Capital Area Astronomy Association

Abrams Planetarium

Next meeting:

March meeting cancelled Be healthy

- **President's column**
- **NASA's TESS discovers new worlds in a river of young stars**
- **Upcoming events (On hold)**
- **On the quest for other Earths**

Presidents column

I hope you were able to watch some of the awesome Mars2020 Rover landing on Feb. 18, 2021! It was an amazing landing to witness live streaming on the internet and the landing videos were stunning.

Abrams Planetarium Facebook page recently held a Night Sky Chat on the Mars mission and the Perseverance Rover. It was a very interesting talk and I highly recommend viewing it.

Professor Michael Velbel from the MSU department of Earth and Environmental Sciences talks about the latest NASA mission to land on Mars, the Rovers scientific instruments, and why the landing site was chosen.

The video can be viewed online at:

https://fb.watch/3_PswxzIXv

As always, please let me know if you have ideas or suggestions for upcoming programs.
Please email your program suggestions to me at mwrogers7@gmail.com

Pres. Mike's E-mail: mwrogers7@gmail.com

Treasurer E-mail: chuck_taricska@yahoo

New website: https://caaastronomy.wixsite.com/caaa

My E-mail: kmelvin33@gmail.com

NASA's TESS discovers new worlds in a river of young stars

February 12, 2021
NASA/Goddard Space Flight Center

Astronomers have discovered a trio of hot worlds larger than Earth orbiting a much younger version of our Sun called TOI 451. The system resides in the recently discovered Pisces-Eridanus stream, a collection of stars less than 3% the age of our solar system that stretches across one-third of the sky.

Using observations from NASA's Transiting Exoplanet Survey Satellite (TESS), an international team of astronomers has discovered a trio of hot worlds larger than Earth orbiting a much younger version of our Sun called TOI 451. The system resides in the recently discovered Pisces-Eridanus stream, a collection of stars less than 3% the age of our solar system that stretches across one-third of the sky. The planets were discovered in TESS images taken between October and December 2018. Follow-up studies of TOI 451 and its planets included observations made in 2019 and 2020 using NASA's Spitzer Space Telescope, which has since been retired, as well as many ground-based facilities. Archival infrared data from NASA's Near-Earth Object Wide-Field Infrared Survey Explorer (NEOWISE) satellite -- collected between 2009 and 2011 under its previous moniker, WISE -- suggests the system retains a cool disk of dust and rocky debris. Other observations show that TOI 451 likely has two distant stellar companions circling each other far beyond the planets. "This system checks a lot of boxes for astronomers," said Elisabeth Newton, an assistant professor of physics and astronomy at Dartmouth College in Hanover, New Hampshire, who led the research. "It's only 120 million years old and just 400 light-years away, allowing detailed observations of this young planetary system. And because there are three planets between two and four times Earth's size, they make especially promising targets for testing theories about how planetary atmospheres evolve." A paper reporting the findings was published on Jan. 14 in *The Astronomical Journal* and is available online. Stellar streams form when the gravity of our Milky Way galaxy tears apart star clusters or dwarf galaxies. The individual stars move out along the cluster's original orbit, forming an elongated group that gradually disperses. In 2019, a team led by Stefan Meingast at the University of Vienna used data from the European Space Agency's Gaia mission to discover the Pisces-Eridanus stream, named for the constellations containing the greatest concentrations of stars. Stretching across 14 constellations, the stream is about 1,300 light-years long. However, the age initially determined for the stream was much older than we now think. Later in 2019, researchers led by Jason Curtis at Columbia University in New York City analyzed TESS data for dozens of stream members. Younger stars spin faster than their older counterparts do, and they also tend to have prominent starspots -- darker, cooler regions like sunspots. As these spots rotate in and out of our view, they can produce slight variations in a star's brightness that TESS can measure. The TESS measurements revealed overwhelming evidence of starspots and rapid rotation among the stream's stars. Based on this result, Curtis and his colleagues found that the stream was only 120 million years old -- similar to the famous Pleiades cluster and eight times younger than previous estimates. The mass, youth, and proximity of the Pisces-Eridanus stream make it an exciting fundamental laboratory for studying star and planet formation and evolution. "Thanks to TESS's nearly all-sky coverage, measurements that could support a search for planets orbiting members of this stream were already available to us when the stream was identified," said Jessie Christiansen, a co-author of the paper and the deputy science lead at the NASA Exoplanet Archive, a facility for researching worlds beyond our solar system managed by Caltech in Pasadena, California. "TESS data will continue to allow us to push the limits of what we know about exoplanets and their systems for years to come." The young star TOI 451, better known to astronomers as CD-38 1467, lies about 400 light-years away in the constellation Eridanus. It has 95% of our Sun's mass, but it is 12% smaller, slightly cooler, and emits 35% less energy. TOI 451 rotates every 5.1 days, which is more than five times faster than the Sun. TESS spots new worlds by looking for transits, the slight, regular dimmings that occur when a planet passes in front of its star from our perspective. Transits from all three planets are evident in the TESS data. Newton's team obtained measurements from Spitzer that supported the TESS findings and helped to rule out possible alternative explanations. Additional follow-up observations came from Las Cumbres Observatory -- a global telescope network headquartered in Goleta, California -- and the Perth Exoplanet Survey Telescope in Australia. Even TOI 451's most distant planet orbits three times closer than Mercury ever approaches to the Sun, so all of these worlds are quite hot and inhospitable to life as we know it. Temperature estimates range from about 2,200 degrees Fahrenheit (1,200 degrees Celsius) for the innermost planet to about 840 F (450 C) for the outermost one. TOI 451 b orbits every 1.9 days, is about 1.9 times Earth's size, and its estimated mass ranges from two to 12 times Earth's. The next planet out, TOI 451 c, completes an orbit every 9.2 days, is about three times larger than Earth, and holds between three and 16 times Earth's mass. The farthest and largest world, TOI 451 d, circles the star every 16 days, is four times the size of our planet, and weighs between four and 19 Earth masses. Astronomers expect planets as big as these to retain much of their atmospheres despite the intense heat from their nearby star. Different theories of how atmospheres evolve by the time a planetary system reaches TOI 451's age predict a wide range of properties. Observing starlight passing through the atmospheres of these planets provides an opportunity to study this phase of development and could aid in constraining current models. "By measuring starlight penetrating a planet's atmosphere at different wavelengths, we can infer its chemical composition and the presence of clouds or high-altitude hazes," said Elisa

Quintana, an astrophysicist at NASA's Goddard Space Flight Center in Greenbelt, Maryland. "TOI 451's planets offer excellent targets for such studies with Hubble and the upcoming James Webb Space Telescope." Observations from WISE show that the system is unusually bright in infrared light, which is invisible to human eyes, at wavelengths of 12 and 24 micrometers. This suggests the presence of a debris disk, where rocky asteroid-like bodies collide and grind themselves to dust. While Newton and her team cannot determine the extent of the disk, they envision it as a diffuse ring of rock and dust centered about as far from the star as Jupiter is from our Sun. The researchers also investigated a faint neighboring star that appears about two pixels away from TOI 451 in TESS images. Based on Gaia data, Newton's team determined this star to be a gravitationally bound companion located so far from TOI 451 that its light takes 27 days to get there. In fact, the researchers think the companion is likely a binary system of two M-type dwarf stars, each with about 45% of the Sun's mass and emitting only 2% of its energy. TESS is a NASA Astrophysics Explorer mission led and operated by MIT in Cambridge, Massachusetts, and managed by NASA's Goddard Space Flight Center. Additional partners include Northrop Grumman, based in Falls Church, Virginia; NASA's Ames Research Center in California's Silicon Valley; the Center for Astrophysics | Harvard & Smithsonian in Cambridge, Massachusetts; MIT's Lincoln Laboratory; and the Space Telescope Science Institute in Baltimore. More than a dozen universities, research institutes, and observatories worldwide are participants in the mission. NASA's Jet Propulsion Laboratory in Southern California manages NEOWISE for NASA's Science Mission Directorate in Washington. Ball Aerospace & Technologies Corp. of Boulder, Colorado, built the spacecraft. Science data processing takes place at IPAC at Caltech in Pasadena. Caltech manages JPL for NASA.

Materials provided by **NASA/Goddard Space Flight Center**. Original written by Francis Reddy.

On the quest for other Earths

February 17, 2021
ETH Zurich

An international research team has developed a new method for directly imaging smaller planets in the habitable zone of a neighboring star system. This opens up new possibilities in the search for extraterrestrial life. In the search for planets capable of sustaining life, an international research team with members from ETH has taken a significant step forward. As the researchers reported recently in the journal *Nature Communications*, they found signs of a Neptune-sized planet in the Alpha Centauri star system, a mere 4.4 light years away from Earth. This exoplanet is located in a zone that may offer suitable conditions for life. The team was able to collect data with unprecedented sensitivity, thus registering even very weak signals.

Earth is a disruptive factor

Thanks to the new process, the researchers have advanced one step closer to a major goal of exoplanet research: the discovery of Earth-like planets capable of supporting life. Direct imaging of planets delivers information about the composition of their atmospheres and possibly even signs of life. To date, however, direct measurements have mostly found exoplanets that are larger than Jupiter and orbit far away from very young host stars. In other words, these planets fall outside the habitable zone where liquid water could form. One reason that the search for Earth-like planets has so far proved fruitless is that it has been conducted in the near-infrared range, even though Earth-like planets that might have water are brightest in the mid-infrared range. Yet it is precisely in that range that measurements with normal telescopes are difficult, because that is where the Earth and its atmosphere are also at their brightest. This means the faint signals from exoplanets are lost in particularly strong background noise. **100 hours of observations** As reported in their study, the researchers have now been able to overcome this difficulty and take measurements in the mid-infrared range. They used the Very Large Telescope at the European Southern Observatory in Chile to examine Alpha Centauri stars A and B, logging nearly 100 hours over the course of a month. "Keeping the telescope pointed at the same star for such a long time is highly unusual," explains Anna Boehle, a postdoc in ETH Professor Sascha Quanz's group. As second author of the study, Boehle was heavily involved in evaluating the data. "We assessed more than five million images," she says. To be able to detect the faint signals from potential planets, the researchers not only processed a huge volume of data, they also employed two sophisticated measurement techniques: one was to use a new deformable secondary telescope mirror, which made it possible to correct for distortions in the light coming through the Earth's atmosphere; and the other was to use a coronagraph to alternately block the light from each of the stars in turn at very short intervals. This let the scientists further reduce signal noise while examining the surroundings of both stars. **Signs of a planet** "Our findings indicate that in principle, this process enables us to discover smaller terrestrial planets capable of hosting life," Boehle explains, "and it represents a clear improvement over previous observation methods." Indeed, in their data the researchers found a light signal that may originate from a Neptune-sized planet. Boehle says, "Whether or not this signal is actually from a planet requires further study. To that end, we plan to combine the infrared measurements with other measurement methods."

Materials provided by **ETH Zurich**. Original written by Felix Würsten.

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Fox Park Observatory Report

Saturday Feb. 20, 2021

We had about a foot of snow on the roof of the observatory that we had to clear off before we could open up on Saturday. Lucky the park staff had plowed a path back to the observatory, so we could get right to it. We were able to clear the snow off the roof, and break the ice out of the tracks, however the winch that pulls the roof open failed and the clutch burned out. We ended up running a rope from the roof to Kevin's truck and he was able to pull through the snow drifts and yank the roof open. Thanks Kevin! Now all we needed were some visitors to brave the COLD!

About 10 visitors came out, including one young student who was taking a virtual astronomy class and she was prepared to make some observations and sketches for a homework assignment. Hopefully we can get some others to come out from that class because the observatory is a perfect way for them to get some real hands on experience.

One thing about trying to observe in the very cold is that the eyepiece fogs up so fast from breathing on it, and it is even worse while wearing masks! Soon we will be warming up and not having to freeze while getting some nice views of the skies.

Come on out to our next observing night on March 5-6 and 19-20!

See you there-- Chuck

UPCOMING EVENTS

Fox park observatory open houses:

Friday and Saturday March 5 &6

Friday and Saturday March 19 &20
Weather permitting, come out and enjoy the stars!!
jb.foxpark@gmail.com

If you have Astronomy items for sale, images, test reports or observations you would like to post to the newsletter, please send them to me at kmelvin33@gmail.com

Club dues. Please send to Chuck $12.00
Treasurer E-mail: chuck_taricska@yahoo
Thank you all for supporting the group.