Space News Update
— May 15, 2020 —

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NASA’s TESS Enables Breakthrough Study of Perplexing Stellar Pulsations

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Sound waves bouncing around inside a star cause it to expand and contract, which results in detectable brightness changes. This animation depicts one type of Delta Scuti pulsation — called a radial mode — that is driven by waves (blue arrows) traveling between the star’s core and surface. In reality, a star may pulsate in many different modes, creating complicated patterns that enable scientists to learn about its interior. Credit: NASA’s Goddard Space Flight Center

Astronomers have detected elusive pulsation patterns in dozens of young, rapidly rotating stars thanks to data from NASA’s Transiting Exoplanet Survey Satellite (TESS). The discovery will revolutionize scientists’ ability to study details like the ages, sizes and compositions of these stars — all members of a class named for the prototype, the bright star Delta Scuti.

“Delta Scuti stars clearly pulsate in interesting ways, but the patterns of those pulsations have so far defied understanding,” said Tim Bedding, a professor of astronomy at the University of Sydney. “To use a musical analogy, many stars pulsate along simple chords, but Delta Scuti stars are complex, with notes that seem to be jumbled. TESS has shown us that’s not true for all of them.”

A paper describing the findings, led by Bedding, appears in the May 14 issue of the journal Nature and is now available online.

Watch the pulsations of a Delta Scuti star! In this illustration, the star changes in brightness when internal sound waves at different frequencies cause parts of the star to expand and contract. In one pattern, the whole star expands and contracts, while in a second, opposite hemispheres swell and shrink out of sync. In reality, a single star exhibits many pulsation patterns that can tell astronomers about its age, composition and internal structure. The exact light variations astronomers observe also depend on how the star’s spin axis angles toward us. Delta Scuti stars spin so rapidly they flatten into ovals, which jumbles these signals and makes them harder to decode. Now, thanks to NASA’s Transiting Exoplanet Survey Satellite, astronomers are deciphering some of them.
Geologists studying seismic waves from earthquakes figured out Earth’s internal structure from the way the reverberations changed speed and direction as they traveled through it. Astronomers apply the same principle to study the interiors of stars through their pulsations, a field called asteroseismology.

Sound waves travel through a star’s interior at speeds that change with depth, and they all combine into pulsation patterns at the star’s surface. Astronomers can detect these patterns as tiny fluctuations in brightness and use them to determine the star’s age, temperature, composition, internal structure and other properties.

Delta Scuti stars are between 1.5 and 2.5 times the Sun’s mass. They’re named after Delta Scuti, a star visible to the human eye in the southern constellation Scutum that was first identified as variable in 1900. Since then, astronomers have identified thousands more like Delta Scuti, many with NASA’s Kepler space telescope, another planet-hunting mission that operated from 2009 to 2018.

But scientists have had trouble interpreting Delta Scuti pulsations. These stars generally rotate once or twice a day, at least a dozen times faster than the Sun. The rapid rotation flattens the stars at their poles and jumbles the pulsation patterns, making them more complicated and difficult to decipher.

To determine if order exists in Delta Scuti stars’ apparently chaotic pulsations, astronomers needed to observe a large set of stars multiple times with rapid sampling. TESS monitors large swaths of the sky for 27 days at a time, taking one full image every 30 minutes with each of its four cameras. This observing strategy allows TESS to track changes in stellar brightness caused by planets passing in front of their stars, which is its primary mission, but half-hour exposures are too long to catch the patterns of the more rapidly pulsating Delta Scuti stars. Those changes can happen in minutes.

But TESS also captures snapshots of a few thousand pre-selected stars — including some Delta Scuti stars — every two minutes. When Bedding and his colleagues began sorting through the measurements, they found a subset of Delta Scuti stars with regular pulsation patterns. Once they knew what to look for, they searched for other examples in data from Kepler, which used a similar observing strategy. They also conducted follow-up observations with ground-based telescopes, including one at the W.M. Keck Observatory in Hawaii and two in the global Las Cumbres Observatory network. In total, they identified a batch of 60 Delta Scuti stars with clear patterns.

"This really is a breakthrough. Now we have a regular series of pulsations for these stars that we can understand and compare with models," said co-author Simon Murphy, a postdoctoral researcher at the University of Sydney. "It’s going to allow us to measure these stars using asteroseismology in a way that we’ve never been able to do. But it’s also shown us that this is just a stepping-stone in our understanding of Delta Scuti stars."

Pulsations in the well-behaved Delta Scuti group fall into two major categories, both caused by energy being stored and released in the star. Some occur as the whole star expands and contracts symmetrically. Others occur as opposite hemispheres alternately expand and contract. Bedding’s team inferred the alterations by studying each star’s fluctuations in brightness.

The data have already helped settle a debate over the age of one star, called HD 31901, a member of a recently discovered stream of stars orbiting within our galaxy. Scientists placed the age of the overall stream at 1 billion years, based on the age of a red giant they suspected belonged to the same group. A later estimate, based on the rotation periods of other members of the stellar stream, suggested an age of only about 120 million years.

Bedding’s team used the TESS observations to create an asteroseismic model of HD 31901 that supports the younger age.

"Delta Scuti stars have been frustrating targets because of their complicated oscillations, so this is a very exciting discovery," said Sarbani Basu, a professor of astronomy at Yale University in New Haven, Connecticut, who studies asteroseismology but was not involved in the study. "Being able to find simple patterns and identify the modes of oscillation is game changing. Since this subset of stars allows normal seismic analyses, we will finally be able to characterize them properly."

The team thinks their set of 60 stars has clear patterns because they’re younger than other Delta Scuti stars, having only recently settled into producing all of their energy through nuclear fusion in their cores. The pulsations occur
more rapidly in the fledgling stars. As the stars age, the frequency of the pulsations slows, and they become jumbled with other signals.

Another factor may be TESS’s viewing angle. Theoretical calculations predict that a spinning star’s pulsation patterns should be simpler when its rotational pole faces us instead of its equator. The team’s TESS data set included around 1,000 Delta Scuti stars, which means that some of them, by chance, must be viewed close to pole-on.

Scientists will continue to develop their models as TESS begins taking full images every 10 minutes instead of every half hour in July. Bedding said the new observing strategy will help capture the pulsations of even more Delta Scuti stars.

“We knew when we designed TESS that, in addition to finding many exciting new exoplanets, the satellite would also advance the field of asteroseismology,” said TESS Principal Investigator George Ricker at the Massachusetts Institute of Technology’s Kavli Institute for Astrophysics and Space Research in Cambridge. “The mission has already found a new type of star that pulsates on one side only and has unearthed new facts about well-known stars. As we complete the initial two-year mission and commence the extended mission, we’re looking forward to a wealth of new stellar discoveries TESS will make.”

The rapid beat of HD 31901, a Delta Scuti star in the southern constellation Lepus. The sound is the result of 55 pulsation patterns TESS observed over 27 days sped up by 54,000 times. Delta Scuti stars have long been known for their apparently random pulsations, but TESS data show that some, like HD 31901, have more orderly patterns Credit: NASA’s Goddard Space Flight Center and Simon Murphy, University of Sydney

Source: NASA
When the New Horizons spacecraft passed by Pluto in 2015, one of the many fascinating features its images revealed was that this small, frigid world in the distant solar system has a hazy atmosphere. Now, new data helps explain how Pluto’s haze is formed from the faint light of the Sun 3.7 billion miles away as it moves through an unusual orbit.

Remote observations of Pluto by NASA’s telescope on an airplane, the Stratospheric Observatory for Infrared Astronomy, or SOFIA, show that the thin haze enshrouding Pluto is made of very small particles that remain in the atmosphere for prolonged periods of time rather than immediately falling to the surface. SOFIA’s data clarify that these haze particles are actively being replenished — a discovery that is revising predictions on the fate of Pluto’s atmosphere as it moves into even colder areas of space on its 248-Earth-year orbit around the Sun. The results are published in the scientific journal Icarus.

“Pluto is a mysterious object that is constantly surprising us,” said Michael Person, the lead author of the paper and director of Massachusetts Institute of Technology’s Wallace Astrophysical Observatory. “There had been hints in earlier remote observations that there might be haze, but there wasn’t strong evidence to confirm it really existed until the data came from SOFIA. Now we’re questioning if Pluto’s atmosphere is going to collapse in the coming years – it may be more resilient than we thought.”

SOFIA studied Pluto just two weeks before New Horizon’s flyby in July 2015. The modified Boeing 747 flew over the Pacific Ocean and pointed its nearly 9-foot telescope at Pluto during an occultation, an eclipse-like event in which Pluto cast a faint shadow on Earth’s surface as it passed in front of a distant star.

SOFIA observed the middle layers of Pluto’s atmosphere in the infrared and visible light wavelengths, and soon after, the New Horizons spacecraft probed its upper and lower layers using radio waves and ultraviolet light. These combined observations, taken so close in time, have provided the most complete picture yet of Pluto’s atmosphere.
Blue, Hazy Atmosphere

Created as surface ice vaporizes under the distant light of the Sun, Pluto’s atmosphere is predominantly nitrogen gas, along with small amounts of methane and carbon monoxide. Haze particles form high up in the atmosphere, more than 20 miles above the surface, as methane and other gases react to sunlight, before slowly raining down to the icy surface.

New Horizons found evidence of these particles when it sent back images showing a blue-tinted haze to Pluto’s atmosphere. Now, SOFIA’s data fills in even more details by discovering that the particles are extremely small, just 0.06-0.10 microns thick, or about 1,000 times smaller than the width of a human hair. Because of their small size, they scatter blue light more than other colors as they drift toward the surface, creating the blue tint.

With these new insights, scientists are reevaluating their predictions on the fate of Pluto’s atmosphere. Many forecasts indicated that as the dwarf planets moved away from the Sun, less surface ice would be vaporized — creating fewer atmospheric gases while losses to space continued — eventually leading to atmospheric collapse. But rather than collapsing, the atmosphere appears to change on a shorter cyclical pattern.

Applying what they learned from SOFIA to reanalyze previous observations, including from SOFIA’s predecessor the Kuiper Airborne Observatory, shows that the haze thickens and then fades in a cycle lasting just a few years. This indicates that the tiny particles are being created relatively quickly. The researchers suggest that Pluto’s unusual orbit is driving the changes in the haze and therefore may be more important in regulating its atmosphere than its distance from the Sun.

Pluto circles the Sun in a long, oval shape, called an elliptical orbit, and at an angle, called an inclined orbit. It also rotates on its side. This causes some areas of the dwarf planet to be exposed to more sunlight at different points in the orbit. When ice-rich regions are exposed to sunlight, the atmosphere may expand and create more haze particles, but as those areas receive less sunlight, it may shrink and become clearer. This cycle has continued even as Pluto’s distance from the Sun has increased, though it’s not clear if this pattern will continue.

“There’s still a lot we don’t understand, but we’re forced now to reconsider earlier predictions,” said Person. “Pluto’s atmosphere may collapse more slowly than previously predicted, or perhaps not at all. We have to keep monitoring it to find out.”

Chasing Pluto’s Shadow

SOFIA was uniquely positioned to study Pluto from afar by taking advantage of a rare moment when Pluto passed in front of a distant star, casting a faint shadow across the Earth’s surface. Momentarily backlit by the star, Pluto’s atmosphere could be analyzed.

Traveling at 53,000 miles per hour, Pluto’s shadow was expected to appear for a brief two minutes over the Pacific Ocean near New Zealand. SOFIA charted its course to intercept, but two hours before the occultation an updated prediction placed the shadow 200 miles to the north.

“Capturing that shadow required a bit of scramble. SOFIA has the benefit of being mobile, but the revised flight plan had to be cleared by air traffic control,” said William Reach, SOFIA’s associate director for science operations. “There were a few tense moments, but the team worked together, and we got clearance. We reached Pluto’s shadow at exactly the right time and were very happy to have made it!”

Remote observations like these allow scientists to monitor planetary bodies in between spacecraft flybys, which can often be separated by many years. The agreement between the data gathered remotely by SOFIA and from New Horizons’ close flyby supports that occultation observations from Earth can provide high quality data between spacecraft missions.
Finally! InSight’s Mole is Making Slow and Steady Progress

The scoop on InSight’s instrument arm exerting pressure on the Mole. This may supply the necessary friction to get the Mole going again. Image Credit: NASA/DLR

Personnel at NASA and the DLR have been working for months to get InSight’s Mole working. They’re at a disadvantage, since the average distance between Earth and Mars is about 225 million km (140 million miles.) They’ve tried a number of things to get the Mole into the ground, and they may finally be making some progress.

The InSight lander (Interior Exploration using Seismic Investigations, Geodesy and Heat Transport) is a joint mission between NASA and the DLR, or German Aerospace Center. One of the lander’s primary instruments is the Heat Flow and Physical Properties Package, or ‘Mole’, so-called because it needs to burrow into the ground to fulfill its mission. The Mole’s job is to measure the heat that flows from the planet’s interior to the surface.

Trouble started when it became clear that the sub-surface soil near the lander was dura-crust. The dura-crust is sand cemented together by salt, and it’s in a layer about 20 cm (8 in.) thick. After the Mole made some
initial progress, it stalled. The Mole relies on soil falling in around its hole as it hammers its way into the surface, giving it the necessary friction to penetrate.

But the dura-crust refused to fall into the hole.

NASA and the DLR tried using the scoop on the end of the instrument arm to push soil into the Mole’s hole, but that didn’t work.

Personnel also tried exerting sideways pressure on the Mole, in an attempt to provide the necessary friction. But that didn’t work, either.

There’s no way to reposition the Mole to a new spot, in hopes of avoiding the troublesome dura-crust. It’s too delicate to be re-deployed safely, so engineers are forced to try everything else.

Now, mission personnel are using the instrument arm’s scoop to apply downward pressure on the Mole. That’s a tricky operation, with a wiring harness protruding from the top of the Mole in a vulnerable spot. Damage the harness, and the whole experiment is probably over.

They began this procedure back in March, and saw some progress.

On May 4th, a representative from the DLR spoke at a webinar as part of the European Geosciences Union General Assembly. Tilman Spohn is the principal investigator for the Mole, and he gave an update. “The mole is going down by its hammering mechanism, but it is aided by the push of the scoop that balances the force of the recoil,” Spohn said.

It’s progress, which is great, but it’s very slow progress. That’s because they need to frequently re-position the instrument arm and its scoop. “That is a very tedious operation,” he said. “We can only go like 1.5 centimeters (0.6 in) at a time before we have to readjust.”

Then there’s the problem of the angle. The Heat Flow and Physical Properties Package was designed to penetrate the surface at a vertical angle. But instead, it’s at a 30 degree angle, adding to the difficulties.

The InSight Lander’s seismometer underneath its protective wind and thermal shield. The Mole may be stalled, but the lander’s other instruments are functioning well. Image Credit: NASA/JPL-Caltech

“It’s not something we like to see,” Spohn said. But if the mole is able to get its whole instrument body to penetrate the surface, that angle might correct itself.

As if things aren’t complicated enough, there’s another problem. The Mole penetrates with a hammering motion. As it hammered at the ground without making any progress, it compacted the soil directly underneath it. Now the Mole must contend with that compacted soil.

There’s no new word on how long it’ll take the Mole to penetrate far enough to do its job. It was designed to penetrate down to 5 meters (16 ft.) but is able to do some work at less depth, perhaps about 2 meters (6 ft.) But with progress this slow, even getting to 2 meters could take a long time.

Spohn didn’t provide an update on the timing. But back on April 17th, NASA’s principal investigator for the InSight mission, Bruce Banerdt, did give an update.

“We anticipate that we’ll have the mole down flush with the ground within another month or two months,” he said at a briefing. Once the Mole is flush with the surface, there’s no way that the scoop on the instrument arm can push on it anymore. It’ll be on its own.

“At that point, it’s either going to be able to go on its own or not.”

Source: Universe Today
The Night Sky

FRIDAY, MAY 15

• **A naked-eye Venus challenge!** All week, the large, thin crescent of Venus is easy to discern with a small telescope or even good, steadily braced binoculars.

But can you resolve the crescent with your unaided eyes? Mere 20/20 vision isn't good enough; success may await the eagle-eyed with 20/15, 20/12, or (rare) 20/10 vision. Try during different stages of twilight before the sky becomes too dark and Venus's glare too overwhelming.

SATURDAY, MAY 16

• **The Arch of Spring sinks lower.** All week, look west-northwest at nightfall for Pollux and Castor. They're lined up almost horizontal (depending on your latitude), some 30° upper left of brilliant Venus: about three fists at arm's length.

Pollux and Castor form the top of the enormous Arch of Spring. Lower left of them is Procyon, the left end of the Arch. Farther to their lower right is the other end, formed by Menkalinan (Beta Aurigae) and then brilliant Capella. Venus shines below the Arch's right side.

SUNDAY, MAY 17

• These dark spring evenings, the long, dim sea serpent Hydra snakes level far across the southern sky. Find his head, a rather dim asterism about the width of your thumb at arm's length, in the southwest. Look for it to the upper right of Procyon, the brightest star low due west, by about a fist and a half.

Hydra's brightest star is Alphard, his 2nd-magnitude orange heart, a fist and a half left of his head. Hydra's tail stretches all the way to Libra rising in the southeast. Dim Crater and brighter Corvus ride on his back.

MONDAY, MAY 18

• Before the Moon comes back into the evening sky, explore the galaxies at the head of Bootes — including as many as three three knife-thin, edge-on spirals if you have 8 to 14 inches of aperture — using the Deep-Sky Wonders article, chart, and photos in the June *Sky & Telescope*, page 54. And with large binoculars or a small rich-field scope, piece out the Kangaroo asterism inside Bootes's head.

TUESDAY, MAY 19

• Zero-magnitude Vega dominates the east-northeastern sky as evening advances. Look for its faint little constellation Lyra, the Lyre, hanging down from it. The most familiar part of Lyra is a small, almost-equilateral triangle with Vega as its top corner, and a larger parallelogram hanging to the lower right from the triangle's bottom corner.

Source: [Sky and Telescope](https://www.skyandtelescope.com/)
### ISS Sighting Opportunities (from Denver)

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Sighting information for other cities can be found at [NASA’s Satellite Sighting Information](https://nssdc.gsfc.nasa.gov/planetary/iss/sight.html)

### NASA-TV Highlights  (all times Eastern Time Zone)

**May 15, Friday**
- 11 a.m. - SpaceCast Weekly All Channels

**May 19, Tuesday**
- 3 p.m. – NASA Science Live: Expanding Our View of the Universe (All Channels)

Watch NASA TV online by going to the [NASA website](https://nasa.gov)
Space Calendar

- May 15 - [Apollo Asteroid 2020 JF1](#) Near-Earth Flyby (0.009 AU)
- May 15 - [Apollo Asteroid 478784 (2012 UV136)](#) Near-Earth Flyby (0.022 AU)
- May 15 - [Apollo Asteroid 2020 HA9](#) Near-Earth Flyby (0.047 AU)
- May 15 - [Mars Trojan 5261 Eureka](#) Closest Approach To Earth (0.565 AU)
- May 15 - [East Coast High Energy Theory Student Meeting 2020](#), Philadelphia, Pennsylvania
- May 15 - 15th Anniversary (2005), Hal Weaver, et al's Discovery of Pluto Moon Nix & Hydra
- **May 16** - [X-37B OTV-6 (AFSPC-7) Atlas 5 Launch](#)
- May 16 - [Comet 284P/McNaught At Opposition](#) (2.680 AU)
- May 16 - [Asteroid 17681 Tweedledum](#) Closest Approach To Earth (0.879 AU)
- May 16 - [Asteroid 19535 Rowanatkinson](#) Closest Approach To Earth (1.525 AU)
- May 16 - [Online Lecture: Near-Earth Asteroids - Impact Hazard and Space Missions](#)
- May 16 - [Online Lecture: The Space Elevator Climber](#)
- **May 17** - [Starlink 8 (60) Falcon 9 Launch](#)
- May 17 - [Amor Asteroid 2020 JY](#) Near-Earth Flyby (0.016 AU)
- May 17 - [Atira Asteroid 434326 (2004 JG6)](#) Closest Approach To Earth (1.042 AU)
- May 17 - [Asteroid 10183 Ampere](#) Closest Approach To Earth (1.102 AU)
- May 17 - [Asteroid 4511 Rembrandt](#) Closest Approach To Earth (1.166 AU)
- May 17 - [Asteroid 1159 Granada](#) Closest Approach To Earth (1.344 AU)
- May 17 - [Asteroid 5277 Brisbane](#) Closest Approach To Earth (1.392 AU)
- May 17 - 390th Anniversary (1630), Niccolo Zucchi's & Daniello Bartoli's Discovery of Jupiter's Belts
- May 18 - [Comet 220P/McNaught At Opposition](#) (1.401 AU)
- May 18 - [Aten Asteroid 2020 HG9](#) Near-Earth Flyby (0.040 AU)
- May 18 - [Atira Asteroid 2012 VE46](#) Closest Approach To Earth (0.530 AU)
- May 18-19 - [International Conference on Big Bang Theory and Physical Cosmology (ICBTPC 2020)](#) Montreal, Canada
- May 19 - [Asteroid 2577 Litva (2 Moons)](#) Closest Approach To Earth (1.192 AU)
- May 19 - [Asteroid 39566 Carlewis](#) Closest Approach To Earth (1.389 AU)
- May 19 - [Asteroid 134346 Pinatubo](#) Closest Approach To Earth (1.399 AU)
- May 19 - 110th Anniversary (1910), Earth Passes Through Halley's Comet's Tail
- May 19-21 - [Satscoms Innovation Group (SIG) Workshop](#), Goonhilly, United Kingdom
- **May 20** - [HTV-9 H-2B Launch (International Space Station)](#)

Source: JPL Space Calendar
Food for Thought

Space Travel May Impact How the Body Handles Sodium

A new study found astronauts excrete less sodium in space than on land, a finding that could have implications for the heart health of future space travelers.

Past research shows exploring the cosmos poses a range of health risks for humans, affecting their brain, eyes and bones. Space travel has a particularly noticeable impact on the cardiovascular system.

Without the pull of gravity, blood and water move into an astronaut's upper body and head, making the face look puffy. The lack of gravity confuses the body into producing less blood and water, and that causes astronauts to become dehydrated when they return to Earth.

The new research, published Monday in the American Heart Association journal *Circulation*, focused on cardiac natriuretic peptides, a hormone which helps the body urinate out sodium. Researchers said the study was the first to measure these peptides in astronauts eating a high-sodium versus low-sodium diet in space and on Earth.

The study included eight male astronauts who each ate both low- and high-sodium diets in space and on Earth. The low-sodium diet was 2 grams a day and the high-sodium diet was 5.5 grams. In addition, 16 cosmonauts were assessed for changes in blood volume before, during and after being in space.

The study found that while in space, astronauts excreted less sodium and their cardiac hormone levels were lower compared to when they were on Earth, regardless of which sodium diet they were on.

"A key finding from our study is that in space, although cardiac natriuretic peptide concentrations respond to changes in sodium intake, they are reset to lower levels," the authors wrote.

In the cosmonauts, blood volume levels also were lower in space than on Earth.

Dr. Michael Bungo, who was not involved in the research, said the study adds to the growing body of evidence that space travel has a profound impact on the human body.

"Astronauts on the news might look like they're having a fun camping trip up there in their short sleeves and their temperature- and oxygen-controlled environment. But a lot of changes actually do occur in their bodies," said Bungo, a cardiologist and former head of the Cardiovascular Laboratory at Houston's NASA Johnson Space Center.

"In the short course – six months or less – none of those changes are deleterious. But what are the long-term effects if we're going to Mars for a three-year trip? What if humans start living in space for a long time?" he said.

"There are a whole host of questions, and the answer to all of them is, 'We just don't know.'

Source: [American Heart Association/Phys.org](http://www.americanheartassociation.org)
The Porpoise Galaxy from Hubble

Image Credit: NASA, ESA, Hubble, HLA; Reprocessing & Copyright: Raul Villaverde

Explanation: What's happening to this spiral galaxy? Just a few hundred million years ago, NGC 2936, the upper of the two large galaxies shown, was likely a normal spiral galaxy -- spinning, creating stars -- and minding its own business. But then it got too close to the massive elliptical galaxy NGC 2937 below and took a dive.

Dubbed the Porpoise Galaxy for its iconic shape, NGC 2936 is not only being deflected but also being distorted by the close gravitational interaction. A burst of young blue stars forms the nose of the porpoise toward the right of the upper galaxy, while the center of the spiral appears as an eye. Alternatively, the galaxy pair, together known as Arp 142, look to some like a penguin protecting an egg. Either way, intricate dark dust lanes and bright blue star streams trail the troubled galaxy to the lower right.

The featured re-processed image showing Arp 142 in unprecedented detail was taken by the Hubble Space Telescope last year. Arp 142 lies about 300 million light years away toward the constellation, coincidently, of the Water Snake (Hydra). In a billion years or so the two galaxies will likely merge into one larger galaxy.

Source: NASA APOD