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The Celestial Mechanic

The Official Newsletter of the Astronomy Associates of Lawrence

Coming Events

Monthly Meeting
None Scheduled During Summer
Baker Wetlands Discovery Center

Public Observing
POST-Band Concert: 6/1, 6/15, 6/29
South Park, Lawrence - after 9PM

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Inside This Issue

Report From the Officers

By Rick Heschmeyer

Summer has finally arrived, or at least it will officially start on June 21st, the Summer Solstice and the longest day of the year. But before I dive into our summer schedule, I'd be remiss if I didn't mention a couple of events from May.

On Sunday evening May 15, and into the early morning hours of the 16th, there was a beautiful Total Lunar Eclipse. While not as deep in color as some, the Moon shone a dark crimson color, earning its nickname of "blood moon". Attached is an image taken by myself and my son Michael of the fully eclipsed Moon.

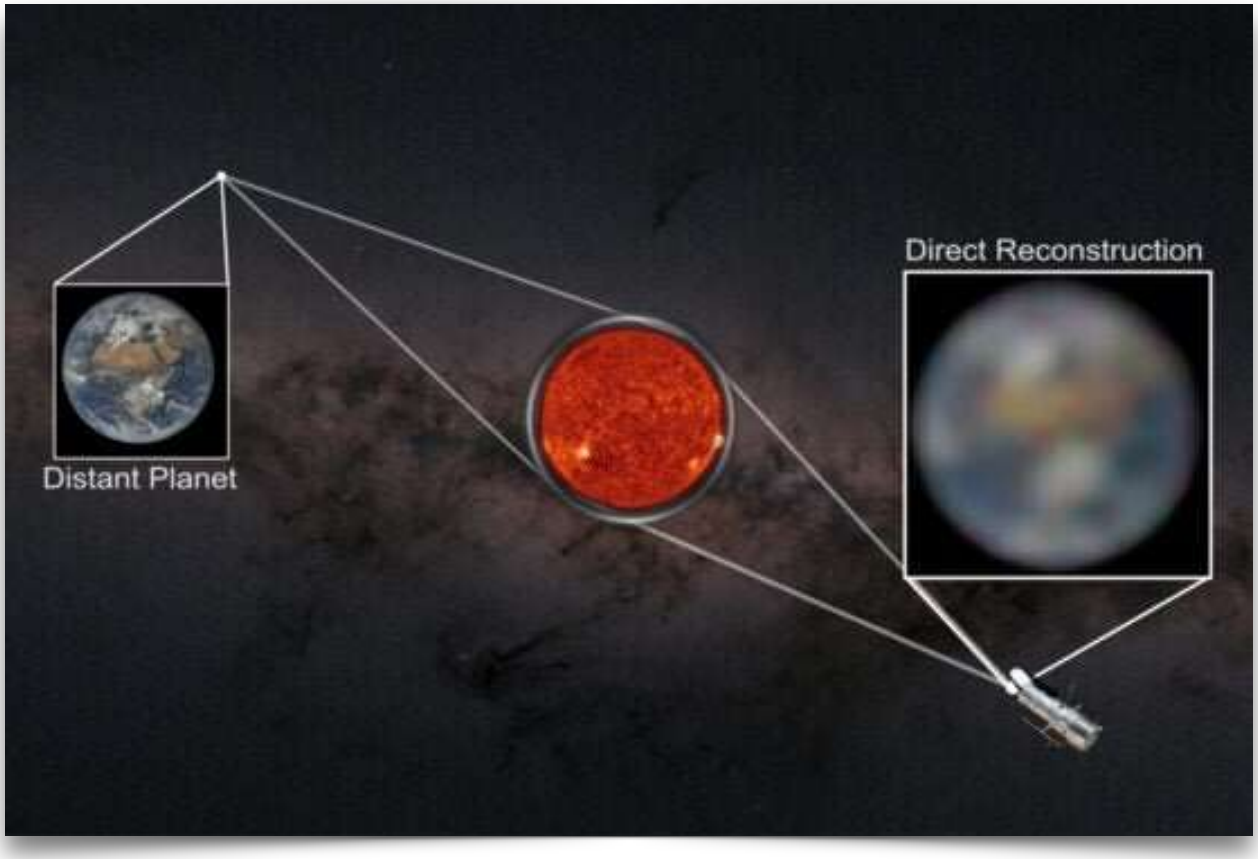
Later that week, on Saturday the 21st, the club held its first private combined Star Party for A.A.L. members and members of the KU Physics & Astronomy program. The clouds parted and we enjoyed clear skies, with a little brisk wind. About a dozen people enjoyed views through a half-dozen telescopes. Some of the objects observed included galaxies M65 & M66 in Leo, M59 & M60 in Virgo, and M51 & NGC 5195 in Canes Venatici, and the globular cluster M13 in Hercules. Thanks to everyone that came out and enjoyed the party!

There were several comments about doing more of these kinds of events, so we are looking at conducting another combined Star Party later this year. More details to follow.

And since it is summer, we have scheduled our Post-City Band Observing Sessions at South Park. The observing dates are June 1, June 15, June 29, and July 13. Observing will begin as soon as the concerts finish, usually around 9 PM, weather permitting of course.

Have a great summer and clear skies to all!

Scientists describe a gravity telescope that could image exoplanets



By Emily Moskal
PHYS.ORG, MAY 2, 2022

In the time since the first exoplanet was discovered in 1992, astronomers have detected more than 5,000 planets orbiting other stars. But when astronomers detect a new exoplanet, we don't learn a lot about it: We know that it exists and a few features about it, but the rest is a mystery.

To sidestep the physical limitations of telescopes, Stanford University astrophysicists have been working on a new conceptual imaging technique that would be 1,000 times more precise than the strongest imaging technology currently in use. By taking advantage of gravity's warping effect on space-time, called lensing, scientists could potentially manipulate this phenomenon to create imaging far more advanced than any present today.

In a paper published on May 2 in *The Astrophysical Journal*, the researchers describe a way to manipulate solar gravitational lensing to view planets outside our solar system. By positioning a telescope, the sun, and exoplanet in a line with the sun in the middle, scientists could use the gravitational field of the sun to magnify light from the exoplanet as it passes by. As opposed to a magnifying glass which has a curved surface that bends light, a gravitational lens has a curved space-time that enables imaging far away objects.

"We want to take pictures of planets that are orbiting other stars that are as good as the pictures we can make of planets in our own solar system," said Bruce Macintosh, a physics professor at in the School of Humanities and Sciences at Stanford and deputy director of the Kavli Institute for Particle Astrophysics and Cosmology (KIPAC). "With this technology, we hope to take a picture of a planet 100 light-years away that has the same impact as Apollo 8's picture of Earth."

The catch, at present, is that their proposed technique would require more advanced space travel than is currently available. Still, the promise of this concept and what it could reveal about other planets, makes it worth continued consideration and development, said the researchers.

The perks of light bending

Gravitational lensing wasn't experimentally observed until 1919 during a solar eclipse. With the moon obstructing the light from the sun, scientists were able

to see stars near the sun offset from their known positions. This was unequivocal proof that gravity could bend light and the first observational evidence that Einstein's theory of relativity was correct. Later, in 1979, Von Eshleman, a Stanford professor, published a detailed account of how astronomers and spacecraft could exploit the solar gravitational lens. (Meanwhile, astronomers including many at Stanford's KIPAC now routinely use the powerful gravity of the most massive galaxies to study the early evolution of the universe.)

But it wasn't until 2020 that the imaging technique was explored in detail in order to observe planets. Slava Turyshev of California Institute of Technology's Jet Propulsion Laboratory described a technique where a space-based telescope could use rockets to scan around the rays of light from a planet to reconstruct a clear picture, but the technique would require a lot of fuel and time.

Building on Turyshev's work, Alexander Madurowicz, a Ph.D. student at KIPAC, invented a new method that can reconstruct a planet's surface from a single image taken looking directly at the sun. By capturing the ring of light around the sun formed by the exoplanet, the algorithm Madurowicz designed can undistort the light from the ring by reversing the bending from the gravitational lens, which turns the ring back into a round planet.

Madurowicz demonstrated his work by using images of the rotating Earth taken by the satellite DSCOVR that sits between Earth and the sun. Then, he used a computer model to see what Earth would look like peering through the warping effects of the sun's gravity. By applying his algorithm to the observations, Madurowicz was able to recover the images of Earth and prove that his calculations were correct.

In order to capture an exoplanet image through the solar gravitational lens, a telescope would have to be placed at least 14 times farther away from the sun than Pluto, past the edge of our solar system, and further than humans have ever sent a spacecraft. But, the distance is a tiny fraction of the light-years between the sun and an exoplanet.

"By unbending the light bent by the sun, an image can be created far beyond that of an ordinary telescope," Madurowicz said. "So, the scientific potential is an untapped mystery because it's opening this new observing capability that doesn't yet exist."

Sights set beyond the solar system

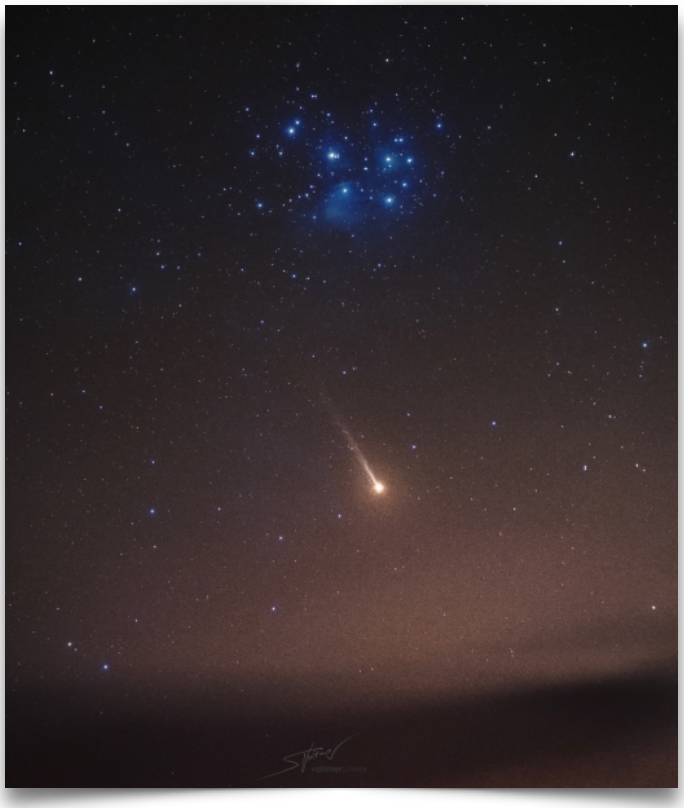
Currently, to image an exoplanet at the resolution the scientists describe, we would need a telescope 20 times wider than the Earth. By using the sun's gravity like a telescope, scientists can exploit this as a massive natural lens. A Hubble-sized telescope in combination with the solar gravitational lens would be sufficient to image exoplanets with enough power to capture fine details on the surface.

"The solar gravitational lens opens up an entirely new window for observation," said Madurowicz. "This will allow investigation of the detailed dynamics of the planet atmospheres, as well as the distributions of clouds and surface features, which we have no way to investigate now."

Madurowicz and Macintosh both say that it will be a minimum of 50 years before this technology could be deployed, likely longer. In order for this to be adopted, we will need faster spacecraft because, with current technology, it could take 100 years to travel to the lens. Using solar sails or the sun as a gravitational slingshot, the time could be as short as 20 or 40 years. Despite the timeline's uncertainty, the possibility to see whether some exoplanets have continents or oceans, Macintosh said, drives them. The presence of either is a strong indicator that there may be life on a distant planet.

"This is one of the last steps in discovering whether there's life on other planets," Macintosh said. "By taking a picture of another planet, you could look at it and possibly see green swatches that are forests and blue blotches that are oceans—with that, it would be hard to argue that it doesn't have life." ☀

THE SODIUM TAIL OF MERCURY



SPACEWEATHER, APRIL 29, 2022

Planets aren't supposed to have tails, but Mercury does. Dr. Sebastian Voltmer just photographed it from La Palma in the Canary Islands:

"This is NOT a comet, not even a meteor, but the planet Mercury, which is currently very close to the Pleiades," says Voltmer. "How is the tail formed? The solar wind and micro-meteorites eject sodium atoms from Mercury's surface. This creates a yellow-orange tail of sodium gas that is around 2.5 million kilometers long."

People around the world have been watching Mercury climb up the evening sky this month. Some of them are probably wondering "why didn't *I* see the tail?"

Answer: A special filter is required. "I used a 589 nm filter tuned to the yellow glow of sodium," says Voltmer. Without this kind of sodium filter, Mercury's tail would be invisible.

Voltmer says the tail is so bright, he could see it in individual 30 second exposures. "I can see some very small changes in shape of the tail," he says, "and the brightness is slightly increasing."

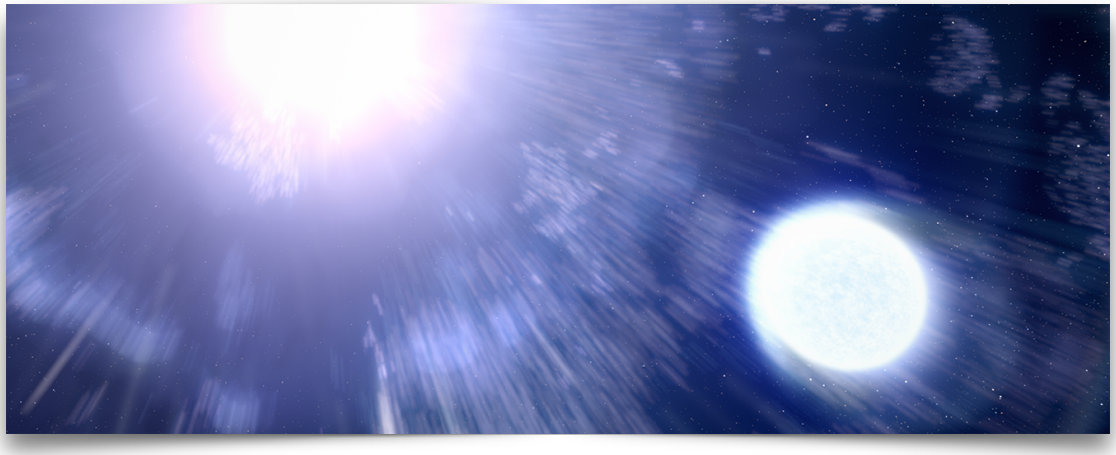
Dr. Sebastian Voltmer observing Mercury from La Palma on April 27, 2022. Inset is the 589 nm sodium filter.

The nights ahead are excellent times to catch this phenomenon. On April 29th and 30th, Mercury will glide past the Pleiades star cluster for a fantastic photo-op. Then, on May 1st and 2nd, the crescent Moon joins the show.

"Currently I'm imaging Mercury day by day just after sunset from the Canary Islands," says Voltmer. Stay tuned for more sodium. ☀

HUBBLE REVEALS SURVIVING COMPANION STAR IN AFTERMATH OF SUPERNOVA

Hubblesite, May 5, 2022



THE DISCOVERY HELPS EXPLAIN THE PUZZLE OF HYDROGEN LOSS PRE-SUPERNOVA, AND SUPPORTS THE THEORY THAT MOST MASSIVE STARS ARE PAIRED.

It's not unheard of to find a surviving star at the scene of a titanic supernova explosion, which would be expected to obliterate everything around it, but the latest research from the Hubble Space Telescope has provided a long-awaited clue to a specific type of stellar death. In some supernova cases, astronomers find no trace of the former star's outermost layer of hydrogen. What happened to the hydrogen? Suspicions that companion stars are responsible—siphoning away their partners' outer shell before their death—are supported by Hubble's identification of a surviving companion star on the scene of supernova 2013ge. The discovery also lends support to the theory that the majority of massive stars form and evolve as binary systems. It could also be the prequel to another cosmic drama: In time, the surviving, massive companion star will also undergo a supernova, and if both the stars' remnant cores are not flung from the system, they will eventually merge and produce gravitational waves, shaking the fabric of space itself.

NASA's Hubble Space Telescope has uncovered a witness at the scene of a star's explosive death: a companion star previously hidden in the glare of its partner's supernova. The discovery is a first for a particular type of supernova—one in which the star was stripped of its entire outer gas envelope before exploding.

The finding provides crucial insight into the binary nature of massive stars, as well as the potential prequel to the ultimate merger of the companion stars that would rattle across the universe as gravitational waves, ripples in the fabric of spacetime itself.

Astronomers detect the signature of various elements in supernova explosions. These elements are layered like an onion pre-supernova. Hydrogen is found in the outermost layer of a star, and if no hydrogen is detected in the aftermath of the supernova, that means it was stripped away before the explosion occurred.

The cause of the hydrogen loss had been a mystery, and astronomers have been using Hubble to search for clues and test theories to explain these stripped supernovae. The new Hubble observations provide the best evidence yet to support the theory that an unseen companion star siphons off the gas envelope from its partner star before it explodes.

"This was the moment we had been waiting for, finally seeing the evidence for a binary system progenitor of a fully stripped supernova," said astronomer Ori Fox of the Space Telescope Science Institute in Baltimore, Maryland, lead investigator on the Hubble research program. "The goal is to move this area of study from theory to working with data and seeing what these systems really look like."

Fox's team used Hubble's Wide Field Camera 3 to study the region of supernova (SN) 2013ge in ultraviolet light, as well as previous Hubble observations in the Barbara A. Mikulski Archive for Space Telescopes (MAST). Astronomers saw the light of the supernova fading over time from 2016 to 2020—but another nearby source of ultraviolet light at the same position maintained its brightness. This underlying source of ultraviolet emission is what the

team proposes is the surviving binary companion to SN 2013ge.

Two by two?

Previously, scientists theorized that a massive progenitor star's strong winds could blow away its hydrogen gas envelope, but observational evidence didn't support that. To explain the disconnect, astronomers developed theories and models in which a binary companion siphons off the hydrogen.

"In recent years many different lines of evidence have told us that stripped supernovae are likely formed in binaries, but we had yet to actually see the companion. So much of studying cosmic explosions is like forensic science—searching for clues and seeing what theories match. Thanks to Hubble, we are able to see this directly," said Maria Drout of the University of Toronto, a member of the Hubble research team.

In prior observations of SN 2013ge, Hubble saw two peaks in the ultraviolet light, rather than just the one typically seen in most supernovae. Fox said that one explanation for this double brightening was that the second peak shows when the supernova's shock wave hit a companion star, a possibility that now seems much more likely. Hubble's latest observations indicate that while the companion star was significantly jostled, including the hydrogen gas it had siphoned off its partner, it was not destroyed. Fox likens the effect to a jiggling bowl of jelly, which will eventually settle back to its original form.

While additional confirmation and similar supporting discoveries need to be found, Fox said that the implications of the discovery are still substantial, lending support to theories that the majority of massive stars form and evolve as binary systems.

One to Watch

Unlike supernovae that have a puffy shell of gas to light up, the progenitors of fully stripped-envelope supernovae have proven difficult to identify in pre-explosion images. Now that astronomers have been lucky enough to identify the surviving companion star, they can use it to work backward and determine characteristics of the star that exploded, as well as the unprecedented opportunity to watch the aftermath unfold with the survivor.

As a massive star itself, SN 2013ge's companion is also destined to undergo a supernova. Its former partner is now likely a compact object, such as a neutron star or black hole, and the companion will likely go that route as well.

The closeness of the original companion stars will determine if they stay together. If the distance is too great, the companion star will be flung out of the system to wander alone across our galaxy, a fate that could explain many seemingly solitary supernovae.

However, if the stars were close enough to each other pre-supernova, they will continue orbiting each other as black holes or neutron stars. In that case, they would eventually spiral toward each other and merge, creating gravitational waves in the process.

That is an exciting prospect for astronomers, as gravitational waves are a branch of astrophysics that has only begun to be explored. They are waves or ripples in the fabric of spacetime itself, predicted by Albert Einstein in the early 20th century. Gravitational waves were first directly observed by the Laser Interferometer Gravitational-Wave Observatory (LIGO).

"With the surviving companion of SN 2013ge, we could potentially be seeing the prequel to a gravitational wave event, although such an event would still be about a billion years in the future," Fox said.

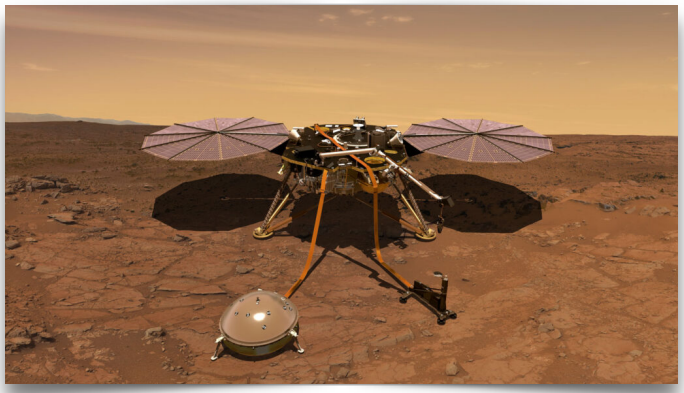
Fox and his collaborators will be working with Hubble to build up a larger sample of surviving companion stars to other supernovae, in effect giving SN 2013ge some company again.

"There is great potential beyond just understanding the supernova itself. Since we now know most massive stars in the universe form in binary pairs, observations of surviving companion stars are necessary to help understand the details behind binary formation, material-swapping, and co-evolutionary development. It's an exciting time to be studying the stars," Fox said.

"Understanding the lifecycle of massive stars is particularly important to us because all heavy elements are forged in their cores and through their supernovae. Those elements make up much of the observable universe, including life as we know it," added co-author Alex Filippenko of the University of California at Berkeley.

The results are published in The Astrophysical Journal Letters. ☀

NASA's InSight Lander has Recorded the Largest Marsquake yet



InSight's seismometer, seen in the lower left of this artist's rendition of the lander, recently detected Mars' largest known quake.

By Katherine Kornei

SCIENCENEWS, MAY 13, 2022

Any Martians out there should learn to duck and cover.

On May 4, the Red Planet was rocked by a roughly magnitude 5 temblor, the largest Marsquake detected to date, NASA's Jet Propulsion Laboratory in Pasadena, Calif., reports. The shaking lasted for more than six hours and released more than 10 times the energy of the previous record-holding quake.

The U.S. space agency's InSight lander, which has been studying Mars' deep interior since touching down on the planet in 2018 (*SN: 11/26/18*), recorded the event. The quake probably originated near the Cerberus Fossae region, which is more than 1,000 kilometers from the lander.

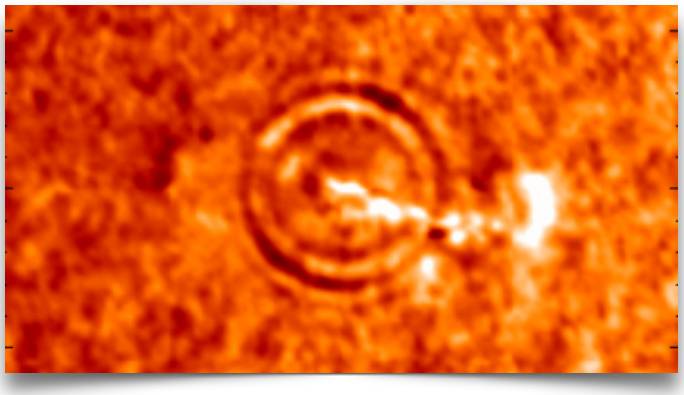
Cerberus Fossae is known for its fractured surface and frequent rockfalls. It makes sense that the ground would be shifting there, says geophysicist Philippe Lognonné, principal investigator of the Seismic Experiment for Interior Structure, InSight's seismometer. "It's an ancient volcanic bulge."

Just like earthquakes reveal information about our planet's interior structure, Marsquakes can be used to probe what lies beneath Mars' surface (*SN: 7/22/21*). And a lot can be learned from studying this whopper of a quake, says Lognonné, of the Institut de Physique du Globe de Paris. "The signal is so good, we'll be able to work on the details." ☀

The First Sunquake of Solar Cycle 25

SPACE WEATHER.COM, MAY 13, 2022

Twenty-six years ago, researchers discovered seismic activity on the sun. A team led by Dr. Alexander Kosovichev, then at Stanford University, found circular waves rippling from the core of some solar flares, like this:



They named the tremors "sunquakes"--much like earthquakes except incredibly more powerful. A typical sunquake contains 40,000 times the energy released in the great San Francisco earthquake of 1906. These solar seismic waves appear to be compression waves like the "P" waves generated by an earthquake. They travel through the sun's interior and probably recombine on the opposite side of the sun to create a faint duplicate of the original ripple pattern.

Kosovichev and colleagues have since observed hundreds of sunquakes. Not all flares produce them, which is a mystery. Moreover, the ripples behave strangely. A typical wave starts off at an initial speed of ~20,000 mph, then accelerates to a maximum of 250,000 mph before disappearing. No one knows exactly why.

"We have just detected the first sunquake of Solar Cycle 25," announces Kosovichev, who is now a professor at the New Jersey Institute of Technology (NJIT). "It rippled away from the X1.5-class solar flare of May 10, 2022." The movie, centered on the blast site, shows concentric rings emerging from the turbulent surface of the sun.

When Kosovichev discovered sunquakes in 1996, he stretched the images fourfold to highlight the ripples for press releases. This week's sunquake he has left in its raw form--not quite as easy to see, but just as

impressive for a different reason. "I wanted people to appreciate how the ripples are nearly overwhelmed by turbulence," he explains. "This is why it took us so long to discover them."

Solar Cycle 25 is intensifying rapidly and many more sunquakes are in the offing. The mysterious ripples could teach researchers a great deal about the magnetic underpinnings of sunspots and how they produce the strongest flares. "We are ready to learn," says Kosovichev. Let the tremors begin. ☀

A first: Scientists grow plants in soil from the Moon

Sciencedaily, May 12, 2022

Scientists have grown plants in soil from the Moon, a first in human history and a milestone in lunar and space exploration.

In a new paper published in the journal *Communications Biology*, University of Florida researchers showed that plants can successfully sprout and grow in lunar soil. Their study also investigated how plants respond biologically to the Moon's soil, also known as lunar regolith, which is radically different from soil found on Earth.

This work is a first step toward one day growing plants for food and oxygen on the Moon or during space missions. More immediately, this research comes as the Artemis Program plans to return humans to the Moon.

"Artemis will require a better understanding of how to grow plants in space," said Rob Ferl, one of the study's authors and a distinguished professor of horticultural sciences in the UF Institute of Food and Agricultural Sciences (UF/IFAS).

Even in the early days of lunar exploration, plants played an important role, said Anna-Lisa Paul, also one of the study's authors and a research professor of horticultural sciences in UF/IFAS.

"Plants helped establish that the soil samples brought back from the moon did not harbor pathogens or other unknown components that would harm terrestrial life, but those plants were only dusted with the lunar regolith and were never actually grown in it," Paul said.

Paul and Ferl are internationally recognized experts in the study of plants in space. Through the UF Space Plants Lab, they have sent experiments on space shuttles, to the International Space Station and on suborbital flights.

"For future, longer space missions, we may use the Moon as a hub or launching pad. It makes sense that we would want to use the soil that's already there to grow plants," Ferl said. "So, what happens when you grow plants in lunar soil, something that is totally outside of a plant's evolutionary experience? What would plants do in a lunar greenhouse? Could we have lunar farmers?"

To begin to answer these questions, Ferl and Paul designed a deceptively simple experiment: plant seeds in lunar soil, add water, nutrients and light, and record the results.

The complication: The scientists only had 12 grams -- just a few teaspoons -- of lunar soil with which to do this experiment. On loan from NASA, this soil was collected during the Apollo 11, 12 and 17 missions to the Moon. Paul and Ferl applied three times over the course of 11 years for a chance to work with the lunar regolith.

The small amount of soil, not to mention its incalculable historical and scientific significance, meant that Paul and Ferl had to design a small scale, carefully choreographed experiment. To grow their tiny lunar garden, the researchers used thimble-sized wells in plastic plates normally used to culture cells. Each well functioned as a pot. Once they filled each "pot" with approximately a gram of lunar soil, the scientists moistened the soil with a nutrient solution and added a few seeds from the Arabidopsis plant.

Arabidopsis is widely used in the plant sciences because its genetic code has been fully mapped. Growing Arabidopsis in the lunar soil allowed the researchers more insight into how the soil affected the plants, down to the level of gene expression.

As points of comparison, the researchers also planted Arabidopsis in JSC-1A, a terrestrial substance that mimics real lunar soil, as well as simulated Martian soils and terrestrial soils from extreme environments. The plants grown in these non-lunar soils were the experiment's control group.

Before the experiment, the researchers weren't sure if the seeds planted in the lunar soils would sprout. But nearly all of them did.

"We were amazed. We did not predict that," Paul said. "That told us that the lunar soils didn't interrupt the hormones and signals involved in plant germination."

However, as time went on, the researchers observed differences between the plants grown in lunar soil and the control group. For example, some of the plants grown in the lunar soils were smaller, grew more slowly or were more varied in size than their counterparts.

These were all physical signs that the plants were working to cope with the chemical and structural make-up of the Moon's soil, Paul explained. This was further confirmed when the researchers analyzed the plants' gene expression patterns.

"At the genetic level, the plants were pulling out the tools typically used to cope with stressors, such as salt and metals or oxidative stress, so we can infer that the plants perceive the lunar soil environment as stressful," Paul said. "Ultimately, we would like to use the gene expression data to help address how we can ameliorate the stress responses to the level where plants -- particularly crops -- are able to grow in lunar soil with very little impact to their health."

How plants respond to lunar soil may be linked to where the soil was collected, said Ferl and Paul, who collaborated on the study with Stephen Elardo, an assistant professor of geology at UF.

For instance, the researchers found that the plants with the most signs of stress were those grown in what lunar geologists call mature lunar soil. These mature soils are those exposed to more cosmic wind, which alters their makeup. On the other hand, plants grown in comparatively less mature soils fared better.

Growing plants in lunar soils may also change the soils themselves, Elardo said.

"The Moon is a very, very dry place. How will minerals in the lunar soil respond to having a plant grown in them, with the added water and nutrients? Will adding water make the mineralogy more hospitable to plants?" Elardo said.

Follow up studies will build on these questions and more. For now, the scientists are celebrating having taken the first steps toward growing plants on the Moon.

"We wanted to do this experiment because, for years, we were asking this question: Would plants grow in lunar soil," Ferl said. "The answer, it turns out, is yes."☀

By Robert Pearlman

SPACE.COM, MAY 23, 2022

With more countries operating spacecraft on and around Mars than ever before, the United Nations is celebrating human achievement at the Red Planet with its latest release of postage stamps.

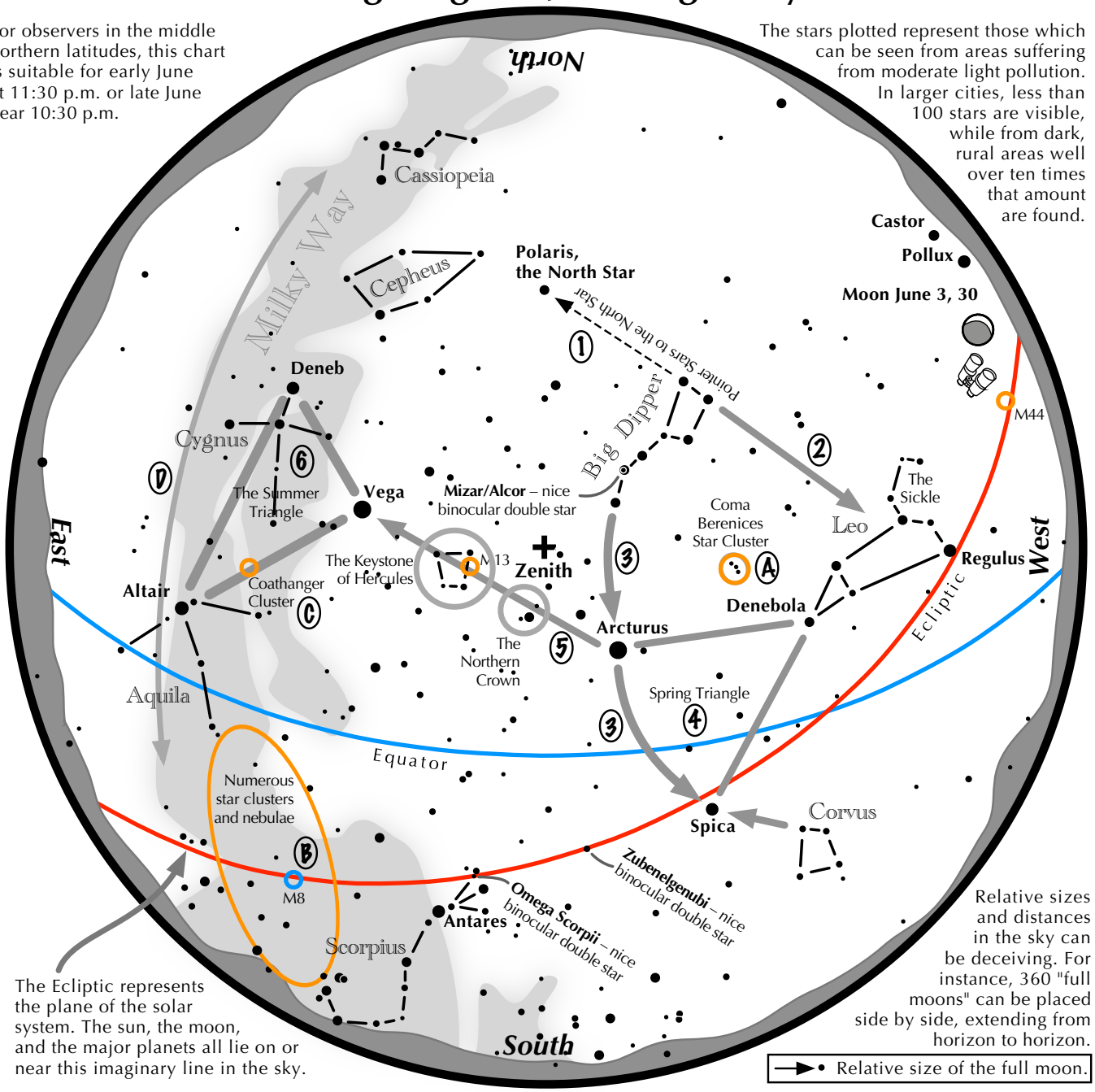
The United Nations Postal Administration (UNPA) has issued six commemorative stamps and three souvenir sheets themed to the Mars missions launched by the United Arab Emirates (UAE), United States and China.

"Mars has been a source of curiosity for centuries. In a historic year for exploration, three missions reached their destinations on, and around, the 'Red Planet' in 2021. This stamp series marks those pioneering achievements," UNPA officials wrote in a press release announcing the new "Planet Mars" stamps. ☀

Navigating the June Night Sky

For observers in the middle northern latitudes, this chart is suitable for early June at 11:30 p.m. or late June near 10:30 p.m.

The stars plotted represent those which can be seen from areas suffering from moderate light pollution. In larger cities, less than 100 stars are visible, while from dark, rural areas well over ten times that amount are found.



The Ecliptic represents the plane of the solar system. The sun, the moon, and the major planets all lie on or near this imaginary line in the sky.

Relative sizes and distances in the sky can be deceiving. For instance, 360 "full moons" can be placed side by side, extending from horizon to horizon.

Relative size of the full moon.

Navigating the June night sky: Simply start with what you know or with what you can easily find.

1. Extend a line north from the two stars at the tip of the Big Dipper's bowl. It passes by Polaris, the North Star.
2. Draw another line in the opposite direction. It strikes the constellation Leo high in the west.
3. Follow the arc of the Dipper's handle. It first intersects Arcturus, the brightest star in the June evening sky, then Spica.
4. Arcturus, Spica, and Denebola form the Spring Triangle, a large equilateral triangle.
5. To the northeast of Arcturus shines another star of the same brightness, Vega. Draw a line from Arcturus to Vega. It first meets "The Northern Crown," then the "Keystone of Hercules." A dark sky is needed to see these two dim stellar configurations.
6. High in the east are the three bright stars of the Summer Triangle: Vega, Altair, and Deneb.

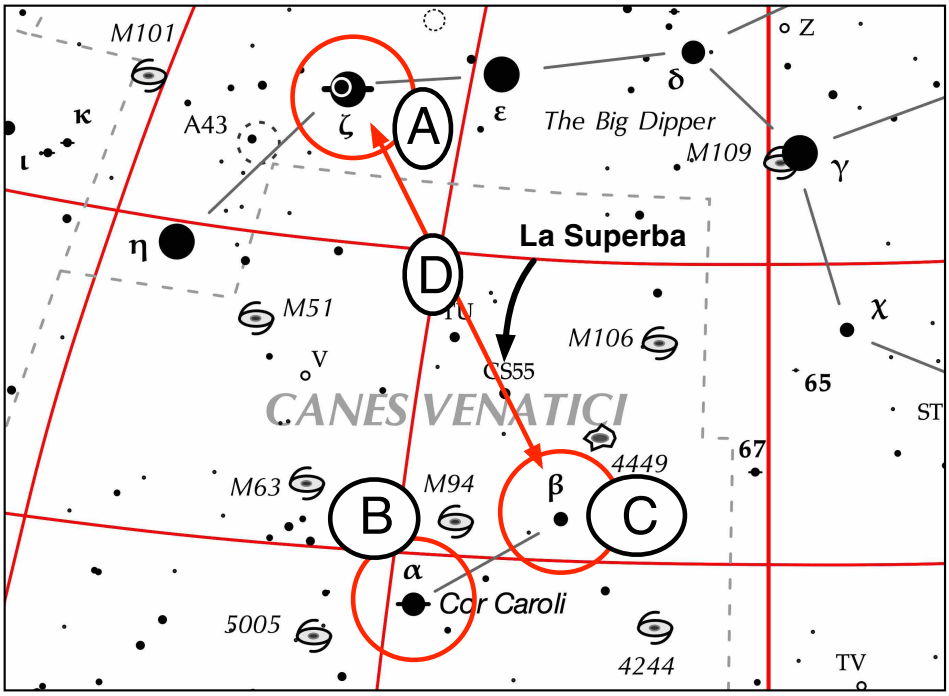
Binocular Highlights

A: Between Denebola and the tip of the Big Dipper's handle, lie the stars of the Coma Berenices Star Cluster.
B: Between the bright stars of Antares and Altair, hides an area containing many star clusters and nebulae.
C: 40% of the way between Altair and Vega, twinkles the "Coathanger," a group of stars outlining a coathanger.
D. Sweep along the Milky Way for an astounding number of faint glows and dark bays.

A Springtime Attraction:
La Superba!

A beautiful, very red star

also known as Y Canum Venaticorum, AL Carbon Star 55



Practice star hopping and triangulation ...

How to find "La Superba"

A. Find Zeta Ursae Majoris – also called Mizar – the next star to the end of the Big Dipper's handle.
B. Locate Cor Caroli, Alpha Canum Venaticorum, near the center of the handle's curvature.
C. Find 4.2 magnitude Beta to Alpha's northwest.
D. Draw a line between Zeta and Beta.
E. About 3/4 along this line shines La Superba.

Appearance in binoculars or a telescope:
1. betweeen 4.8 and 6.3 magnitude
2. Redder than Betelgeuse.

Physical Characteristics:
Distance: 760 light-years
Radius: 350 suns; 3.3 AU (past the orbit of Mars)
Temperature: 5000 F (sun = 10,000 F
Luminosity: 6200 suns

How bright and how red is La Superba to you?

About Astronomy Associates

The club is open to all people interested in sharing their love for astronomy. Monthly meetings are typically on the last Sunday of each month and often feature guest speakers, presentations by club members, and a chance to exchange amateur astronomy tips. These meetings and the public observing sessions that follow are scheduled at the Baker Wetlands Discovery Center, south of Lawrence. All events and meetings are free and open to the public. Periodic star parties are scheduled as well.

Because of the flexibility of the schedule due to holidays and alternate events, it is always best to check the Web site for the exact Sundays when events are scheduled.

Copies of the Celestial Mechanic can also be found on the web at newsletter.
Annual Dues for the club are: $12 for regular members; $6 for students Membership forms can be accessed at the club website form.