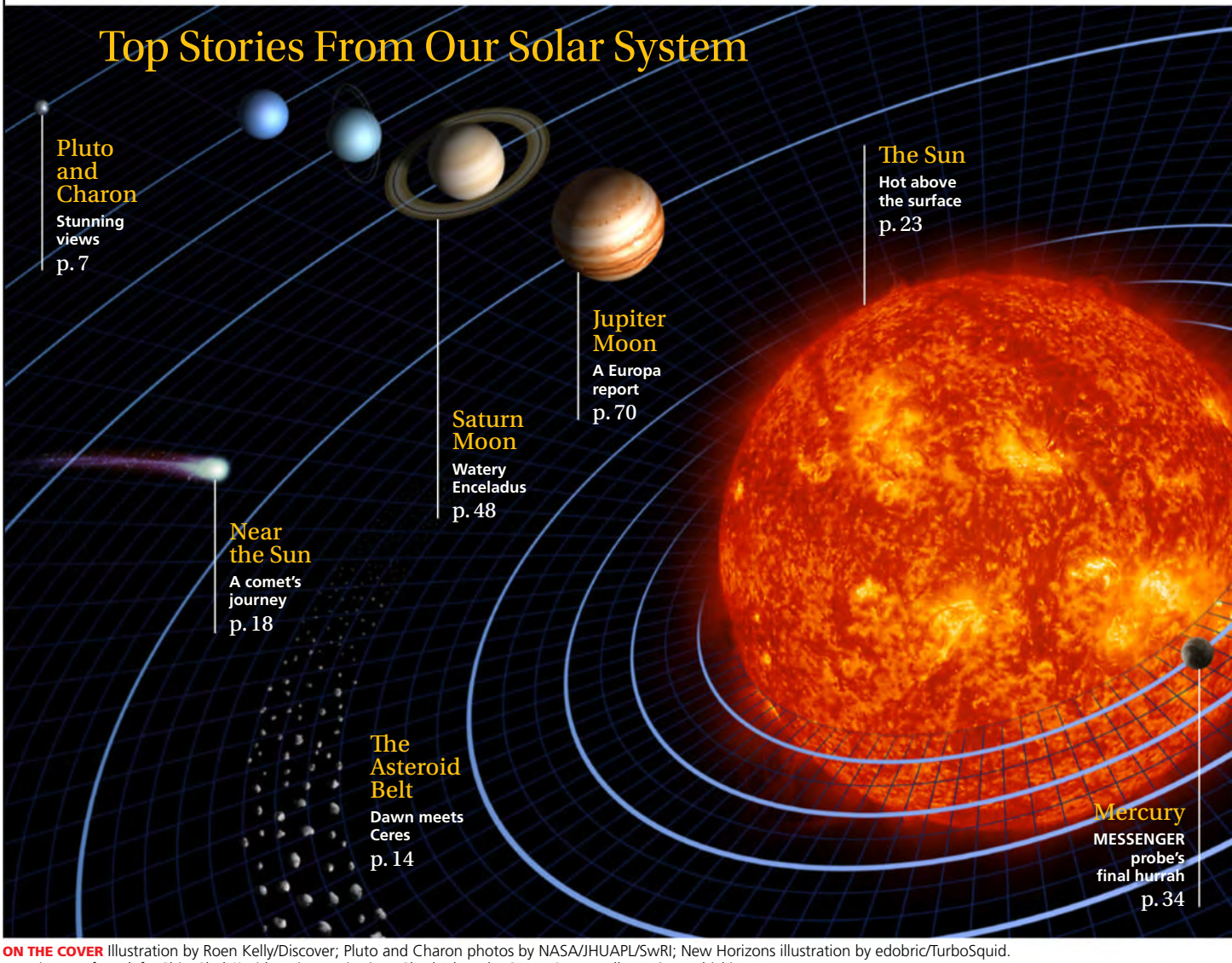

ON THE COVER Illustration by Roen Kelly/Discover; Pluto and Charon photos by NASA/JHUAPL/SwRI; New Horizons illustration by edobric/TurboSquid. Inset images from left: Chip Clark/Smithsonian Institution; Chad Edwards; CERN; Stuart Palley; Brian Kubicki.

100 TOP STORIES OF 2015

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New Horizons Unmasks the Mysteries of Pluto

For 85 years, Pluto has been a blank space in our portrait of the solar system, so obscured that astronomers did not even know its exact size or color. But no longer.

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NASA/JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LABORATORY/SOUTHWEST RESEARCH INSTITUTE

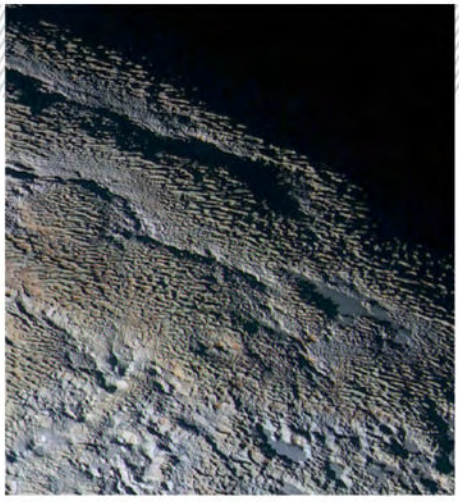
Above: The heart-shaped Tombaugh Regio stands out in this portrait of Pluto and its largest moon, Charon. (The distance between them is not shown to scale.) Far left: A 220-mile-wide view of Pluto's surface shows ancient craters, smooth younger terrain and a field of aligned ridges, possibly dunes. Left: Members of the New Horizons team, including Principal Investigator Alan Stern (center), react to new images from the probe's July 14 flyby.

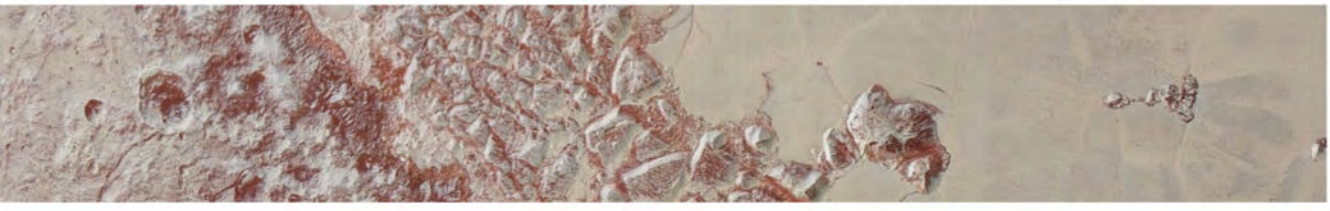
ALL PLUTO IMAGES: NASA/JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LABORATORY/SOUTHWEST RESEARCH INSTITUTE. GROUP PHOTO: BILL INGALLS/NASA

On July 14, NASA's New Horizons probe flew just 7,750 miles past Pluto's surface and began radioing back detailed pictures. The sudden unveiling has revealed a complex and inexplicably varied landscape. "It's a total surprise," said mission leader Alan Stern as he pondered the images. "If an artist had painted this Pluto before our flyby, I probably would've called it over the top."

Some areas of Pluto appear dark and heavily cratered, indicating extreme age. Their coloration may come from frozen methane irradiated by the sun and converted into tarlike compounds known as tholins, notes Will Grundy of Lowell Observatory. The whole globe evidently has been painted ruddy brown by a thin coating of such chemicals, prompting New Horizons scientists to dub it "the other red planet." Right next to Pluto's ancient terrain are utterly different landforms, including rippled fields — dunes, possibly — and craggy, 11,000-foot mountains. Those peaks must be composed of water ice, Stern explains, because it is the only likely surface material strong enough to support them. (Water is as hard as granite at Pluto's surface temperature of minus 390 degrees Fahrenheit.)

From there, the findings get even stranger: Some material appears to flow down from the mountains. Most likely it is nitrogen ice, accumulated as gases in Pluto's atmosphere freeze during its 60-year-long winter. Beyond the nitrogen glaciers are extensive plains, devoid of the expected craters and marked instead by polygonal depressions where relatively warm material may be seeping up from below. Such fresh-looking regions indicate recent — possibly ongoing — geologic





Right: Round and strangely textured mountains rise near Pluto's day-night border in this 330-mile-wide view. Far right: A departing shot from New Horizons captures Pluto's hazy atmosphere. Below: Another view of Pluto's diverse landscape, captured just before closest approach, reveals features as small as 270 yards across. Bottom: Icy mountains up to 11,000 feet high border the smooth Sputnik Planum, the left "lobe" of Tombaugh Regio's heart.

activity. Even more surprising, New Horizons images show that Pluto's moon Charon, about half the size of the 1,473-mile-wide world, is also dynamic, with long fractures, smooth lowlands and odd, isolated massifs.

The new views of Pluto and Charon consolidate a revolutionary idea brewing since the Voyager missions of the 1970s. Before then, scientists had broadly assumed that small bodies in the outer solar system must be cold and inert. In reality, space probes showed that the moons of the outer planets are wildly active, from the sulfur volcanoes of Jupiter's Io to the dusty geysers of Neptune's Triton. The fallback assumption was that moons are special, energized by the giant worlds they orbit, but that surely small standalone bodies like Pluto must be deadly dull. New Horizons has now blown away that bit of planetary chauvinism as well, and replaced it with a captivating mystery: What is the energy source driving all the activity?

One idea is that oceans deep inside these worlds hold residual heat for billions of years. Whatever the cause, the effect is probably extremely common. Pluto and Charon have hundreds of thousands of cousins, collectively filling a zone called the Kuiper Belt. It's a good bet that many of those little-understood objects are active, too.

New Horizons' mission is still far from over. In January 2019, it is scheduled to visit another, much smaller Kuiper Belt object known as 2014 MU69. Meanwhile, the probe will continue sending data from the Pluto flyby through the end of 2016. The results should fill in many more brushstrokes — not just for Pluto's portrait, but also for the entire process of planetary formation.

— COREY S. POWELL

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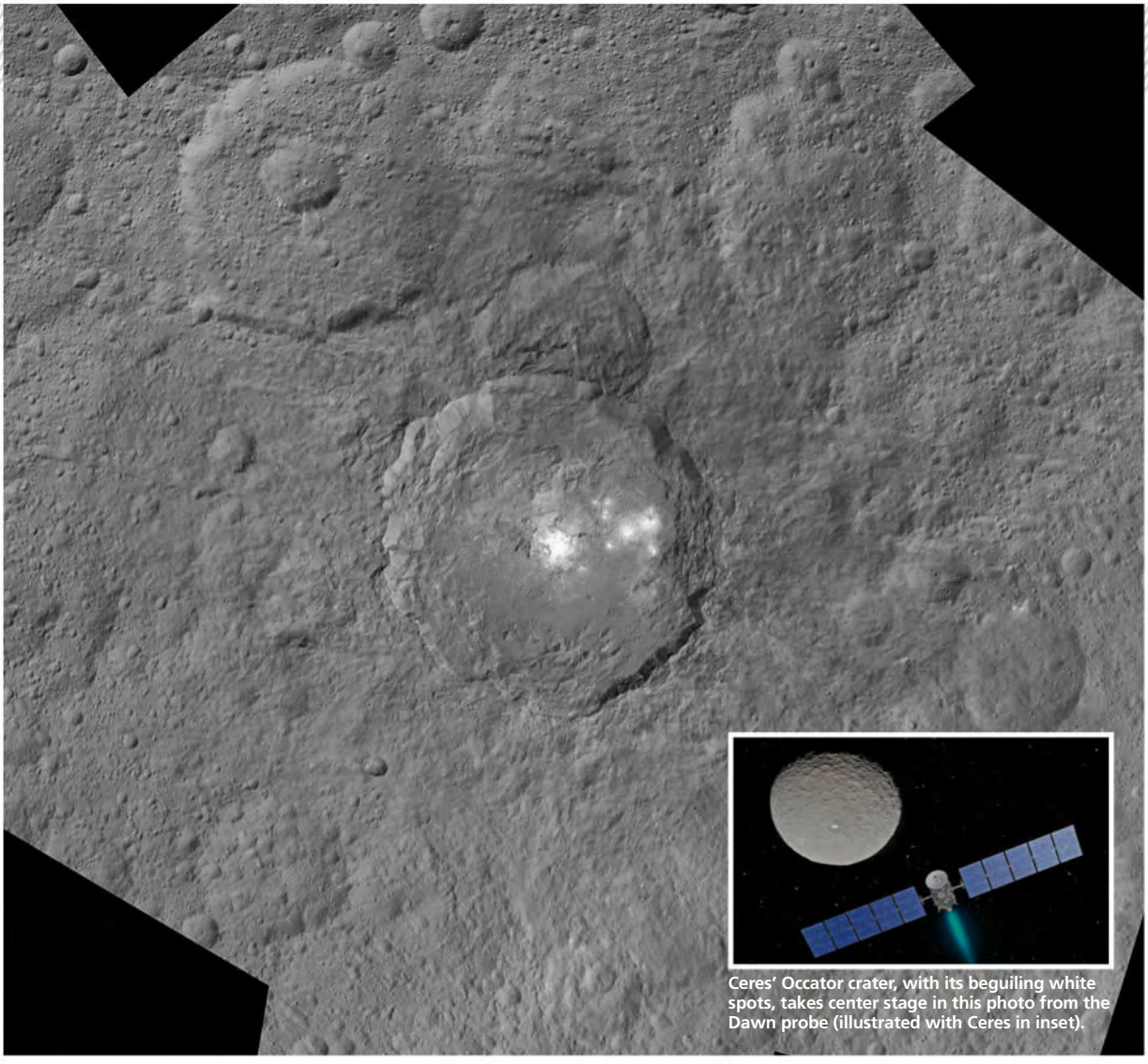


Ceres' Occator crater, with its beguiling white spots, takes center stage in this photo from the Dawn probe (illustrated with Ceres in inset).

When Dawn Met Ceres

Pluto wasn't the only dwarf planet to host a guest this year. In March, four months before New Horizons made it to Pluto, NASA's Dawn probe entered Ceres' orbit, becoming the first to see a dwarf planet up close.

Dawn launched in 2007 and visited asteroid Vesta first, keeping that rock company for 14 months before flitting off to its final destination: Ceres, the largest body in the asteroid belt between Mars and Jupiter. Hovering around Ceres like a nosy paparazzo, Dawn has been snapping photos and maneuvering ever closer since March. It was expected to reach its closest and permanent orbit, 230 miles above the surface, in December.

Ceres is so big, nearly 600 miles across, that astronomers considered it a regular planet for almost 50 years after its 1801 discovery. That size means gravity has pulled Ceres into a sphere, with a core of rock, an icy coating and perhaps an ocean of liquid water locked between. But Ceres remained fuzzy from afar, until Dawn revealed a fascinating world with miles-high mountains and miles-deep craters. Ceres' surface is covered by landslides and plump with ice. The diminutive planet is more dynamic than scientists expected.

"Exploring a new world, even virtually, is a thrill," says Carol Raymond, Dawn's deputy principal investigator. The greatest thrill so far came from a crater named Occator, 2 miles deep. From inside, a cluster of bright spots stares out. Scientists believe they are splotches of salt, magnesium sulfate, perhaps left by saline water that bubbled — or maybe still bubbles — up from the underground ocean and splashes over the terrain.

In fact, the water on our planet likely came from pre-planets much like Ceres. "Bodies like Vesta and Ceres were the building blocks of the solar system, like Legos," says Christopher Russell, Dawn's principal investigator. "Give me a bunch of corner pieces, and I can build something that looks like a house. Give me a bunch of Vestas, and I can make a dry Earth with a rocky core. Add a few Ceres, and I can fill the oceans and lakes and streams." —SARAH SCOLES

NASA/JPL-CALTECH/UCLA/MPS/DLR/IDA. INSET: NASA/JPL-CALTECH/UCLA/MPS/DLR/IDA/VERNIE MASTROIANNI/DISCOVER



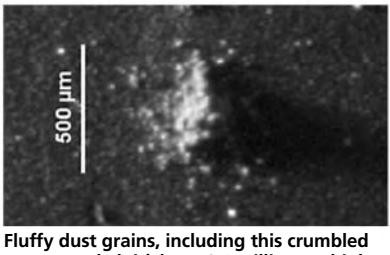

Rosetta Reveals the Heart of a Comet

Rosetta became the first spacecraft to orbit a space iceball when it reached Comet 67P/Churyumov-Gerasimenko in 2014. This year we learned even more about the ancient object and, in turn, the solar system.

"Comets have been stored far from the sun in a deep freeze," says Rosetta principal investigator Alan Stern of the Southwest Research Institute. "They represent samples of the original material out of which planets were formed."

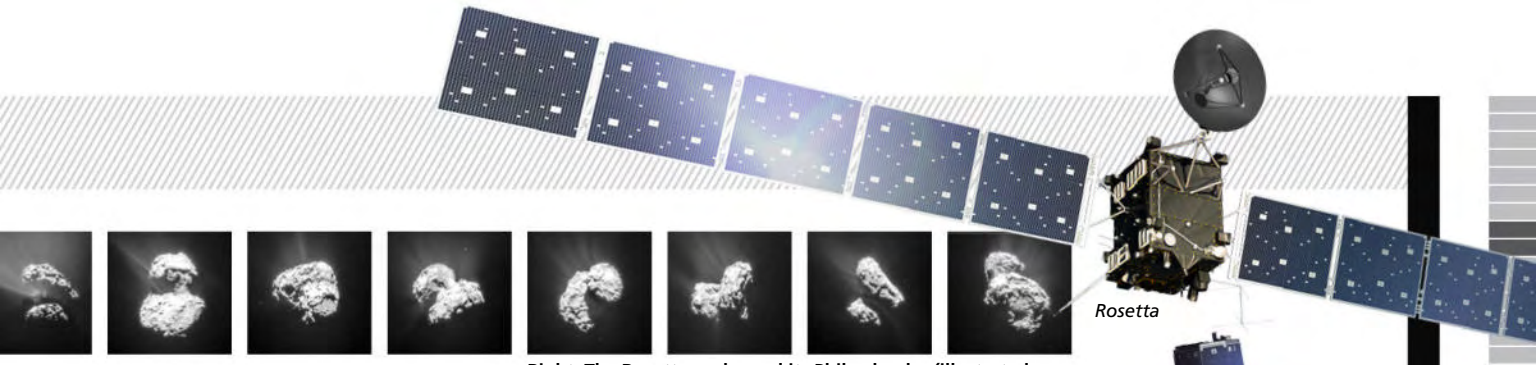
Rosetta's been telling the comet's secrets ever since its May 2014 arrival, starting with its rubber duck-shaped body, 4.1 miles long with a head 1.6 miles wide. Fluffy dust up to 16 feet thick coats the comet's surface and acts like sunscreen, protecting the vulnerable ice from the sun's heat. This has kept 67P together despite its millions of close encounters with the sun, around which it orbits every 6.6 years.

But as it approaches the sun, the comet does release into space some dust and gas, which form its tails.



Fluffy dust grains, including this crumbled one named Eloi (about 0.1 millimeter high and half a millimeter across), likely built up since the comet's last close pass to the sun.

FAR LEFT: STEPHEN VOSS



Right: The Rosetta probe and its Philae lander (illustrated here) have brought us the best views of a comet ever. Above: Comet 67P/Churyumov-Gerasimenko from multiple angles. Below: A close-up of the comet's bifurcated form.

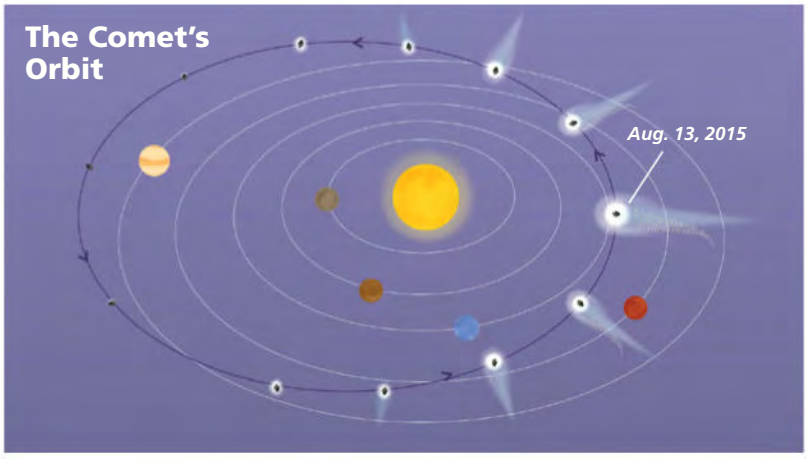
Astronomers were surprised to see molecular oxygen, the kind humans breathe, blasting from the comet. The comet also released about 24 times as much water as oxygen, as well as a great deal of carbon monoxide and carbon dioxide. The liberated dust contains many organic molecules, showing that comets may have seeded our planet with the chemistry that life needs to thrive. The probe further revealed the comet is less than half as dense as water and three-quarters empty space.

Scientists had also long suspected that comets' crashing into Earth had given our planet its water stores, but Rosetta found otherwise. The water on Comet 67P has more neutrons than earthly water, suggesting different origins.

To get a closer look, in November 2014 Rosetta deployed its lander, Philae. Instead of landing smoothly on the surface, the solar-fueled lander bounced and rolled away, coming to rest in the shade where it soon lost power. While scientists did revive Philae in June 2015 and confirmed that all its instruments had a pulse, they couldn't get those instruments to actually do anything. It went silent a week later.

During its brief but productive life, Philae detected 16 organic molecules, confirming the orbiter's findings and showing that the chemicals of life can form and survive in space. The lander also found the comet has no magnetic field, meaning magnetism doesn't affect how the early solar system's building blocks came together, contrary to several models.

Just after Philae's momentary resurrection, 67P roared to life. On July 29, the comet released a huge jet of gas and dust moving at 22 mph. On Aug. 13, the comet reached perihelion — its closest approach to the sun — and released two bathtubs' worth of water every second. Engineers moved Rosetta farther away from the comet to protect it from the deluge and dust.



Comet 67P/Churyumov-Gerasimenko's 6.6-year orbit has taken it around the solar system countless times, but Rosetta joined it for its most recent close pass to the sun in August.

Since its close encounter, 67P has been spewing less and cooling off, getting ready to return to its cosmic freezer, with Rosetta in tow. The probe will continue to watch the show until its mission ends in September 2016, when scientists will likely send it to rest on the comet's surface. — SARAH SCOLES

COMET: ESA/ROSETTA/NAVCAM. SPACECRAFT: ESA/ATG MEDIALAB. COMET DUST: ESA/ROSETTA/MPS FOR COSIMA TEAM. MAP: ESA

Hot Answer to a Solar Mystery

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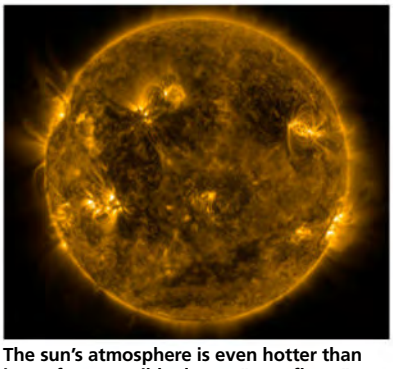
The sun's surface is hot, sure — almost 10,000 degrees Fahrenheit — but the solar atmosphere, or corona, is somehow 4 million degrees. What gives? In April, scientists announced the main reason: small bursts of magnetic energy called nanoflares, which temporarily heat pockets of gas to 20 million degrees.

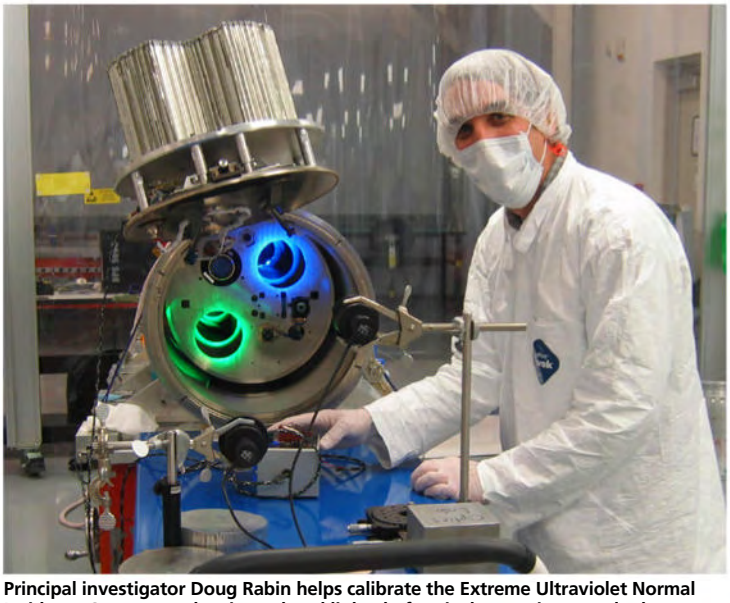


The sun's atmosphere is even hotter than its surface, possibly due to "nanoflares" confirmed by astronomers this year.

"The sun's surface is much like a pot of hot oil on the stove," says NASA solar scientist James Klimchuk. "Hot oil rises, spreads out horizontally, cools and falls back down to the bottom of the pot, only to rise again." That constant movement can twist and tangle the magnetic fields that thread through the sun and extend into the corona. Eventually, like a rubber band, they reach a point where they snap. Scientists had theorized this would cause a nanoflare.

The tiny bursts, each releasing just one-billionth the energy of a normal flare, proved elusive. But in December 2013, during its 15-minute rocket flight, the Extreme Ultraviolet Normal Incidence Spectrograph spied solar material measuring 20 million degrees, matching nanoflare predictions.

"[These observations] confirm that nanoflares exist and heat at least some of the corona," says Klimchuk. Next up is confirming nanoflares' magnetic births and determining how often they occur. —LIZ KRUESI



Principal investigator Doug Rabin helps calibrate the Extreme Ultraviolet Normal Incidence Spectrograph using colored lights before its latest trip to study the sun.

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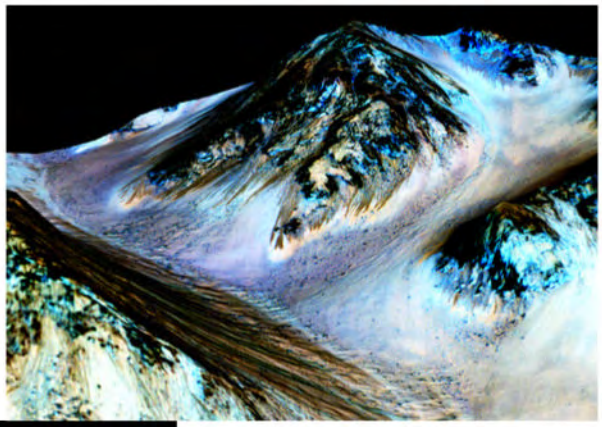
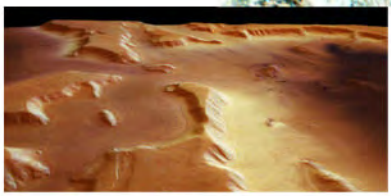
Mars: Wetter Than Ever

Mars was a major disappointment, at first. Although the planet had been long seen as the home of elaborate alien civilizations imagined by the likes of H.G. Wells, NASA's 1965 Mariner 4 probe glimpsed a dry and cratered place unlikely to support life. Each subsequent mission to the Red Planet, however, has found a slightly wetter world. And we now know that saltwater ice lurks just below the surface, occasionally breaking through as liquid water.

In September, NASA announced evidence that when the warm season strikes, the briny substance briefly bursts above Mars' sandy slopes, flowing as liquid for hundreds of feet in narrow streaks. The agency's Mars Reconnaissance Orbiter picked out the chemical fingerprints of hydrated minerals there, the first direct evidence that liquid water can still exist on the surface under certain circumstances, though years of evidence had implied as much.





A false color image (top) shows liquid as dark, narrow streaks (bottom left); glaciers also lurk beneath the planet's dust (above).

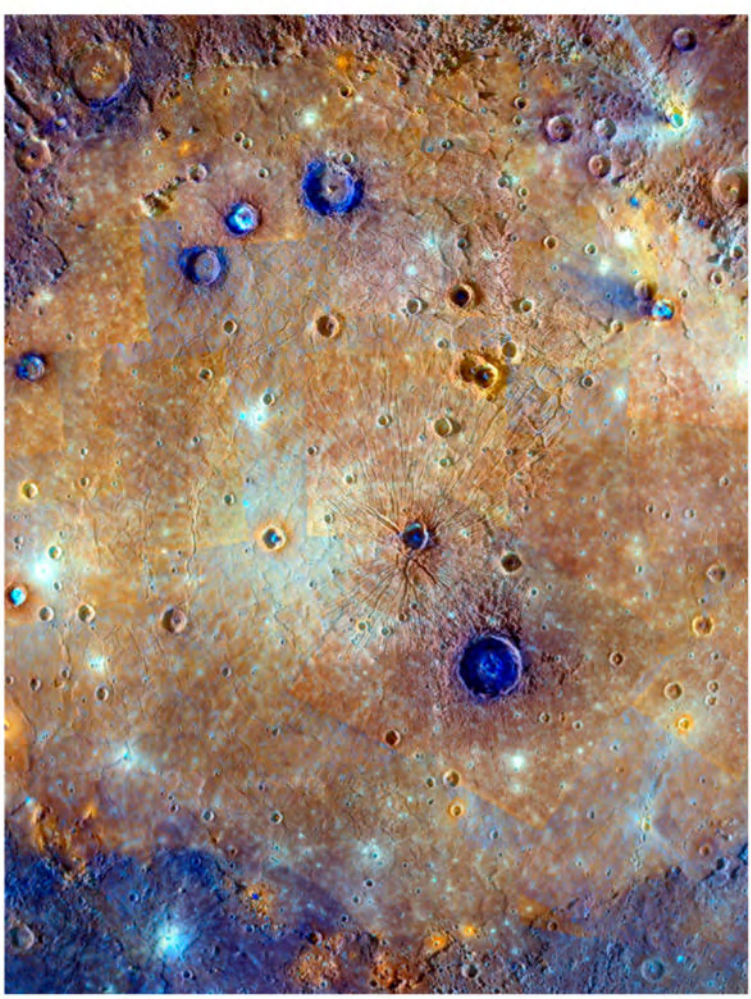
In recent years, MRO has also revealed vast glacial deposits. These belts wrap around the planet's central latitudes in the northern and southern hemispheres, hidden beneath a thick layer of dust that protects them from the sun. In 2015, researchers from the Niels Bohr Institute in Copenhagen, Denmark, modeled these glaciers using MRO radar measurements and showed that, if melted, their water could cover the entire Red Planet in a sea 3 feet deep. Aside from stoking hopes that Mars might nurture microbial communities, the deposits could also provide crucial water supplies for any future human visits.

And MRO wasn't alone in its watery finds in 2015. NASA's eyes on the ground — the Curiosity rover — found clues that liquid brine could also lurk just beneath its wheels at night. The craft's weather instrument recorded temperature and humidity levels that would likely result in saltwater formation, albeit in amounts and temperatures unfavorable to life. —ERIC BETZ

26

A Final Message From Mercury

Mercury was the "dead" planet when NASA's MESSENGER mission launched in 2004. But the spacecraft's 2011 orbital arrival, and more than 250,000 subsequent images, documented an active planet. Running on fumes this year, MESSENGER (short for Mercury Surface, Space Environment, Geochemistry and Ranging) saved the best for last, swooping just miles above the virtually atmosphereless planet. It gathered fresh evidence for frozen water in crater corners, strange rock features called hollows and the evolution of a magnetic field almost 4 billion years old. The craft finally smacked into Mercury at 8,800 mph on April 30. This view of 1,000-mile-wide Caloris basin — among the largest known asteroid impacts in the solar system — shows how lava (orange) filled the blast site before new craters excavated the original basin (purple). — ERIC BETZ



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Saturn's Watery Moon

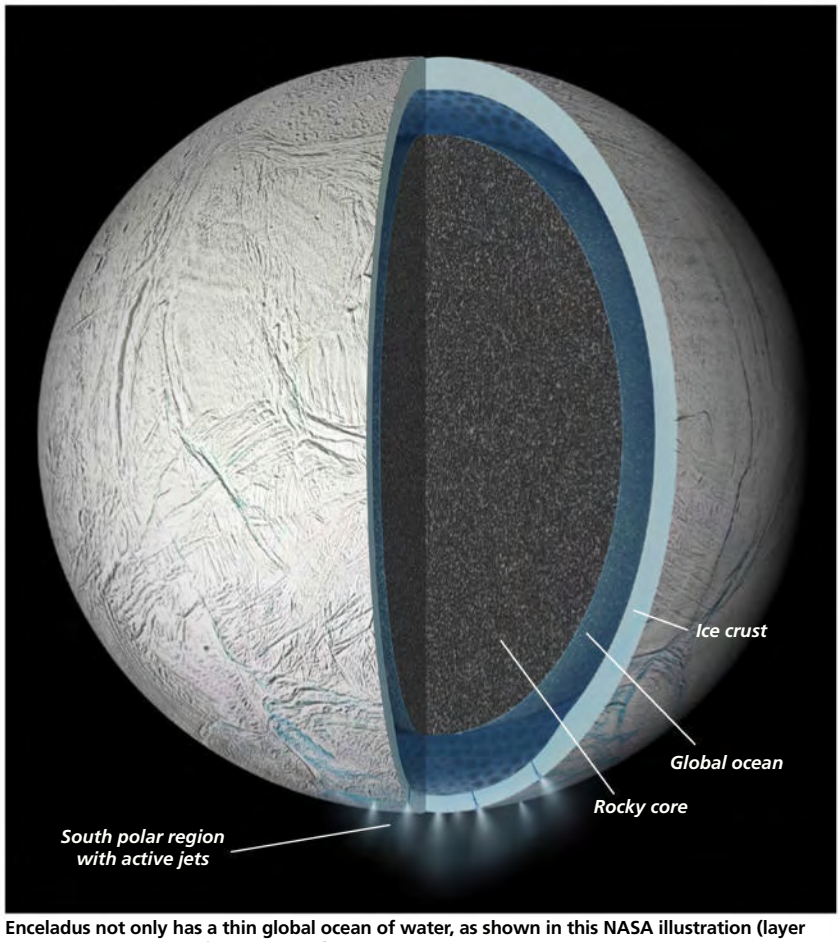
Saturn's moon Enceladus made waves in 2015 with two dramatic liquid-water-related discoveries, establishing the world as a target of great interest in the search for life.

After astronomers analyzed seven years' worth of Enceladus data from NASA's Cassini probe, they detected a slight rocking motion in the moon's rotation, suggesting an outer shell of ice.

"That could only be the case if the ice shell was not frozen to the core but separated by a layer of liquid," says team member Carolyn Porco. The team believes a shallow global ocean, perhaps only a mile deep, lies between Enceladus' rocky core and its 30-mile-thick icy crust. At the south polar region, where about 100 saltwater geysers erupt from the surface, the ocean is likely deeper and the crust thinner.

This news came on the heels of an earlier discovery, when a team of planetary scientists announced the likely presence of hydrothermal vents on the Saturnian satellite. They studied nanometer-size silicate particles in one of Saturn's rings that had originated deep in Enceladus' south pole. The analysis suggested the size and composition of the particles meant they must have been dissolved from wet rocks at least 90 degrees Celsius, suggesting hydrothermal activity — warm water.

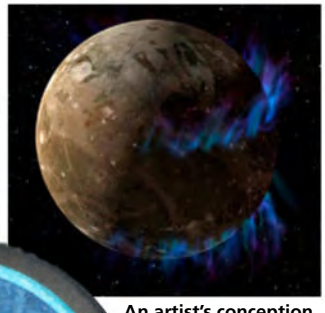
Enceladus was already a prime spot to look for life, and these new detections only make it a more enticing destination. — LIZ KRUESI



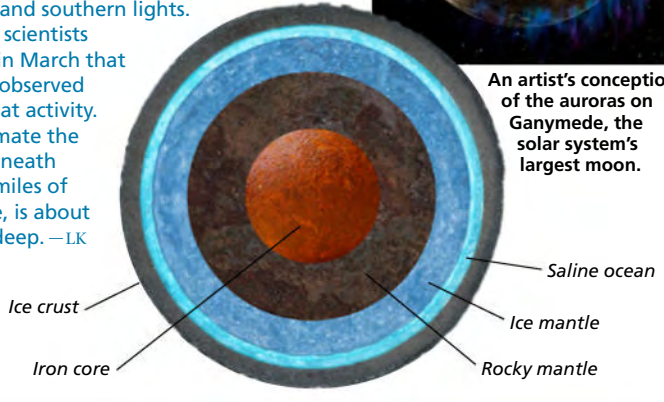
Enceladus not only has a thin global ocean of water, as shown in this NASA illustration (layer thickness is not to scale), but some of the water is likely heated via hydrothermal vents.

Another Global Ocean

Another 2015 finding confirms that Jupiter's moon Ganymede hides its own salty global ocean below a frozen rock crust, as was long suspected. Such a world-spanning saltwater ocean would be electrically conductive, producing telltale activity in Ganymede's auroras, the equivalent of our northern and southern lights. Planetary scientists revealed in March that they had observed exactly that activity. They estimate the ocean, beneath some 95 miles of mostly ice, is about 60 miles deep. — LK



An artist's conception of the auroras on Ganymede, the solar system's largest moon.



FROM TOP: NASA/JPL-CALTECH; NASA/ESA/G. BACON (STSCI); NASA/ESA/A. FEILD (STSCI)

Scientists think the body that smashed into a nascent Earth, and eventually became the moon, was likely made of the same materials as our planet.

The Moon's Violent Birth

The origin of Earth's abnormally large moon is a long-standing mystery in astronomy. Most scientists believe our satellite formed from the remains of a small world called Theia after it smacked into Earth 4.5 billion years ago. Models show that chunks of the Mars-size interloper spun off and coalesced into the moon. So astronomers were puzzled when lunar samples returned by Apollo astronauts showed striking similarities to Earth rocks instead.

A moon rock recovered during the Apollo 16 mission puzzled researchers initially because its composition of a rare metal is identical to Earth's.

In April, astrophysicists announced they'd found a possible reason: Theia was Earth's twin. In a *Nature* study, scientists modeled the solar system's birth and watched virtual worlds collide like wrecking balls. They found that Theia likely formed close to Earth and collected the same cosmic debris as it grew. It makes sense, then, that the moon, as a spinoff of Earth-like Theia, is made from the same stuff as our planet.

But that doesn't tell the whole story, according to a University of Maryland study published the same month. Exploring why Earth and its moon both contain the same isotopes of the rare metal tungsten — something that couldn't be explained by the Theia collision theory — the researchers' model showed that after the moon formed, other nearby collisions blasted tungsten-containing debris onto both Earth and the newborn moon. — ERIC BETZ

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Galactic Gains

The starry disk that is our galaxy may extend at least 50 percent farther from its apparent edge than we thought. Instead of being flat, the Milky Way appears grooved like a vinyl record, upping its width to at least 150,000 light-years, researchers now say.

In 2002 and 2004, astronomers found two rings of stars, Monoceros and Triangulum Andromeda, beyond the disk's known edge. But this new study, published in *The Astrophysical Journal* in March, suggests that what looked like the disk's edge is just a deep groove, and the two apparent stellar rings are actually part of the disk.

Study co-author Heidi Jo Newberg of Rensselaer Polytechnic Institute in Troy, N.Y., and colleagues believe the grooves might be caused by one or more small galaxies, or galaxy-size nuggets of dark matter, being gravitationally dunked into the Milky Way, like stones thrown into water. — MAGGIE MCKEE

Two rings of stars once thought outside our galaxy might actually be part of it and would extend the disk 50 percent farther from its edge.

TOP: RALPH PACE. BOTTOM: DANA BERRY/RENSSELAER POLYTECHNIC INSTITUTE

Blame It on the Iron Rain

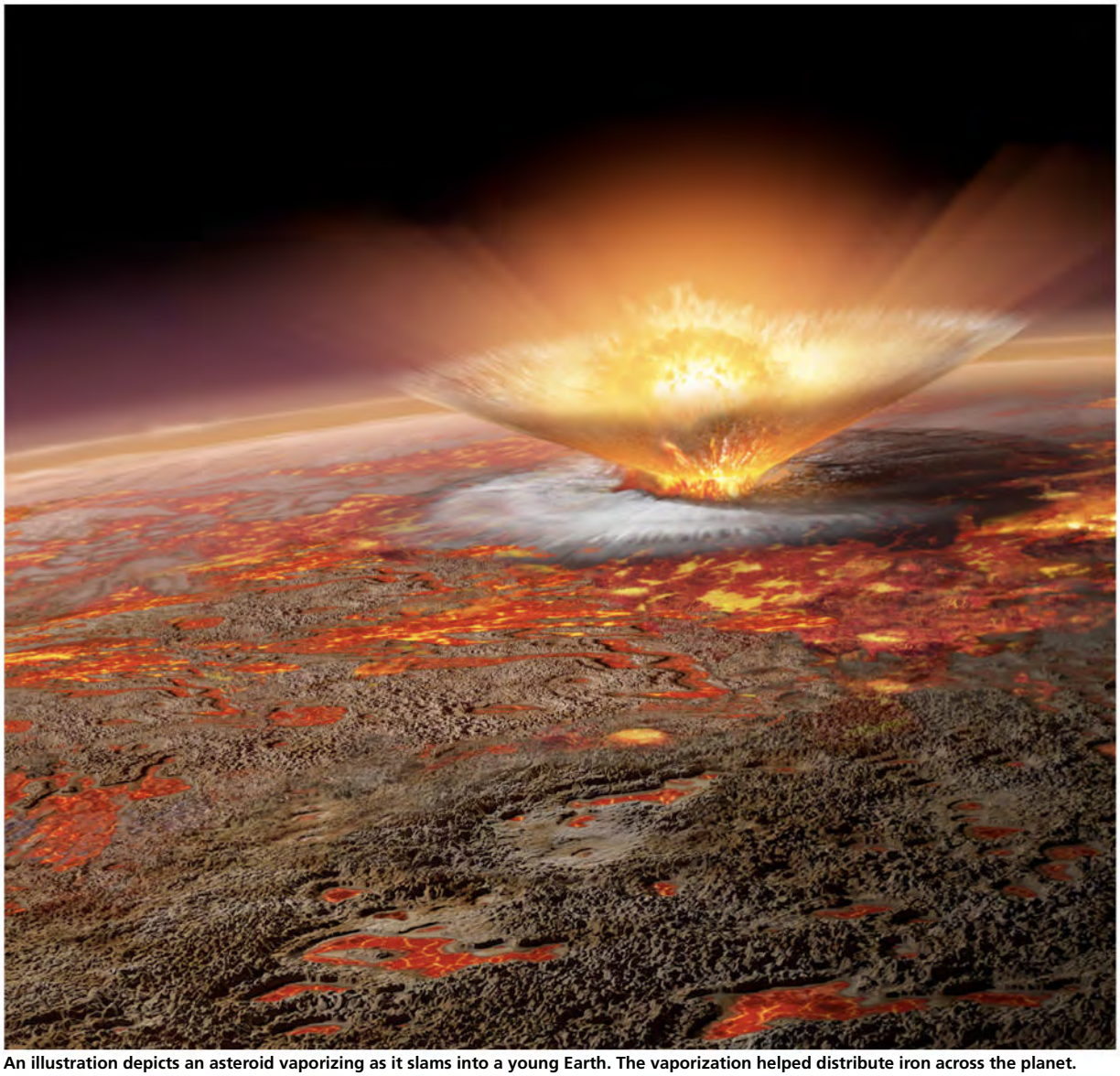
62

Early Earth was a violent place. City-size planetesimals — rocky microworlds that clumped together in the solar nebula — smashed into our planet's surface at incredible velocities and seeped down to Earth's iron core, depositing yet more iron. But now it appears that iron is instead spattered throughout our world's mantle.

To figure out how this happened, Harvard University planetary scientists paired with researchers working at Sandia National Laboratories' Z machine and shot metal projectiles into tiny iron squares at up to 55,000 mph.

Through these impacts, researchers discovered that iron vaporizes much easier than scientists had assumed. Instead of sinking into the core, iron-rich planetesimals vaporized on impact and spread out across the planet. This iron rain explains the element's distribution.

"We did not expect to find that at all. We were very surprised based on the fact that previous models people used for planet formation suggested a much higher critical shock pressure," says Richard Kraus, now a scientist at Lawrence Livermore National Laboratory and lead author on the paper published in March in *Nature Geoscience*. — ERIC BETZ



DON DIXON/COSMOGRAPHICA.COM

An illustration depicts an asteroid vaporizing as it slams into a young Earth. The vaporization helped distribute iron across the planet.

64

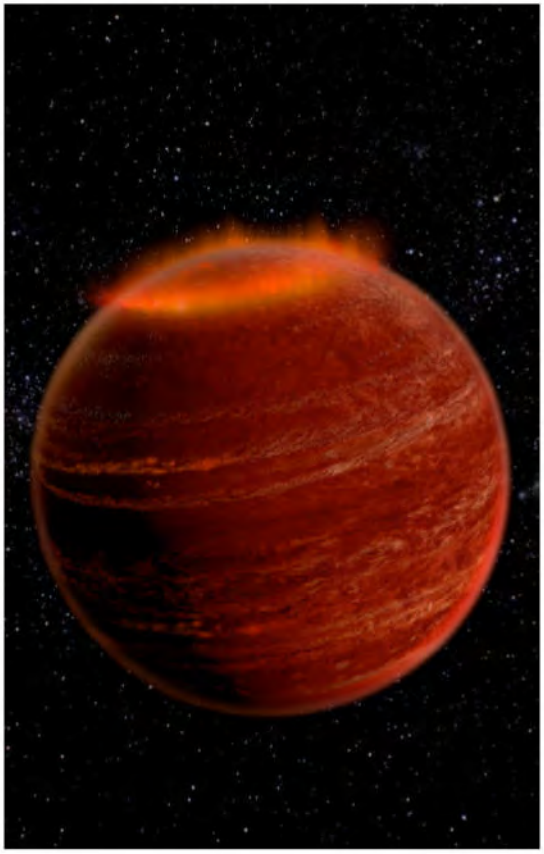
Alien Aurora

For the first time, astronomers have spotted an aurora, akin to our northern and southern lights, shimmering on a world outside our solar system. The find may bolster the search for extraterrestrial life, since the magnetic fields that drive auroras likely keep planets habitable.

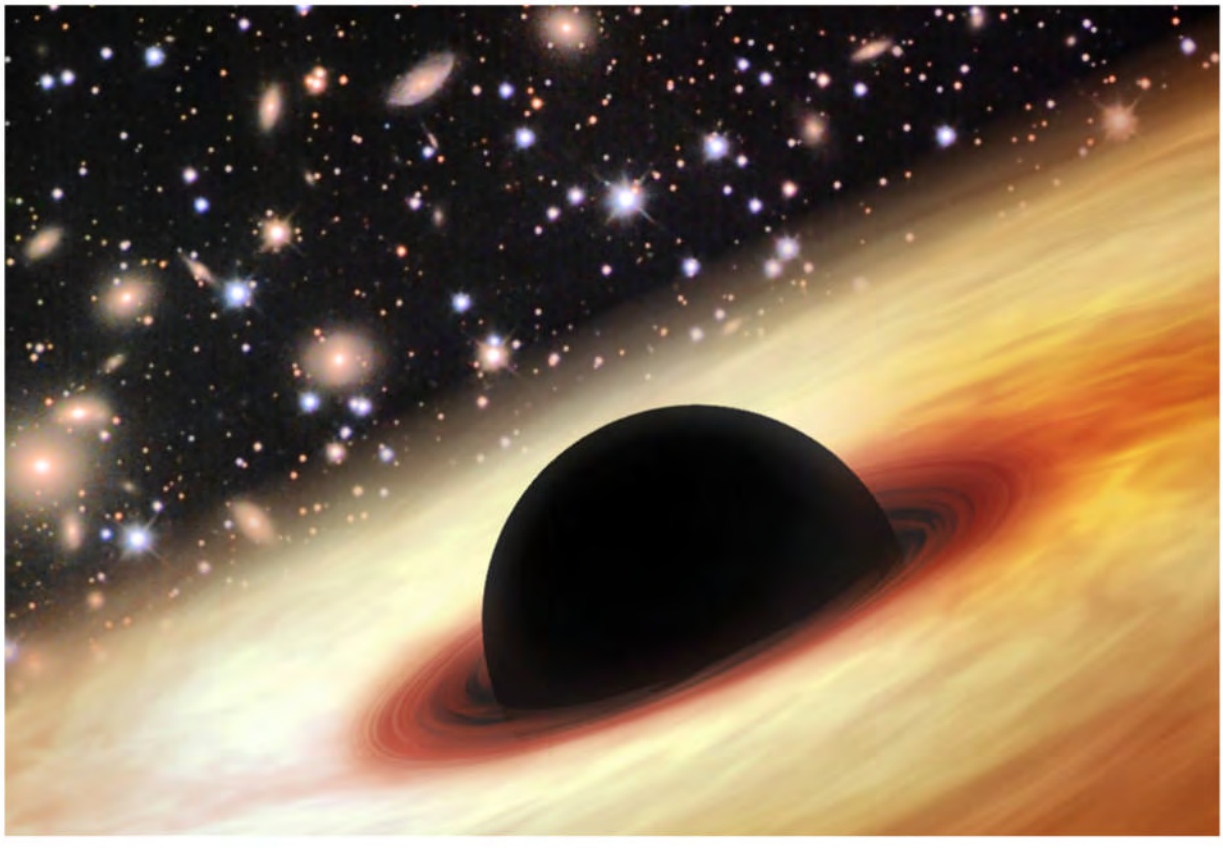
Every planet in our solar system (and even some moons) with a moderate magnetic field boasts these celestial light shows. They occur when charged space particles, typically from the sun, stream along a planet's magnetic field lines and interact with atmospheric atoms, producing not only optical light but also radio emissions.

Gregg Hallinan of the California Institute of Technology and colleagues have detected both types of radiation from what appears to be a brown dwarf, an object that straddles the boundary between planet and star. The world's aurora, reported in *Nature* in July as about a million times brighter than Earth's, suggests that brown dwarfs have magnetic activity more like planets than stars. Hallinan hopes more observations shed light on the origins of the charged particles that power the aurora, which are currently unknown.

The brown dwarf in question, called LSR J1835+3259, lies 18 light-years away, suggesting astronomers may soon glimpse auroras on similarly distant planets, too. That could help narrow the search for habitable planets, since the auroras reveal the strength of their planets' magnetic fields, which can shield against harmful stellar radiation and help retain life-friendly conditions. —MAGGIE MCKEE



FROM TOP: SINGH LAB/CORNELL UNIVERSITY (3); CHUCK CARTER AND GREGG HALLINAN, CALTECH



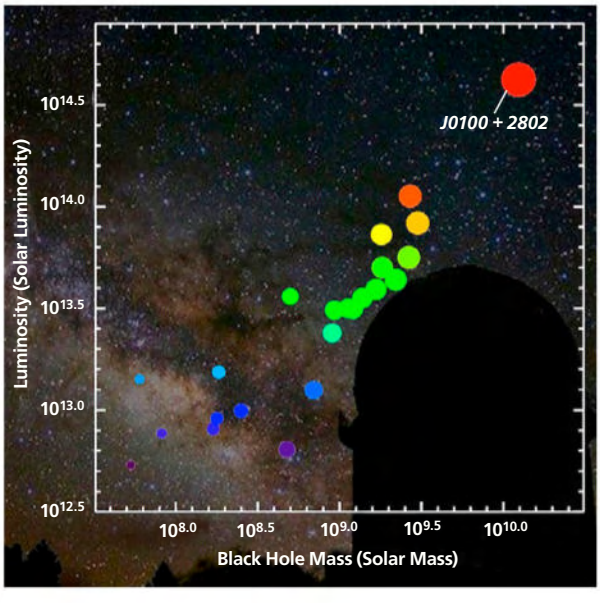
Ferocious Black Hole Found

Sometimes black holes just don't follow the rules. Astronomers announced in February that they found a black hole much bigger than it has any right to be — 12 billion times our sun's mass, a shocking weight considering its age. The finding challenges theories of how black holes form.

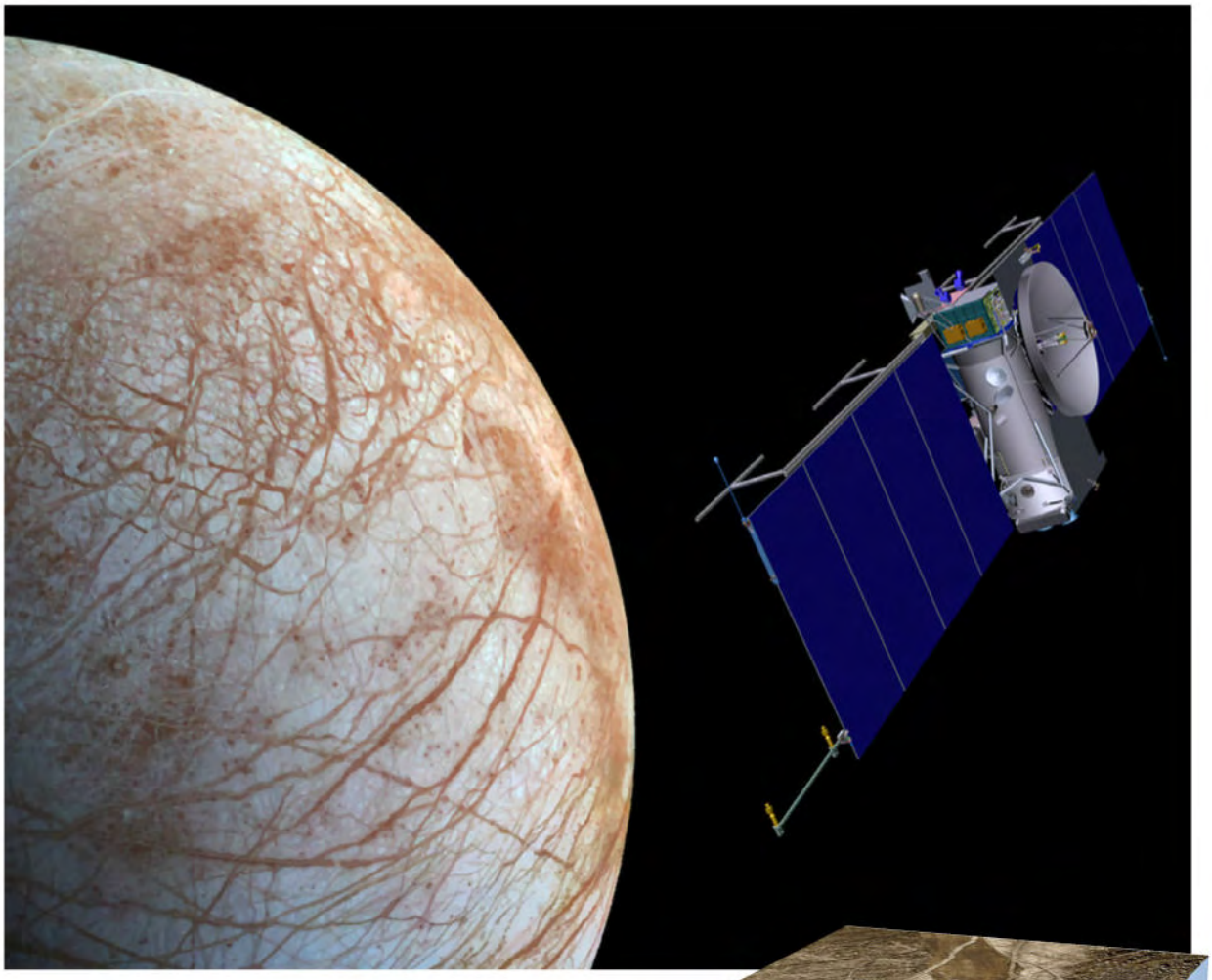
When Xue-Bing Wu of Beijing's Peking University and colleagues wanted to find the universe's oldest black holes, they looked for bright old galaxies, since most large galaxies have a central supermassive black hole. When a black hole pulls in nearby stars and gas clumps, the material circles the dark object, like water around a drain. Friction in this disk heats the material, which then glows.

Wu's team searched archived images of the sky for bright light sources, and after finding a promising one, called J0100+2802, they focused on it with five telescopes. Once Wu's team confirmed that the black hole was indeed ancient — formed just 900 million years after the birth of the universe — they discovered its outsized weight by analyzing its light.

This supersized black hole is about 10 times heavier and brighter than others discovered from the same time period, says Wu, suggesting it grew extremely rapidly. Theorists are now trying to figure out how. — LIZ KRUESI



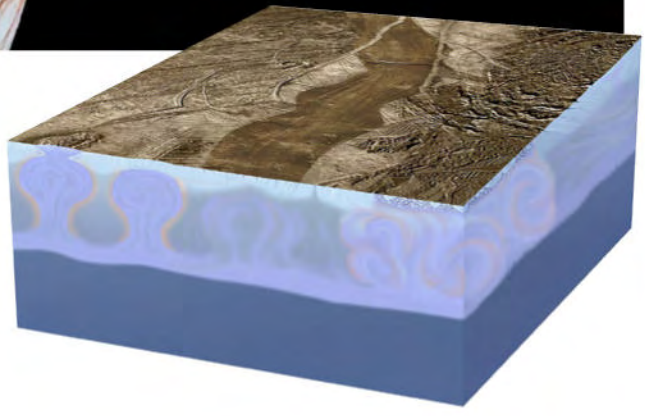
TOP: ZHAOYU LI/NASA/JPL-CALTECH/MISTI MOUNTAIN OBSERVATORY. BOTTOM: ZHAOYU LI/YUNNAN OBSERVATORY



NASA Hunts for Life on Europa

Life on Earth likely emerged in the deep ocean, where simple organisms fed off toxic gas from volcanic vents. Earth's oldest ecosystems have inspired NASA to send a probe to search for signs of life in even harsher climes: Jupiter's ocean moon Europa. After NASA selected the mission's instruments in May, it officially moved the probe into development in June, setting the stage for a possible 2022 launch.

Scientists have long suspected a process similar to that around Earth's volcanic vents takes place beneath Europa's fragile icy shell, making the moon one of the most promising locations to find extraterrestrial life.



A NASA probe may study Jupiter's moon Europa for signs of life within a decade (top). A cross section of the moon's surface (above) shows its layer of icy crust above a liquid water ocean.

Depending on the probe's final configuration and launch date, it could reach Europa as early as 2026. With 45 close approaches — including some just 15 miles from Europa's surface — the probe will finally provide some answers, studying the moon's interior and taking pictures as good as the best close-ups of Mars from orbit. —ERIC BETZ

NASA/JPL-CALTECH (2)

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NASA Tech Finds Buried Survivors

The April 25 earthquake in Nepal claimed more than 8,000 lives, but four men trapped under debris survived, thanks to the first field use of some NASA technology.

At the time of the quake, NASA happened to be working on a briefcase-size prototype of FINDER, a device that can detect a beating heart thumping beneath 30 feet of rubble. (FINDER stands for "Finding Individuals for Disaster and Emergency Response.") NASA sent two prototypes to Nepal to assist rescue workers scrambling to find people trapped beneath collapsed buildings.

FINDER sends out a microwave signal (which penetrates rubble), and software loaded onto a laptop pinpoints anomalies in the returning signal produced by tiny movements, such as the motion of a beating heart or a victim's breathing. The system filters out extraneous noise, identifies uniquely human movements and reveals a victim's location — the latest version to within 5 feet.

NASA uses the same microwave technology in satellites to measure, for example, sinking land due to changes in aquifer levels, or the motion of other planets' satellites. Jim Lux, FINDER project manager, says the device could also monitor patients' vital signs in trauma centers or ambulances — where every second counts — without needing to connect cumbersome electrodes. — CARL ENGELKING

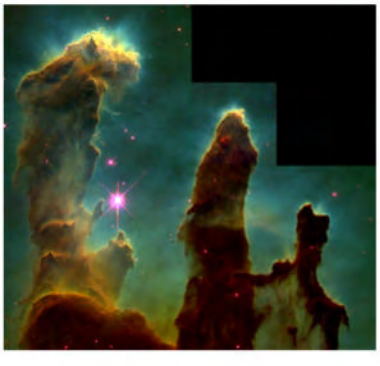
Jim Lux (above) demonstrates the final prototype for FINDER, which was deployed to the field for the first time to help find survivors of the Nepal earthquake in April (top).

TOP: DAVID LEWIS, R4 INC. VIA NASA. BOTTOM: AUBREY GEMIGNANI/NASA

Hubble Revisits an Iconic Stellar Nursery

To celebrate Hubble's 25th anniversary, scientists captured a new look at a star-forming region seen in one of the space telescope's most iconic images. Using its latest camera, Hubble shows a wider and sharper view of the Eagle Nebula's "Pillars of Creation," immense columns of cold gas bathed in the ultraviolet light of nearby massive young stars. Such an environment likely reflects the same kind of setting in which our sun formed 4.5 billion years ago. —KARRI FERRON

The "Pillars of Creation" have changed subtly since the original photo (below).



TOP: NASA, ESA AND THE HUBBLE HERITAGE TEAM (STSCI/AURA). BOTTOM: NASA, ESA, STSCI AND J. HESTER AND P. SCOWEN (ARIZONA STATE UNIVERSITY)

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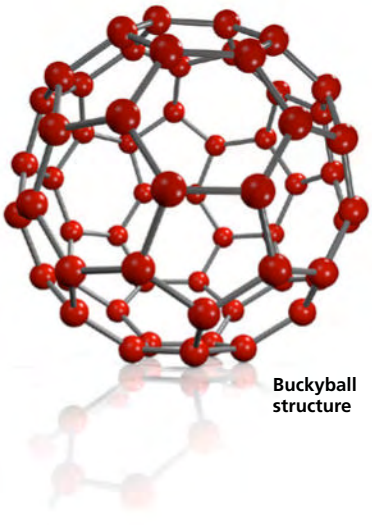
Organic Molecule Solves Space Mystery

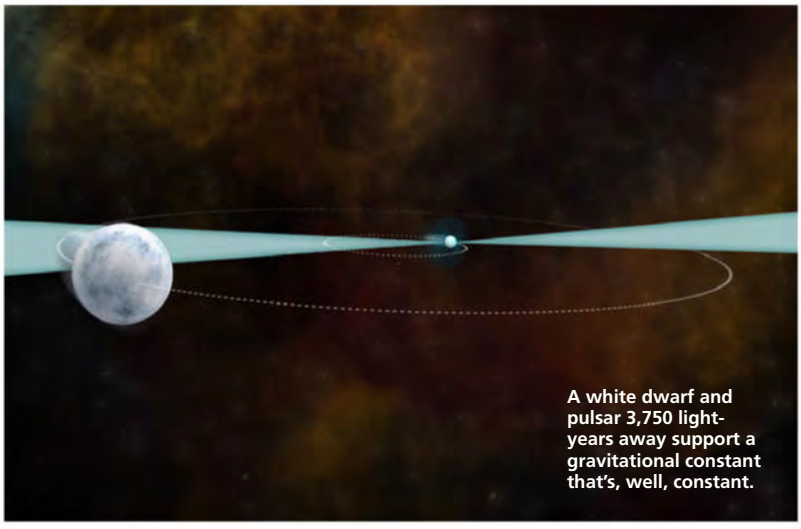
Buckyballs, carbon compounds shaped like soccer balls, can survive between stars and absorb their light, astronomers announced, helping solve a nearly century-old mystery.

In 1919, Mary Lea Heger, a graduate student at the University of California, Berkeley, saw that certain stars were missing some colors. Something between the star and Earth must be absorbing them, but what? In 1993, a team led by John Maier of the University of Basel in Switzerland found that buckyballs encased in a frozen solid absorbed the right colors. But did they behave the same way in interstellar space?

In July, Maier and his team proved it. They chilled buckyballs to nearly absolute zero and put them in a vacuum, mimicking the conditions of the cosmos. The balls absorbed the same colors missing in space. Mystery solved. —SARAH SCOLES



Buckyball structure



A white dwarf and pulsar 3,750 light-years away support a gravitational constant that's, well, constant.

86

Testing Gravity's Reach

While your own weight may fluctuate, the fundamental constant of gravity, which keeps your feet on the ground and the Earth going around the sun, is the same everywhere at all times. Or so Einstein's theory of gravitation claims, at least. Alternative theories have speculated that this constant might in fact vary as the universe expands, or near objects of drastically different densities, fundamentally changing our understanding of how the cosmos operates.

Astronomers tested for changes in the gravitational constant using 21 years of data from a pulsar (the ultradense remnant core of a dead star that spins like a crazed lighthouse, sending astronomers bursts of light a thousand times per second). PSR J1713+0747, as it is known, has a tiny white dwarf companion star, and the two orbit each other exceptionally predictably. By accounting for every factor that perturbed their dance over 21 years, astronomers ruled out any change in the underlying gravitational constant.

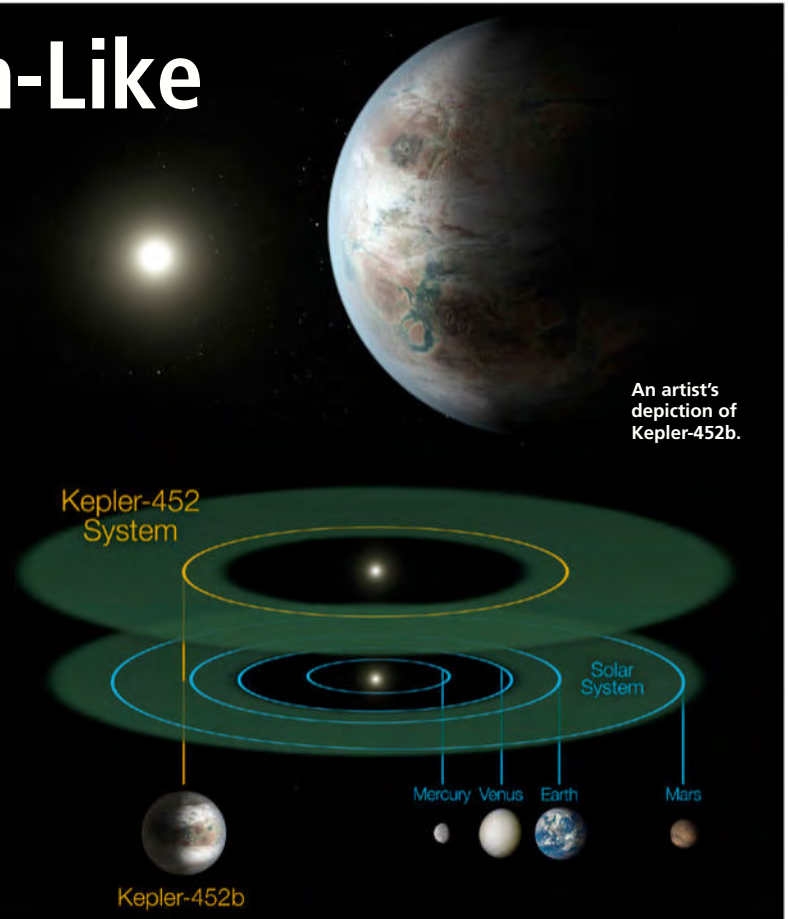
The Arecibo Observatory (above) and Green Bank Telescope helped astronomers study gravity's strength in the universe.

Astronomers have used laser ranging studies, bouncing light beams between Earth and the moon, to prove gravity's constancy locally for decades. And if gravity is changing, a dramatic and faraway pulsar system should show the effects most clearly. Combined with the local lunar data, the new research, published in August, is the best proof yet that gravity is truly constant no matter where in the universe scientists look. —KOREY HAYNES

FROM TOP: B. SAXTON (NRAO/AUI/NSF); COURTESY OF THE NAIC-ARECIBO OBSERVATORY, A FACILITY OF THE NSF; MAGGIO07/ISTOCK

New Earth-Like Exoplanet

Good news for exoplanet enthusiasts: For the first time, astronomers have found an Earth-like planet within a sunlike star's habitable zone. The new world — named Kepler-452b after the orbiting telescope that found it — has a diameter just 1.6 times Earth's, and it takes 385 days to orbit its star, Kepler-452. The planet's orbital distance is just 5 percent farther away than Earth's, putting it safely within its star's habitable zone (green in this diagram). That means liquid water — and thus potentially life — can occur there. Unfortunately, at 1,400 light-years away from Earth, Kepler-452b is too distant for scientists to learn much more about the planet's habitability. — BILL ANDREWS



An artist's depiction of Kepler-452b.

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This Is the End

Using the most comprehensive set of telescope observations ever assembled, astronomers found that the universe is dying.

By studying such a large data set — over 200,000 galaxies in 21 different wavelengths, or colors of light, from ultraviolet to infrared — astronomers compared the energy emissions from galaxies across a wide swath of space and time to read the history of the universe.

In August, the international team revealed that the universe is winding down, with the galaxy population producing twice as much energy 2 billion years ago compared with today. Interstellar dust is also piling up, working to dim the universe's starlight. This falls in line with many predictions that the energy of the cosmos will slowly fade to heat within many billions of years, then cold, empty darkness. Don't worry, though: Our sun will burn out long before the rest of the universe. — KOREY HAYNES

NASA/ESA/HUBBLE FRONTIER FIELD TEAM (STSCI)/L. SCHMIDT

The universe's galaxies are only producing half the energy they used to, suggesting an eventual untimely end for the cosmos.

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