Temecula Valley Astronomer

The monthly newsletter of the Temecula Valley Astronomers Jul 2017

Events:

General Meeting : No general meeting this month. Check your TVA email for details about the Star-B-Que in Anza.

For the latest on Star Parties, check the web page.

APOD 17 June 2017 - Saturn near Opposition

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WHAT'S INSIDE THIS MONTH:

Send newsletter submissions to Mark DiVecchio <markd@silogic.com> by the 20th of the month for the next month's issue.

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Subscription to the TVA is included in the annual $25 membership (regular members) donation ($9 student; $35 family).

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Cosmic Comments – July/2017
by President Mark Baker

It's funny sometimes what "little" things in life excite me. Like looking for a diamond chip on a pure white beach!! Such is the effort being put in so as to view occultations of background stars by New Horizons next target, 2014 MU69. Keep in mind that this smaller-than-Pluto object is 1.6 BILLION kilometers farther out and all the occultation observing and recording is being done with "amateur" sized telescopes and imaging equipment!!! Not only are we able to project the proper trajectories to get NH there, but we can actually observe it against the celestial background as it "blocks" out stars behind it. The recent June 3rd occultation will be followed by two more in 2017, and each one will provide more data on what to expect from 2014 MU69…that's what is exciting to me!! We are no longer earthbound in perspective and we have the potential to grow our knowledge exponentially because of it…

And of course, this translates into something I hope the TVA will participate in commencing in the near future…all kinds of science opportunities. And if we are doing it, then I hope we are dragging the local communities and schools into the work as well…we can NEVER have too many eyes on the skies. Here's to what the future can bring…

Clear, Dark Skies my Friends…

Looking Up – July 2017
by Curtis Croulet

First Quarter Moon is June 30 at 5:51 PM PDT; Full Moon is July 8 at 9:07 PM PDT; Last Quarter Moon is July 16 at 12:26 PM PDT; New Moon is July 23 at 2:46 PM PDT; another First Quarter Moon is July 30 at 8:23 AM PDT.

The good news about **Mercury** is that it's in the evening sky all of July. The bad news is that never gets particularly high. Greatest eastern elongation is July 30.

Venus is in the pre-dawn sky. It has already passed greatest brilliancy. It dims from mag -4.2 to -4.0.

Mars is too close to the Sun for observation. It reaches conjunction with the Sun on July 27.

Jupiter is in the western evening sky. It sets as early as 11 PM by July's end.

Saturn is up most of the night. It's in southern Ophiuchus, the part of this giant constellation that splits Scorpius and Sagittarius.

Uranus is in the morning sky. It's in Pisces.

Neptune rises in late evening at the beginning of July and as early as 9:30 PM by month's end.

Pluto is in northeastern Sagittarius. You need a big scope and a dark sky. The July 2017 issue of *Sky & Telescope* has a detailed finder chart for the dwarf planet on pp.48-49.

There are two **meteor showers** for July. The **Southern Delta Aquariids** peak on July 30. The **Perseids**, which famously peak on the night of August 12, begin to show up in mid July.

Let's look up.

As spectacular as the winter night sky is, I must say that I like the mid-summer sky even more. The sight of the Scorpius-Sagittarius region from a very dark location is a sight not soon forgotten. We are looking in the direction of the center of the Milky Way galaxy. We can't see the actual core of the galaxy, because there's an intervening spiral arm. But in that direction there are many and various dark nebulae caused by clouds of cold interstellar dust and gas. A particularly prominent dark nebula is the large east-west Pipe Nebula, which lies between the head of the scorpion and the teapot of Sagittarius. If you look at this in photographs, you can, if you choose, see the Pipe Nebula as the rear leg of a rearing horse. In all my years of looking at the night sky, I never noticed the horse until night-sky photographer Wally Pacholka pointed it out to me. Now I can't look at this region in photographs *without* seeing the horse. The horse is hard to see visually except from the darkest skies. One memorable night in southern Arizona, over 40 years ago, this region stood out so clearly that it almost looked like we were looking at a velvet cloth with very dark infoldings. The center of the Milky Way galaxy, coincident with the radio source Sagittarius A, lies about halfway between the tip of Sagittarius's teapot spout and the Pipe Nebula.

Scorpius is one of the most distinctive of the constellations, one of the few that suggest their mythological namesakes. We're lucky that we can see the entire pattern of Scorpius. In most of Europe and Canada, for example, the bottom part of the scorpion's tail is cut off by the horizon. The Ancient World of the Middle East saw this as a Scorpion from very early times. The scorpion's image shows up in jewelry from Egypt. Mesoamerican cultures also saw this constellation as a scorpion, but in China it was seen as part of a dragon. In ancient times, what we call the constellation Libra was often depicted as the scorpion's grasping "claws." An arachnologist would call these claws "pedipalps." Alpha and Beta Librae, brightest stars in Libra, have the tongue-twisting names Zubenelgenubi and Zubeneschamali – the southern and northern claws. In Greek and Roman mythology, Scorpius is the scorpion that fatally stung Orion, and that's why Scorpius and Orion are on opposite sides of the sky.

In the heart of the scorpion lies the star Antares, sixteenth brightest star in the night sky. The name translates to "Rival of Mars" (Ares is the Greek name for Mars), so named because of the similarity of the color of the star and plant. In astrophysics, Antares is a red supergiant star. If you know the H-R diagram, Antares is in the upper-right corner, very close to Betelgeuse. Antares is spectral class M, which includes red stars on the right side of the H-R diagram. Antares and Betelgeuse are the only 1st magnitude stars in class M. The estimated distance of Antares is about 600 light years. Betelgeuse, in comparison, is about 430 light years. As is typical of red supergiants, Antares is irregularly variable. Its average apparent brightness is mag 1.06. Red supergiants vary not just in brightness, but in physical size. They are in the late stages of their lives, and they will eventually destroy themselves as supernovae. The average diameter of Antares is about 600 million miles. If Antares were substituted for the Sun, its outer edges would be somewhere between Mars and Jupiter. Antares may have been dimmer within human history. The Greek astronomer and mathematician Eratosthenes, who lived from about 276 BCE to 194 BCE, considered Antares to be dimmer than Beta Librae (Zubeneschamali). A century later, Ptolemy considered them to be of equal brightness.

Antares has a 5th magnitude companion, Antares B, often described as green in color. Antares B is a blue-white main sequence star, not a white dwarf. The angular separation of Antares and Antares is currently about 2.5 arc sec, a distance which is slowly decreasing. Seeing the companion is a regular fun challenge at summer star parties. The great contrast in brilliance between Antares and Antares B can make seeing the companion difficult if there's too much light being scattered within the telescope. Bad seeing can also render the companion invisible. I have seen it with my 150mm (6-inch) Maksutov-Cassegrain at Star-B-Ques, traditionally held in July.

Clear skies.

Random Thoughts
by Chuck Dyson

A HIT and A MISS

I think most people are familiar with the Thomas Alvin Edison story or at least with the part that he tried everything under the sun that would work as a filament for his electric lightbulb idea. Eventually Mr. Edison found that he could get a light bulb with a carbonized bamboo filament to last over 1200 hours of operation and he was awarded a patent on this bulb and this was Mr. Edison's big hit. Mr. Edison wasn't interested in only producing an electric light bulb but also in producing the electricity that was needed to power it, this is where the big bucks were, and to this end Mr. Edison had several patents on designs for electrical generating plants. Mr. Edison was backing DC (direct current) electricity to power light bulbs and for all home use; unfortunately, DC does not lend itself to being transmitted over long distances and must be generated and used on a fairly local bases. A Mr. Tesla and his business partner/ financial backer Mr. Westinghouse, who knew a thing or two about inventions because he had invented a thing or two, were promoting Mr. Tesla's patents on AC (alternating current) as the way to generate electricity for homes. AC unlike DC can be transmitted over long distances and eventually eclipsed Mr. Edison's DC system (after a long and nasty current war) and that was Mr. Edison's big miss but do not grieve for our Mr. Edison as he went on to have several other hits in his lifetime.

Obviously the forgoing story has nothing to do with astronomy except that the story is not unique or limited to business adventures as this sort of thing virtually permeates the astronomy and astrophysics fields. For the first example of hit and miss I would like to talk about Sir Fred Hoyle. If you read research papers then you know that they are usually three to five pages in length and a ten pager is a really long one and for subject review papers twenty to twenty-five pages is a big one. Another fact that you need to be aware of in order to appreciate this story is that the first particle accelerators were produced in 1928 (linear) and 1931 (circular) but were not really used for detailed research on the structure of atoms until 1949, thus it is even all the more remarkable that in 1957 with coauthors William Fowler and Margret and G. R. Burbidge (a husband and wife astrophysics team) published the B^2FH paper. The B^2FH paper is 109 pages long and in great and accurate detail describes how all the elements up to Iron other than Hydrogen, Helium, and Lithium are produced in stars and how all of the elements heavier than Iron are produced in supernova. This massive and monumental paper still stands as the reference manual on how stars work as of today, as hits go this is a biggie. So, what was Sir Hoyle's big miss? In 1948 Hoyle and two friends who were not happy with Hubble's expanding universe and Monseigneur Lemaitre and George Gamow's work showing that the universe formed from an ultra-dense and ultra-hot ball proposed a model of a universe that was in a steady state. In a bit of irony Hoyle was the one who in a 1949 coined the term Big Bang to describe this hot, dense ball of matter. Theories always reach beyond the available reliable data from observations and good data can be hard to come by; so, in a survey taken in 1960 only 39% of the physicists surveyed supported the Big Bang theory, the Steady state and other theories of the origin of the universe were alive and well. In 1965 things started to change with the discovery of the cosmic background radiation which helped bolster the Big Bang scenario this, coupled with the inability of researchers to find any evidence for white holes and young galaxies, lead to 69% of physicists surveyed in 1980 supporting the Big Bang. Until his death in 2001 Hoyle continued to point out the flaws and weaknesses in the Big Bang theory and espouse his steady state theory. To be sure several parts of the Big Bang theory have run into trouble of late. Unfortunately no parts of the steady state theory have been confirmed.

Our next person to have a hit and a miss is a relatively well known gentleman by the name of Albert Einstein; yep even Einstein had an off day or two. Although Einstein had a hit with his special theory of relativity in 1905 but the special theory did not explain light in all situations. For the next ten years Einstein worked on a solution that permitted the description of the action of light in a gravitational field. The problem was that in 1915 virtually everyone who was any one thought the universe was static and unchanging and Einstein's equations indicated that it in fact was not and that gravity would collapse it, awkward. In order to save the universe from his equations Einstein introduced his cosmological constant into his equations and he calls the constant lambda and it exactly counterbalances the attraction of gravity that all celestial bodies have for each other. The big problem in 1915, other than WWI was raging, was that we didn't know anything about the universe except that we were in it. In 1908 Henrietta Leavitt publishes her paper on period luminosity of specific variable stars (Cepheid variables) and in 1918 Harlow Shapley using the Mt. Wilson 60 in. telescope and Henrietta Leavitt's Cepheid variables as yard sticks works out the size of our galaxy at 100,000 light years across no one can imagine that there is anything else in the universe except this galaxy that we are in. In 1924 with the Mt. Wilson 100 in. telescope Hubble announces that spiral nebula are actually other galaxies way outside of our galaxy (two million light years plus outside of our galaxy). Then just to top matters off in 1929, just 14 years after Einstein puts his cosmological constant into his equations to make the universe static, Hubble announces there are many galaxies and they are almost all moving away from us. Einstein announces that he is throwing out the cosmological constant and declares it his greatest mistake ever. In the 1990's two groups of researchers using type 1A supernova as a new yard stick are measuring the distances to very far galaxies in order to assess the rate at which the cosmic expansion speed is slowing. To the surprise of both groups they find that the rate of expansion is increasing in defiance of the laws of physics as we know them. Enter dark energy or negative energy or whatever you want to call it but we need the cosmological constant back into Einstein's equations to account for the acceleration of expansion. So, was Einstein's greatest mistake putting the constant in or taking it out or not admitting that we still might not know enough about the universe to even write a meaningful equation; the reader must decide which is the correct answer.

Our last hit and miss celebrity is Robert Andrews Millikan a local boy who is famous for his oil drop experiment. First let me start out by saying that Millikan is universally recognized as one of the great teachers of physics in the first half of the 20th century and the author of several excellent text books on physics. Millikan started his career in Chicago and he recognized early on that his teaching and books were not going to advance his professional career; so, he stopped writing books cut back on his teaching and concentrated on his laboratory experiments. It was in Chicago that performed his oil drop experiments, in this experiment Millikan produced very small drops of oil and then ionized the air around them with X-rays and the electrons would attach to the oil drops. When the charged oil drops would drift between two charged plates a charge could be applied and when the droplet stopped drifting down the charge could be calculated and the charge was always found to be a multiple of a small fraction of a Coulomb and with a "little" math Millikan was able to work out the charge and mass of a single electron, finally as the mass ratio between the electron and the proton was known Millikan was also able to work out the mass of the proton. Hello Nobel Prize! George Ellery Hale recognizing talent when he saw it invited Millikan to come to Pasadena and work with him at a small technical school in Pasadena, and the rest is history. As he was coming to Pasadena Millikan had an almost miss with his research. Millikan hated and completely disagreed with Einstein's paper on the photoelectric effect and so he set up an experiment to disprove Einstein. The experiment completely confirmed Einstein and Millikan published the results. Millikan published and acknowledged his results and not his prejudice, now that is good science. Millikan had his miss while at Cal Tech. Millikan could not stop believing that cosmic rays were very high energy photons and not atomic particles and even whole atomic nuclei. Millikan's reluctance can be understood when you consider how much energy is required to accelerate a particle up to very nearly the speed of light and to do it on a regular basis as we have cosmic rays hitting the Earth all the time. On this occasion Millikan refused to accept the data and abandon his prejudice and so he had his miss. Please note we are still not sure how all of these particles are made and how they survive the trip here but the job of science is not to deny it but to explain it.

Next month: Eclipse Follies and maybe a tale or two on transit chasing.

Cheers
Chuck

Something Wicked This Way Went – Part I
by Clark Williams

Although this is the July Newsletter, you will get it in June and June 30th is National “Asteroid Day”, a time to increase the awareness people have of NEOs (Near Earth Objects), asteroids and the efforts of professionals and amateurs in detection, tracking and defense against these objects. We'll break this story across three Newsletters

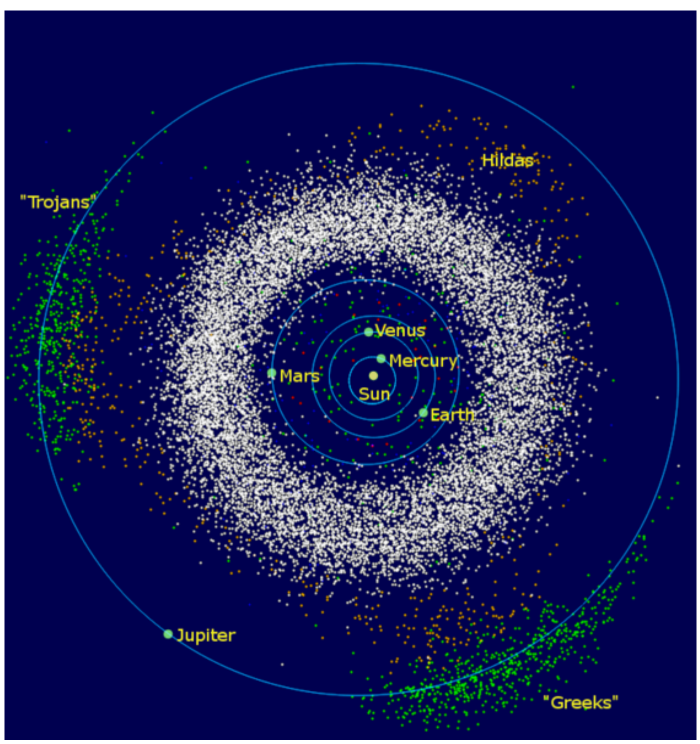
Part One – The problem:

The problem is that we live in a dirty solar system. One filled with dust, dirt, pebbles, rocks, boulders, mountains, planetoids and apparently, dwarf planets. Unsurprisingly rocks and dirt are everywhere! We have a saving grace:

> “Space is big. You just won't believe how vastly, hugely, mind-bogglingly big it is. I mean, you may think it's a long way down the road to the chemist's, but that's just peanuts to space.”

Douglas Adams, The Hitchhiker's Guide to the Galaxy
English humorist & science fiction novelist (1952 - 2001)

In fact we have trouble describing things in space because of the huge scales and emptiness we find there. Consider for a moment that between Mars and Jupiter, starting at about 2.2 and



Asteroid Belt (Public Domain)

3.2 astronomical units (AU) from the Sun – 329 million to 478 million km (204 million to 297 million miles) is a cylinder about 1 AU thick (150 million km, or 93 million mi), of rocks we call the "Asteroid Belt". It is filled with detritus ranging from grains of rock to minor planets and yet the average distance between these objects is estimated to be 965,600 km (600,000 miles), meaning that the Asteroid Belt consists largely of empty space. The low density of detritus within the Belt means the odds of a probe running into an asteroid within the Belt are less than one-in-a-billion.

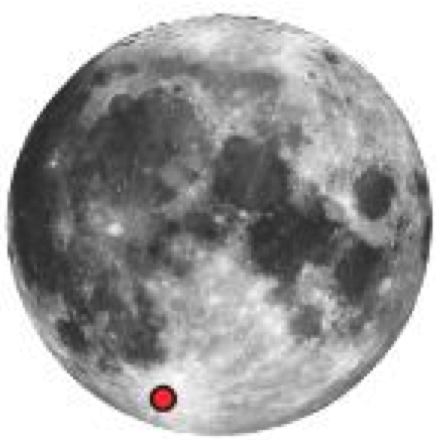
Like any ring system (which is what the Asteroid Belt acts like) there are gaps in this cylinder. These gaps are called Kirkwood Gaps after "Daniel Kirkwood" who in 1886 first noticed the gaps and correctly explained them as a consequence of the orbital resonances of Jupiter and Saturn.

In these Kirkwood Gaps we have found some highly eccentric orbits of a few asteroids. Eventually we will see an altering of the orbits of these asteroids and interactions with larger bodies, including planets, may occur. Of course these will happen over rather large timescales.

There are also some asteroids that will get tugged and pushed that lie outside the Kirkwood Gaps and they may eventually also change their orbits and interact with other bodies.

These interactions have led to orbital alterations that eventually caused planetary interactions to occur and in some cases these interactions resulted in collisions. Well actually, in a lot of cases.

Look at the moon. There is a rather large crater on the moon named Tycho. You've heard of this crater before. In the movie *2001: A Space Odyssey*. The Monolith was called the "Tycho Anomaly". You've also seen the crater every time you look at the moon:



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Tycho Crater on Luna

Tycho is the red dot. That crater is believed to have been made by a collision with an asteroid about 4.8 km (3-miles) in diameter. Most of the craters on the Moon are thought to be impact craters although in the time of Galileo they were thought to be largely volcanic.

The Earth too is riddled with craters. The next time you go visit Lowell Observatory in Flagstaff, keep going east about 60 km (37 miles) you'll come to "Barringer Crater". This is a hole in the ground about 170 m (560 ft) deep, 1.882 km (3,900 ft) in diameter, and surrounded by a rim that rises 45m (148 ft) above the surrounding desert floor.

Meteor (Barringer) Crater, AZ Photo: Clark Williams

Although Earth is pretty well cratered, the natural erosion effects of our atmosphere tend to erase the surface evidence of the craters more quickly than you would see on the Moon. Earth only has one perfectly preserved impact crater. It is in the Gulf of Mexico near the Mexican village of Chicxulub and is buried under water and sediment.

Falling Bits of Rock:

Asteroids that are not in the Earth's atmosphere are called meteoroids. If they enter the atmosphere of Earth they are called meteors. If they make it to the ground they become meteorites. Meteoroids come in many sizes. Little grains of dust and small pebbles to mountains and planet sized objects.

On any given night of good viewing you should be able to see about five meteors per hour. Most of these burn up in the mesosphere: 50 to 80 km (31 to 50 miles) from the surface of Earth.

The glow you see in a meteor-tail is not the heating of the meteor. When these little bullets hit the atmosphere they are traveling up to 15 kps (33,554 mph). If you hit a fluid with the viscosity of air suddenly with that much speed, the air molecules will compress and begin to heat turning into plasma. In fact there is a kind of barrier built up just behind this plasma that helps to insulate the meteor from the heat of the plasma and the effect is that the plasma boils off the heat around the meteor. In most cases the supersonic shock wave at max-Q shatters the meteor and the dust disperses. The plasma dissipates and the streak of light generated fades from view.

If the meteor lasts long enough it will begin to heat the surface of the rock. Most meteors of this kind are good insulators and the rock itself experiences only very short term surface heating.

Meteorites often, when found immediately, are cold. Remember that this rock has been in space a LONG time and it has been cold-soaked for all that time. This little trip through the atmosphere took a few seconds, not nearly long enough to heat the rock significantly.

Why Worry:

So why worry about these things? Well these effects are caused from small rocks. Next time we'll take a look at something a little bigger.

----------- TO BE CONTINUED ---------------

The Shape of the Solar System

By Marcus Woo

When Stamatios (Tom) Krimigis was selected for the Voyager mission in 1971, he became the team's youngest principal investigator of an instrument, responsible for the Low Energy Charged Particles (LECP) instrument. It would measure the ions coursing around and between the planets, as well as those beyond. Little did he know, though, that more than 40 years later, both Voyager 1 and 2 still would be speeding through space, continuing to literally reshape our view of the solar system.

The solar system is enclosed in a vast bubble, carved out by the solar wind blowing against the gas of the interstellar medium. For more than half a century, scientists thought that as the sun moved through the galaxy, the interstellar medium would push back on the heliosphere, elongating the bubble and giving it a pointy, comet-like tail similar to the magnetospheres—bubbles formed by magnetic fields—surrounding Earth and most of the other planets

"We in the heliophysics community have lived with this picture for 55 years," said Krimigis, of The Johns Hopkins University Applied Physics Laboratory in Laurel, Maryland. "And we did that because we didn't have any data. It was all theory."

But now, he and his colleagues have the data. New measurements from Voyager and the Cassini spacecraft suggest that the bubble isn't pointy after all. It's spherical.

Their analysis relies on measuring high-speed particles from the heliosphere boundary. There, the heated ions from the solar wind can strike neutral atoms coming from the interstellar medium and snatch away an electron. Those ions become neutral atoms, and ricochet back toward the sun and the planets, uninhibited by the interplanetary magnetic field.

Voyager is now at the edge of the heliosphere, where its LECP instrument can detect those solar-wind ions. The researchers found that the number of measured ions rise and fall with increased and decreased solar activity, matching the 11-year solar cycle, showing that the particles are indeed originating from the sun.

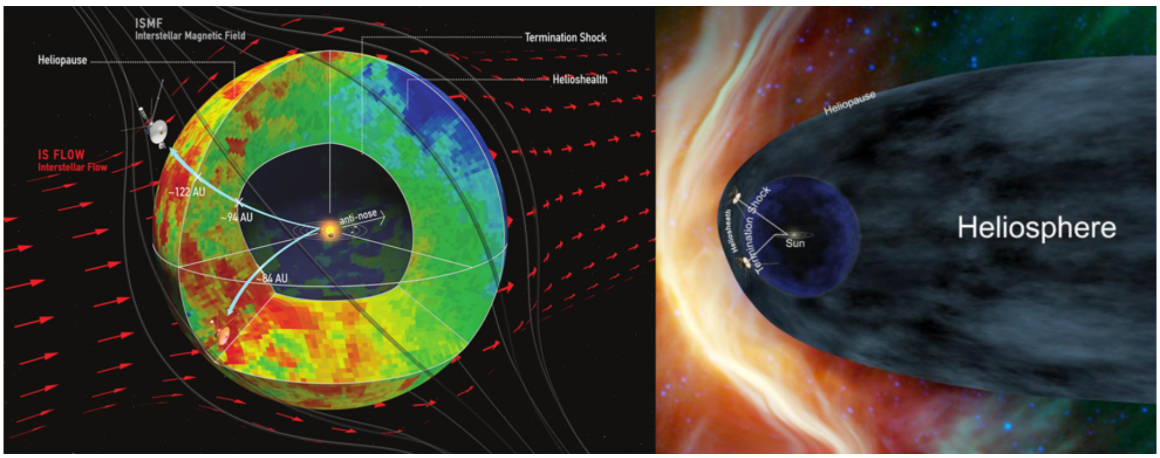
Meanwhile, Cassini, which launched 20 years after Voyager in 1997, has been measuring those neutral atoms bouncing back, using another instrument led by Krimigis, the Magnetosphere Imaging Instrument (MIMI). Between 2003 and 2014, the number of measured atoms soared and dropped in the same way as the ions, revealing that the latter begat the former. The neutral atoms must therefore come from the edge of the heliosphere.

If the heliosphere were comet-shaped, atoms from the tail would take longer to arrive at MIMI than those from the head. But the measurements from MIMI, which can detect incoming atoms from all directions, were the same everywhere. This suggests the distance to the heliosphere is the same every which way. The heliosphere, then, must be round, upending most scientists' prior assumptions.

It's a discovery more than four decades in the making. As Cassini ends its mission this year, the Voyager spacecraft will continue blazing through interstellar space, their remarkable longevity having been essential for revealing the heliosphere's shape.

"Without them," Krimigis says, "we wouldn't be able to do any of this."

To teach kids about the Voyager mission, visit the NASA Space Place:
https://spaceplace.nasa.gov/voyager-to-planets



New data from NASA's Cassini and Voyager show that the heliosphere — the bubble of the sun's magnetic influence that surrounds the solar system — may be much more compact and rounded than previously thought. The image on the left shows a compact model of the heliosphere, supported by this latest data, while the image on the right shows an alternate model with an extended tail. The main difference is the new model's lack of a trailing, comet-like tail on one side of the heliosphere. This tail is shown in the old model in light blue. ***Image credits: Dialynas, et al. (left); NASA (right)***

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