Space News Update

— May 11, 2018 —

Contents

In the News

Departments

1. A Giant 'Singing' Cloud in Space Will Help Us to Understand How Star Systems Form

We know that the birthplaces of stars are large molecular clouds of gas and dust found in space.

But what exactly determines the number and kind of stars and planets that are formed in these clouds? How was our Solar system nursed and how did it emerge from such a cloud billions of year ago?

These are mysteries that have been puzzling astronomers for decades, but research published today in Science adds an extra dimension to our understanding.

A 3-D approach

Knowledge of the 3-dimensional structure of these clouds would be an important leap in our understanding of how stars and planets are born.

The physics responsible for the formation of stars is also responsible for shaping the clouds. But even with the most advanced telescopes in the world we can only see the two-dimensional projections of clouds on the plane of the sky.

Thankfully, there is a way around this problem. A recently discovered type of structure in molecular clouds, called striations, was found to form because of waves.

Here enters Musca, a molecular cloud that "sings". Musca is an isolated cloud in the Southern sky, below the Southern Cross, that looks like a thin needle (see top image). It is hundreds of light years away and stretches about 27 light years across, with a depth of about 20 light years and width up to a fraction of a light year.

Musca is surrounded by ordered hair-like striations produced by trapped waves of gas and dust caused by the global vibrations of the cloud.

Trapped waves act like a fingerprint – they are unique and can be used to identify the sizes of the boundaries that trapped them. Boundaries are naturally created at the edges of clouds where their physical properties change abruptly.

Just like a cello and a violin make very distinct sounds, clouds with different sizes and structures will vibrate in very different manners – they will "sing" different "songs".

A 'song' in the cloud

By using this concept and calculating the frequencies seen in observations of Musca it was possible to measure for the first time the third dimension of the cloud, the one that extends along our line of sight.

The frequencies found in the observations were scaled to the frequency range of human hearing to produce the "song of Musca".

The results from this method were amazing. Despite the fact that Musca looks like a thin cylinder from Earth, the true size of its hidden dimension is not small at all. In fact, it is comparable to its largest visible dimension on the plane of the sky.

No longer a thin cylinder when the extra dimension is revealed (Aris Tritsis)

Musca is not actively forming stars. It will be millions of years before gravity can overcome all opposing forces that support the cloud.

As a result, with its structure now determined, Musca can be used as a prototype laboratory against which we can compare our models and study the early stages of star formation.

We can use Musca to better constraint our numerical models and learn about our own Solar system. It could help solve many mysteries. For example, could the ices found in comets have formed in clouds rather than at a later time during the life of our solar system?

Explore further: Star-forming filaments

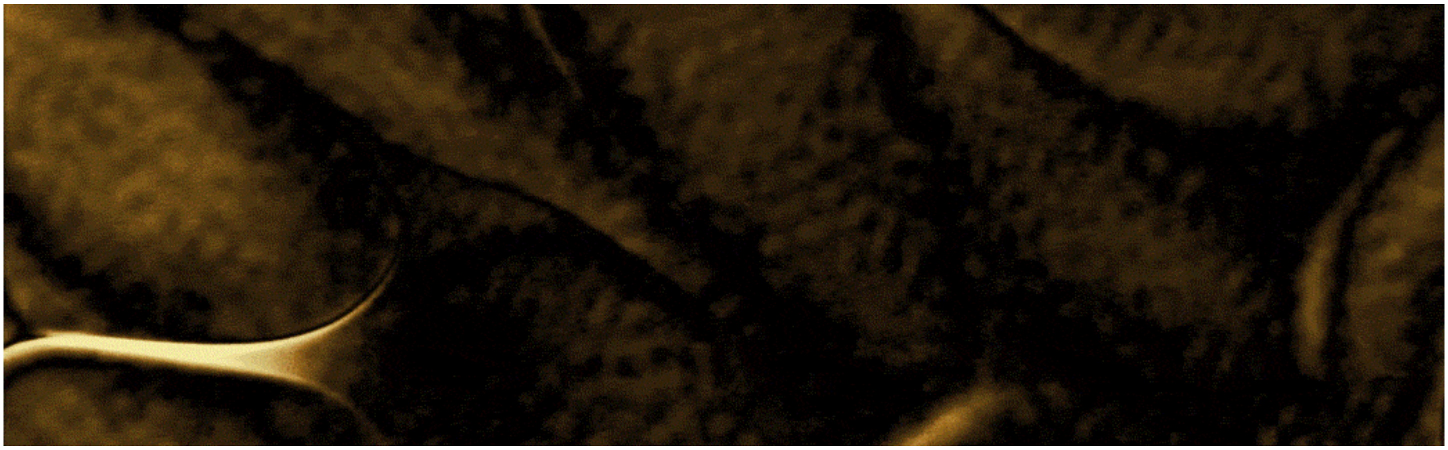
More information: Aris Tritsis et al. Magnetic seismology of interstellar gas clouds: Unveiling a hidden dimension, *Science* (2018). DOI: 10.1126/science.aao1185

Journal reference: Science

Source: Phys.org

Return to Contents

2. NASA Spacecraft Discovers New Magnetic Process in Turbulent Space



Though close to home, the space immediately around Earth is full of hidden secrets and invisible processes. In a new discovery reported in the journal Nature, scientists working with NASA's Magnetospheric Multiscale spacecraft — MMS — have uncovered a new type of magnetic event in our near-Earth environment by using an innovative technique to squeeze extra information out of the data.

Magnetic reconnection is one of the most important processes in the space — filled with charged particles known as plasma — around Earth. This fundamental process dissipates magnetic energy and propels charged particles, both of which contribute to a dynamic space weather system that scientists want to better understand, and even someday predict, as we do terrestrial weather. Reconnection occurs when crossed magnetic field lines snap, explosively flinging away nearby particles at high speeds. The new discovery found reconnection where it has never been seen before — in turbulent plasma.

"In the plasma universe, there are two important phenomena: magnetic reconnection and turbulence," said Tai Phan, a senior fellow at the University of California, Berkeley, and lead author on the paper. "This discovery bridges these two processes."

Magnetic reconnection has been observed innumerable times in the magnetosphere — the magnetic environment around Earth — but usually under calm conditions. The new event occurred in a region called the magnetosheath, just outside the outer boundary of the magnetosphere, where the solar wind is extremely turbulent. Previously, scientists didn't know if reconnection even could occur there, as the plasma is highly chaotic in that region. MMS found it does, but on scales much smaller than previous spacecraft could probe.

MMS uses four identical spacecraft flying in a pyramid formation to study magnetic reconnection around Earth in three dimensions. Because the spacecraft fly incredibly close together — at an average separation of just four-and-a-half miles, they hold the record for closest separation of any multi-spacecraft formation — they are able to observe phenomena no one has seen before. Furthermore, MMS's instruments are designed to capture data at speeds a hundred times faster than previous missions.

Even though the instruments aboard MMS are incredibly fast, they are still too slow to capture turbulent reconnection in action, which requires observing narrow layers of fast moving particles hurled by the recoiling field lines. Compared to standard reconnection, in which broad jets of ions stream out from the site of reconnection, turbulent reconnection ejects narrow jets of electrons only a couple miles wide.

“The smoking gun evidence is to measure oppositely directed electron jets at the same time, and the four MMS spacecraft were lucky to corner the reconnection site and detect both jets”, said Jonathan Eastwood, a lecturer at Imperial College, London, and a co-author of the paper.

Crucially, MMS scientists were able to leverage the design of one instrument, the Fast Plasma Investigation, to create a technique to interpolate the data — essentially allowing them to read between the lines and gather extra data points — in order to resolve the jets.

“The key event of the paper happens in only 45 milliseconds. This would be one data point with the basic data,” said Amy Rager, a graduate student at NASA’s Goddard Space Flight Center in Greenbelt, Maryland, and the scientist who developed the technique. “But instead we can get six to seven data points in that region with this method, allowing us to understand what is happening.”

With the new method, the MMS scientists are hopeful they can comb back through existing datasets to find more of these events, and potentially other unexpected discoveries as well.

Magnetic reconnection occurs throughout the universe, so that when we learn about it around our planet — where it’s easiest for Earthlings to examine it — we can apply that information to other processes farther away. The finding of reconnection in turbulence has implications, for example, for studies on the Sun. It may help scientists understand the role magnetic reconnection plays in heating the inexplicably hot solar corona — the Sun’s outer atmosphere — and accelerating the supersonic solar wind. NASA’s upcoming Parker Solar Probe mission launches directly to the Sun in the summer of 2018 to investigate exactly those questions — and that research is all the better armed the more we understand about magnetic reconnection near home.

Related Links

- Learn more about the Magnetospheric Multiscale Mission
- Learn more about NASA’s research on the Sun-Earth environment

Source: NASA

Return to Contents

3. Jupiter and Venus Change Earth's Orbit Every 405,000 Years

It is a well-known fact among Earth scientists that our planet periodically undergoes major changes in its climate. Over the course of the past 200 million years, our planet has experienced four major geological periods (the Triassic, Jurassic and Cretaceous and Cenozoic) and one major ice age (the Pliocene-Quaternary glaciation), all of which had a drastic impact on plant and animal life, as well as effecting the course of species evolution.

For decades, geologists have also understood that these changes are due in part to gradual shifts in the Earth's orbit, which are caused by Venus and Jupiter, and repeat regularly every 405,000 years. But it was not until recently that a team of geologists and Earth scientists unearthed the first evidence of these changes – sediments and rock core samples that provide a geological record of how and when these changes took place.

The study which describes their findings, titled "Empirical evidence for stability of the 405-kiloyear Jupiter–Venus eccentricity cycle over hundreds of millions of years", recently appeared in the *Proceedings of the National Academy of Sciences of the USA.* The study was led by Dennis V. Bent, a, a Board of Governors professor from Rutgers University–New Brunswick, and included members from the Lamont–Doherty Earth Observatory, the Berkeley Geochronology Center, the Petrified Forest National Park in Arizona, and multiple universities.

As noted, the idea that Earth experiences periodic changes in its climate (which are related to changes in its orbit) has been understood for almost a century. These changes consist of Milankovitch Cycles, which consist of a 100,000-year cycle in the eccentricity of Earth's orbit, a 41,000-year cycle in the tilt of Earth's axis relative to its orbital plane, and a 21,000-year cycle caused by changes in the planet's axis.

Combined with the 405,000-year swing, which is the result of Venus and Jupiter's gravitational influence, these shifts cause changes in how much solar energy reaches parts of our planet, which in turn influences Earth's climate. Based on fossil records, these cycles are also known to have had a profound impact on life on Earth, which likely had an effect on the course of species of evolution. As Prof. Bent explained in a Rutgers Today press release:

"The climate cycles are directly related to how Earth orbits the sun and slight variations in sunlight reaching Earth lead to climate and ecological changes. The Earth's orbit changes from close to perfectly circular to about 5 percent elongated especially every 405,000 years."

For the sake of their study, Prof. Kent and his colleagues obtained sediment samples from the Newark basin, a prehistoric lake that spanned most of New Jersey, and a core rock sample from the Chinle Formation in Petrified Forest National Park in Arizona. This core rock measured about 518 meters (1700 feet) long, 6.35 cm (2.5 inches) in diameter, and was dated to the Triassic Period – ca. 202 to 253 million years ago.

The team then linked reversals in Earth's magnetic field – where the north and south pole shift – to sediments with and without zircons (minerals with uranium that allow for radioactive dating) as well as to climate cycles in the geological record. What these showed was that the 405,000-years cycle is the most regular astronomical pattern linked to Earth's annual orbit around the Sun.

The results further indicated that the cycle been stable for hundreds of millions of years and is still active today. As Prof. Kent explained, this constitutes the first verifiable evidence that celestial mechanics have played a historic role in natural shifts in Earth's climate. As Prof. Kent indicated:

"It's an astonishing result because this long cycle, which had been predicted from planetary motions through about 50 million years ago, has been confirmed through at least 215 million years ago. Scientists can now link changes in the climate, environment, dinosaurs, mammals and fossils around the world to this 405,000-year cycle in a very precise way."

Previously, astronomers were able to calculate this cycle reliably back to around 50 million years, but found that the problem became too complex prior to this because too many shifting motions came into play. "There are other, shorter, orbital cycles, but when you look into the past, it's very difficult to know which one you're dealing with at any one time, because they change over time," said Prof. Kent. "The beauty of this one is that it stands alone. It doesn't change. All the other ones move over it."

In addition, scientists were unable to obtain accurate dates as to when Earth's magnetic field reversed for 30 million years of the Late Triassic – between ca. 201.3 and 237 million years ago. This was a crucial period for the evolution of terrestrial life because it was when the Supercontinent of Pangaea broke up, and also when the dinosaurs and mammals first appeared.

This break-up led to the formation of the Atlantic Ocean as the continents drifted apart and coincided with a mass extinction event by the end of the period that effected the dinosaurs. With this new evidence, geologists, paleontologists and Earth scientists will be able to develop very precise timelines and accurately categorize fossil evidence dated to this period, which show differences and similarities over wide-ranging areas.

This research, and the ability to create accurate geological and climatological timelines that go back over 200 million years, is sure to have drastic implications. Not only will climate studies benefit from it, but also our understanding of how life, and even how our Solar System, evolved. What emerges from this could include a better understanding of how life could emerge in other star systems.

After all, if our search for extra-solar life life comes down to what we know about life on Earth, knowing more about how it evolved here will better the odds of finding it out there.

Further Reading: Rutgers Today, Columbia University, PNAS

Source: Universe Today

Return to Contents

The Night Sky

Friday, May 11

• The Arch of Spring, the last part of the Winter Hexagon, spans the western sky in late twilight. Pollux and Castor form its top: they're lined up roughly horizontally in the west-northwest, about three finger-widths at arm's length apart. Look far to their lower left for Procyon, and farther to their lower right for Menkalinan and then bright Capella.

Venus glares below the Arch. Two fists at arm's length left or lower left from Venus, look for Betelgeuse twinkling on its way out.

Saturday, May 12

• Three zero-magnitude stars shine after dark in May: Arcturus very high in the southeast (high above Jupiter), Vega much lower in the northeast, and Capella in the northwest (upper right of Venus). They appear so bright because each is at least 60 times as luminous as the Sun, and because they're all relatively nearby: 37, 25, and 42 light-years from us, respectively.

Sunday, May 13

• Jupiter's biggest moon, Ganymede, crosses the planet's face from 8:53 to 10:07 p.m. Eastern Daylight Time. Following behind is its tiny black shadow, which is more readily visible in a telescope than Ganymede itself when in transit, from 9:07 to 10:52 p.m. EDT. Jupiter will be high in a dark or mostly dark sky for the Eastern time zone.

For a list of all such "phenomena of Jupiter's moons" this month, complete for observers worldwide, see the May Sky & Telescope, page 50.

Monday, May 14

• Can you see the big Coma Berenices star cluster? Does your light pollution *really* hide it, or do you just not know exactly where to look? It's high overhead after dark, 2/5 of the way from Denebola (Leo's tail) to the end of the Big Dipper's handle. Its brightest members form an inverted Y. The entire cluster is about 5° wide — a big, dim glow in a dark sky. It's sparse and nearly fills the view in binoculars.

• Not far away, explore the leading galaxies of the Virgo Cluster with Sue French's Deep-Sky Wonders article, photos, sketches, and chart in the May Sky & Telescope, page 54.

Tuesday, May 15

• For the rest of this spring and summer, Jupiter stays within less than 2° or 3° of 3rd-magnitude Alpha Librae (Zubenelgenubi): a fine, wide double star for binoculars. Its two components, magnitudes 2.8 and 5.1, are a generous 231 arcseconds apart. Nevertheless they form a real, gravitationally bound pair; they're both measured to be 77 light-years away.

Source: Sky & Telescope Return to Contents

ISS Sighting Opportunities

For Denver:

Date	Visible	Max Height	Appears	Disappears
Sat May 12, 1:57 AM	< 1 min	10°	10° above NE	10° above NE
Sat May 12, 3:30 AM	2 min	14°	12° above NW	12° above N
Sat May 12, 5:08 AM	1 min	10°	10° above N	10° above NNE
Sun May 13, 2:39 AM	< 1 min	17°	17° above N	15° above N
Sun May 13, 4:16 AM	< 1 min	10°	10° above N	10° above N
Mon May 14, 3:23 AM	1 min	11°	10° above NNW	10° above N

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

NASA-TV Highlights

(all times Eastern Daylight Time)

Friday, May 11

2 p.m., 6 p.m., 10 p.m., Replay of SpaceCast Weekly (all channels)

4 p.m., Video File of the ISS Expedition 56-57 Crew First Soyuz Qualification Training at the Gagarin Cosmonaut Training Center in Star City, Russia (Recorded on May 10-11; Prokopyev, Aunon-Chancellor, Gerst) (all channels)

7:30 p.m., Friday, May 11 - ISS Expedition 55 In-Flight Event for Purdue University conferring an Honorary Degree on Flight Engineer Drew Feustel of NASA (NASA Flight Engineer Scott Tingle, a Purdue graduate, also participates) (starts at 7:35 p.m.) (all channels)

Saturday, May 12

8 a.m., 6 p.m., Replay of the Pre-Launch Briefing on NASA's Next Earth-Observing Mission: The Gravity Recovery and Climate Experiment Follow-On (GRACE-FO) Mission (all channels)

9 a.m., 4 p.m., Replay of the Smithsonian National Air and Space Museum Presents "STEM in 30" with Astronauts Randy Bresnik of NASA and Paolo Nespoli of the European Space Agency (NTV-1 (Public))

10 a.m., 8 p.m., Replay of SpaceCast Weekly (all channels)

1 p.m., 10 p.m., Replay of the U.S. Spacewalk Briefing (all channels)

3 p.m., 11 p.m., Replay of NASA Administrator Jim Bridenstine Delivers the Keynote Address at the 2018 Humans 2 Mars Summit (all channels)

Sunday, May 13

8 a.m., 5 p.m., Replay of NASA Administrator Jim Bridenstine Delivers the Keynote Address at the 2018 Humans 2 Mars Summit (all channels)

9 a.m., 7 p.m., Replay of the Pre-Launch Briefing on NASA's Next Earth-Observing Mission: The Gravity Recovery and Climate Experiment Follow-On (GRACE-FO) Mission (all channels)

11 a.m., Replay of the Smithsonian National Air and Space Museum Presents "STEM in 30" with Astronauts Randy Bresnik of NASA and Paolo Nespoli of the European Space Agency (NTV-1 (Public))

4 p.m., 10 p.m., Replay of the U.S. Spacewalk Briefing (all channels)

9 p.m., Sunday, May 13 - Replay of SpaceCast Weekly (all channels)

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

Return to Contents

Space Calendar

- May 11 - [May 04] Richard Feynman's 100th Birthday (1918)
- May 11 - Comet 255P/Levy Closest Approach To Earth (2.658 AU)
- May 11 - NEW [May 10] Apollo Asteroid 2018 JZ Near-Earth Flyby (0.011 AU)
- May 11 - Apollo Asteroid 2018 GR2 Near-Earth Flyby (0.034 AU)
- May 12 - Mercury Passes 2.4 Degrees From Uranus
- May 12 - Comet 168P/Hergenrother At Opposition (3.043 AU)
- May 12 - Comet 322P/SOHO At Opposition (3.605 AU)
- May 12 - NEW [May 11] Apollo Asteroid 2018 JM1 Near-Earth Flyby (0.065 AU)
- May 12 - Atira Asteroid 434326 (2004 JG6) Closest Approach To Earth (0.937 AU)
- May 12 - Asteroid 128523 Johnmuir Closest Approach To Earth (1.775 AU)
- May 12 - John Hind's, 195th Birthday (1823)
- May 13 - NEW [May 07] Apollo Asteroid 2016 HP6 Near-Earth Flyby (0.006 AU)
- May 13 - NEW [May 10] Apollo Asteroid 2018 JA1 Near-Earth Flyby (0.011 AU)
- May 13 - Asteroid 2874 Jim Young Closest Approach To Earth (1.532 AU)
- May 13 - Asteroid 15495 Bogie Closest Approach To Earth (2.119 AU)
- May 13 - Alexis-Claude Clairaut's 305th Birthday (1713)
- May 14 - Comet P/2018 H2 (PANSTARRS) At Opposition (1.235 AU)
- May 14 - Comet 227P/Catalina-LINEAR Closest Approach To Earth (2.152 AU)
- May 14 - Comet 348P/PANSTARRS At Opposition (2.874 AU)
- May 14 - Comet 113P/Spitaler At Opposition (4.203 AU)
- May 14 - NEW [May 11] Aten Asteroid 2018 JL1 Near-Earth Flyby (0.019 AU)
- May 14 - NEW [May 10] Apollo Asteroid 2018 JY Near-Earth Flyby (0.023 AU)
- May 14 - Asteroid 6336 Dodo Closest Approach To Earth (1.675 AU)
- May 14 - Asteroid 16 Psyche Closest Approach To Earth (2.238 AU)
- May 14 - Asteroid 4255 Spacewatch Closest Approach To Earth (2.422 AU)
- May 14 - Asteroid 580 Selene Closest Approach To Earth (2.474 AU)
- May 14 - 45th Anniversary (1973), Skylab Launch

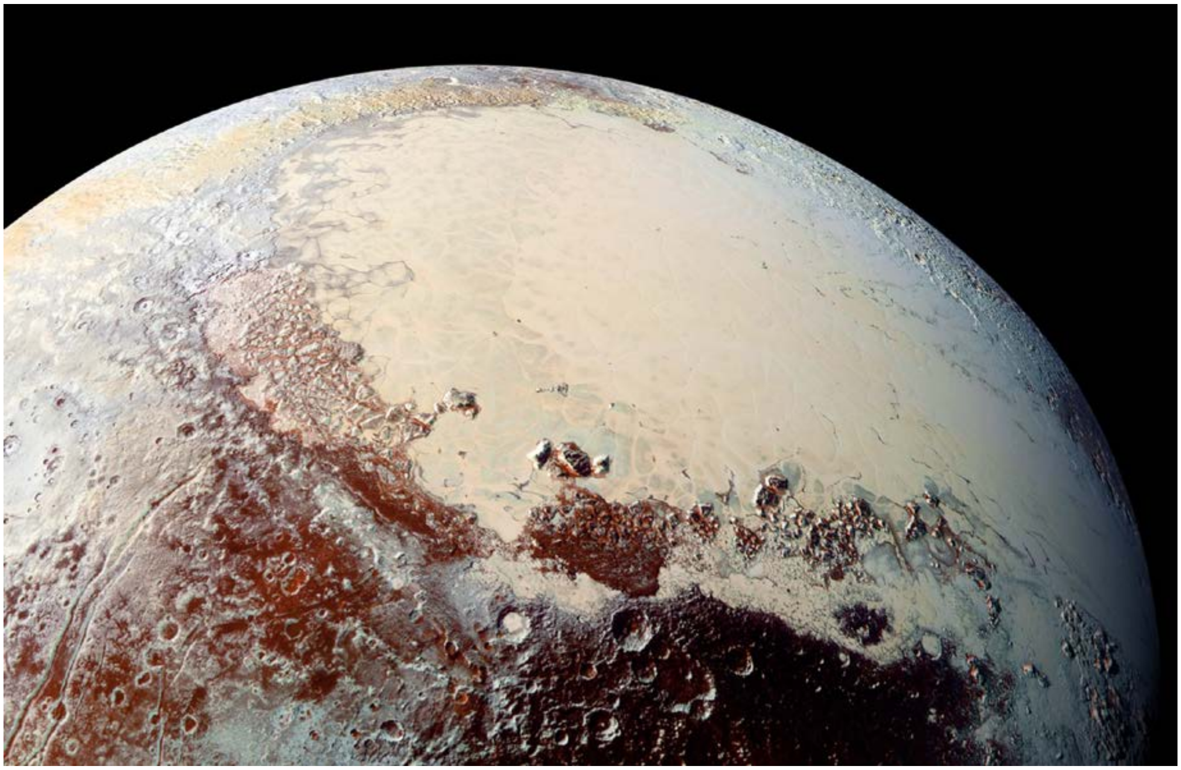

Skylab as photographed by its departing final crew (Skylab 4)

Source: JPL Space Calendar

Return to Contents

Food for Thought

Welcome Back, Pluto? Planethood Debate Reignites



The long-simmering argument about Pluto's planethood has just flared up again.

For more than 75 years after its 1930 discovery, Pluto was regarded as our solar system's ninth planet — a distant and frigid oddball, to be sure, but a member of Earth's immediate family nonetheless. Then, in 2006, the International Astronomical Union (IAU) reclassified Pluto as a "dwarf planet," a newly created category that the organization explicitly stressed made Pluto distinct from the eight "true" planets.

A true planet, according to the IAU's newly devised definition, must meet three criteria: It must circle the sun and no other object (so, moons are out); it must be big enough to be rounded into a sphere or spheroid by its own gravity, but not so large that its innards host the fusion reactions that power stars; and it must have "cleared its neighborhood" of other orbiting bodies.

Pluto failed at this last hurdle, because its neighborhood — the ring of icy bodies beyond Neptune known as the Kuiper Belt — is far from cleared.

Many scientists and Plutophilic members of the public objected strongly to the IAU's decision, on various grounds. For starters, some folks pointed out, the new planet definition rules out anything not orbiting the sun — meaning that the hundreds of billions of exoplanets in our Milky Way galaxy aren't planets at all, at least according to the IAU.

And the "clear your neighborhood" requirement seemed ridiculous to many researchers, including Alan Stern, the principal investigator of NASA's New Horizons mission, which famously flew by Pluto in July 2015. Stern has been a vocal proponent of Pluto's planethood and has argued that the IAU's decision stemmed at least partly from a very nonscientific desire to keep the solar system's planetary stable down to a "manageable" number.

Which brings us to the most recent flare-up. Stern and planetary scientist David Grinspoon have just published a book about the Pluto flyby, called "Chasing New Horizons: Inside the Epic First Mission to Pluto" (Picador, 2018). On Monday (May 7), The Washington Post published a "Perspectives" piece the two scientists wrote titled, "Yes, Pluto Is a Planet."

In the piece, Grinspoon and Stern took aim at the IAU's "hastily drawn" and "flawed" planet definition, reserving special ire for the "clearing your neighborhood" requirement.

"This criterion is imprecise and leaves many borderline cases, but what's worse is that they chose a definition that discounts the actual physical properties of a potential planet, electing instead to define 'planet' in terms of the other objects that are — or are not — orbiting nearby," the scientists wrote. "This leads to many bizarre and absurd conclusions. For example, it would mean that Earth was not a planet for its first 500 million years of history, because it orbited among a swarm of debris until that time, and also that if you took Earth today and moved it somewhere else, say out to the asteroid belt, it would cease being a planet." [Destination Pluto: NASA's New Horizons Mission in Pictures]

The duo pushed instead for a much simpler "geophysical planet definition," which was presented last spring at a planetary science conference in Texas. And this definition is indeed simple; boiled down, it holds that planets are "round objects in space that are smaller than stars."

Under this definition, Pluto and other dwarf planets, such as Ceres and Eris, are considered planets, as are large moons like Jupiter's Europa, Ganymede, Io and Callisto and Saturn's huge satellite Titan (as well as Earth's own moon). Indeed, the solar system's planet count would easily top 100 if everyone agreed to use the geophysical definition.

But getting such widespread agreement about this, and about Pluto's "official" classification, will be a hard row to hoe. For example, astrophysicist and author Ethan Siegel argued in a piece for Forbes on Tuesday (May 8) that a cosmic object's environmental context is important to understanding the object's nature.

"The simple fact is that Pluto was misclassified when it was first discovered; it was never on the same footing as the other eight worlds. The 2006 move by the IAU was an incomplete attempt to repair that mistake," Siegel wrote.

The geophysical definition, he added, "is a step in the opposite direction: It's a step towards making a larger, more confusing mistake that will render a definition meaningless to the majority of people who use it."

And then there's the pithy take by California Institute of Technology astronomer Mike Brown, whose discovery of outer-solar-system objects helped spark the rethink of Pluto's place in the solar system.

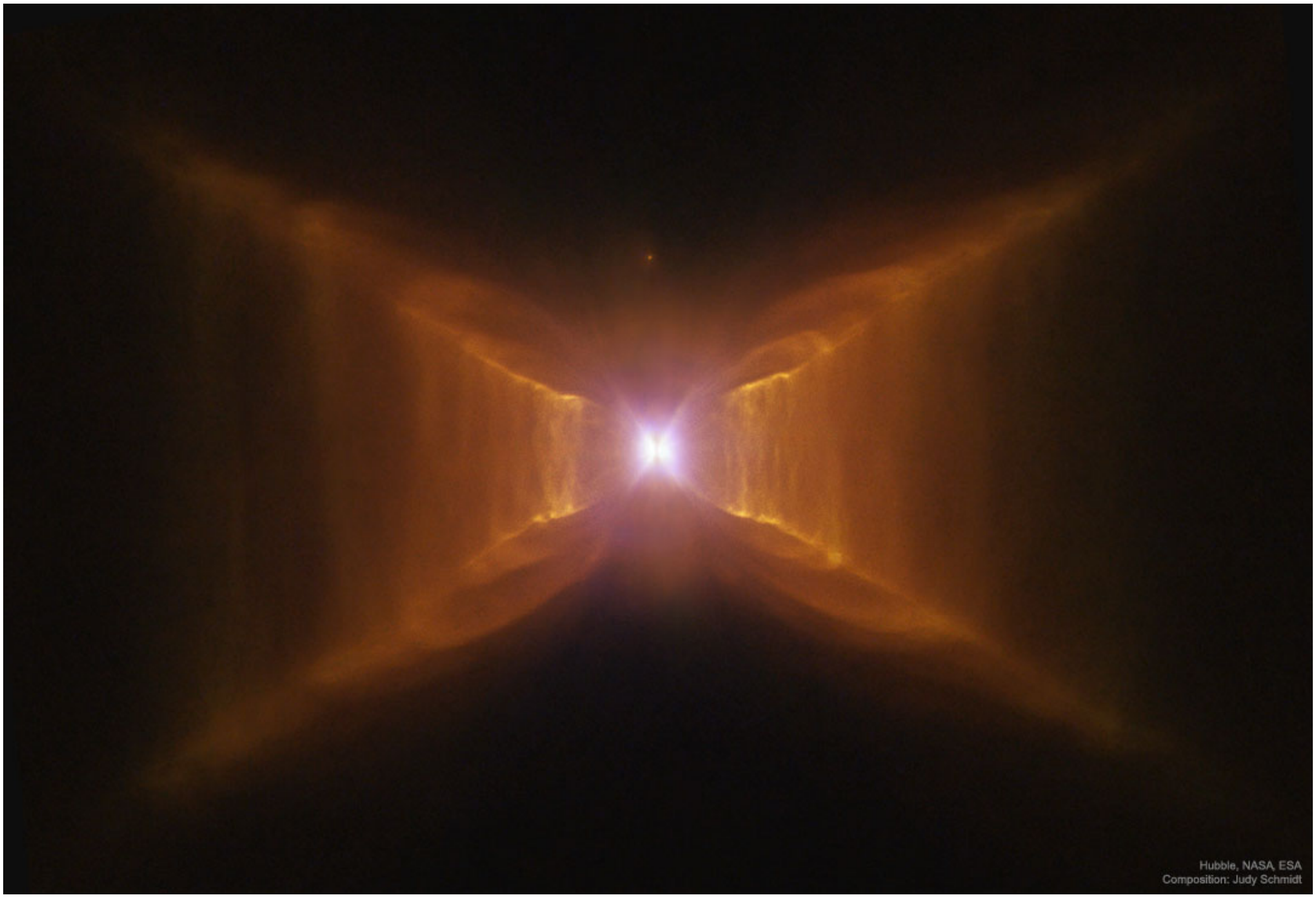
"So, hey, Pluto is still not a planet. Actually, never was. We just misunderstood it for 50 years. Now, we know better. Nostalgia for Pluto is really not a very good planet argument, but that's basically all there is. Now, let's get on with reality," Brown wrote via Twitter, where his handle is @plutokiller.

Brown also wrote a book, titled "How I Killed Pluto and Why It Had It Coming" (Spiegel & Grau, 2010), so his feelings on the topic are pretty well-known.

Will the geophysical planet definition catch on? Will the IAU welcome Pluto back into the "true planet" fold, along with Ceres, Europa, Titan, Earth's moon and many other objects? Who knows? But it seems clear that people will be fighting about this stuff for a long time to come.

Source: Space.com Return to Contents

Space Image of the Week



The Red Rectangle Nebula from Hubble

Explanation How was the unusual Red Rectangle nebula created? At the nebula's center is an aging binary star system that surely powers the nebula but does not, as yet, explain its colors. The unusual shape of the Red Rectangle is likely due to a thick dust torus which pinches the otherwise sphericaloutflow into tip-touching cone shapes. Because we view the torus edge-on, the boundary edges of the cone shapes seem to form an X. The distinct rungssuggest the outflow occurs in fits and starts. The unusual colors of the nebula are less well understood, however, and speculation holds that they are partly provided by hydrocarbon molecules that may actually be building blocks for organic life. The Red Rectangle nebula lies about 2,300 light yearsaway towards the constellation of the Unicorn (Monoceros). The nebula is shown here in great detail as recently reprocessed image from Hubble Space Telescope. In a few million years, as one of the central stars becomes further depleted of nuclear fuel, the Red Rectangle nebula will likely bloom into aplanetary nebula.

Image Credit: Hubble**,** NASA**,** ESA**;** *Processing & License:* Judy Schmidt

Source: APOD

Return to Contents