Capital Area Astronomy Association

Abrams Planetarium

Presidents column

Next meeting,

May meeting cancelled

Be healthy

President's column

- **Earth-size, habitable-zone planet found hidden in early NASA Kepler data**
- **Upcoming events (On hold)**
- **New formation theory explains the mysterious interstellar object 'Oumuamua**

We hope to see you soon!

Mike Rogers

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

I have put together a list of NASA Night Sky Network webinars on the website- they have some interesting ones on Mars, Hubble's 30th Anniversary, The Parker Solar Probe, and many more. Please check out the NASA network website for more info:

https://nightsky.jpl.nasa.gov/download-search.cfm

https://caaastronomy.wixsite.com/caaa/newsletter

-Chuck

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Earth-size, habitable-zone planet found hidden in early NASA Kepler data

While the star it orbits is much smaller than our Sun, it gets about 75 percent of the sunlight Earth does
April 16, 2020
NASA/Jet Propulsion Laboratory
A reanalysis of data from NASA's Kepler space telescope has revealed an Earth-size exoplanet orbiting in its star's habitable zone, the area around a star where a rocky planet could support liquid water.

A team of transatlantic scientists, using reanalyzed data from NASA's Kepler space telescope, has discovered an Earth-size exoplanet orbiting in its star's habitable zone, the area around a star where a rocky planet could support liquid water. Scientists discovered this planet, called Kepler-1649c, when looking through old observations from Kepler, which the agency retired in 2018. While previous searches with a computer algorithm misidentified it, researchers reviewing Kepler data took a second look at the signature and recognized it as a planet. Out of all the exoplanets found by Kepler, this distant world -- located 300 light-years from Earth -- is most similar to Earth in size and estimated temperature. This newly revealed world is only 1.06 times larger than our own planet. Also, the amount of starlight it receives from its host star is 75% of the amount of light Earth receives from our Sun -- meaning the exoplanet's temperature may be similar to our planet's as well. But unlike Earth, it orbits a red dwarf. Though none have been observed in this system, this type of star is known for stellar flare-ups that may make a planet's environment challenging for any potential life. "This intriguing, distant world gives us even greater hope that a second Earth lies among the stars, waiting to be found," said Thomas Zurbuchen, associate administrator of NASA's Science Mission Directorate in Washington. "The data gathered by missions like Kepler and our Transiting Exoplanet Survey Satellite [TESS] will continue to yield amazing discoveries as the science community refines its abilities to look for promising planets year after year." There is still much that is unknown about Kepler-1649c, including its atmosphere, which could affect the planet's temperature. Current calculations of the planet's size have significant margins of error, as do all values in astronomy when studying objects so far away. But based on what is known, Kepler-1649c is especially intriguing for scientists looking for worlds with potentially habitable conditions. There are other exoplanets estimated to be closer to Earth in size, such as TRAPPIST-1f and, by some calculations, Teegarden c. Others may be closer to Earth in temperature, such as TRAPPIST-1d and TOI 700d. But there is no other exoplanet that is considered to be closer to Earth in both of these values that also lies in the habitable zone of its system.

"Out of all the mislabeled planets we've recovered, this one's particularly exciting -- not just because it's in the habitable zone and Earth-size, but because of how it might interact with this neighboring planet," said Andrew Vanderburg, a researcher at the University of Texas at Austin and first author on the paper released today in *The Astrophysical Journal Letters*. "If we hadn't looked over the algorithm's work by hand, we would have missed it." Kepler-1649c orbits its small red dwarf star so closely that a year on Kepler-1649c is equivalent to only 19.5 Earth days. The system has another rocky planet of about the same size, but it orbits the star at about half the distance of Kepler-1649c, similar to how Venus orbits our Sun at about half the distance that Earth does. Red dwarf stars are among the most common in the galaxy, meaning planets like this one could be more common than we previously thought. **Looking for False Positives** Previously, scientists on the Kepler mission developed an algorithm called Robovetter to help sort through the massive amounts of data produced by the Kepler spacecraft, managed by NASA's Ames Research Center in California's Silicon Valley. Kepler searched for planets using the transit method, staring at stars, looking for dips in brightness as planets passed in front of their host stars. Most of the time, those dips come from phenomena other than planets -- ranging from natural changes in a star's brightness to other cosmic objects passing by -- making it look like a planet is there when it's not. Robovetter's job was to distinguish the 12% of dips that were real planets from the rest. Those signatures Robovetter determined to be from other sources were labeled "false positives," the term for a test result mistakenly classified as positive. With an enormous number of tricky signals, astronomers knew the algorithm would make mistakes and would need to be double-checked -- a perfect job for the Kepler False Positive Working Group. That team reviews Robovetter's work, going through each false positive to ensure they are truly errors and not exoplanets, ensuring fewer potential discoveries are overlooked. As it turns out, Robovetter had mislabeled Kepler-1649c. Even as scientists work to further automate analysis processes to get the most science as possible out of any given dataset, this discovery shows the value of double-checking automated work. Even six years after Kepler stopped collecting data from the original Kepler field -- a patch of sky it stared at from 2009 to 2013, before going on to study many more regions -- this rigorous analysis uncovered one of the most unique Earth analogs discovered yet. **A Possible Third Planet** Kepler-1649c not only is one of the best matches to Earth in terms of size and energy received from its star, but it provides an entirely new look at its home system. For every nine times the outer planet in the system orbits the host star, the inner planet orbits almost exactly four times. The fact that their orbits match up in such a stable ratio indicates the system itself is extremely stable and likely to survive for a long time.

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

Nearly perfect period ratios are often caused by a phenomenon called orbital resonance, but a nine-to-four ratio is relatively unique among planetary systems. Usually resonances take the form of ratios such as two-to-one or three-to-two. Though unconfirmed, the rarity of this ratio could hint to the presence of a middle planet with which both the inner and outer planets revolve in synchronicity, creating a pair of three-to-two resonances. The team looked for evidence of such a mystery third planet, with no results. However, that could be because the planet is too small to see or at an orbital tilt that makes it impossible to find using Kepler's transit method. Either way, this system provides yet another example of an Earth-size planet in the habitable zone of a red dwarf star. These small and dim stars require planets to orbit extremely close to be within that zone -- not too warm and not too cold -- for life as we know it to potentially exist. Though this single example is only one among many, there is increasing evidence that such planets are common around red dwarfs. "The more data we get, the more signs we see pointing to the notion that potentially habitable and Earth-size exoplanets are common around these kinds of stars," said Vanderburg. "With red dwarfs almost everywhere around our galaxy, and these small, potentially habitable and rocky planets around them, the chance one of them isn't too different than our Earth looks a bit brighter." For more information about Kepler and its discoveries, go to:https://www.nasa.gov/kepler

Materials provided by **NASA/Jet Propulsion Laboratory**.

New formation theory explains the mysterious interstellar object 'Oumuamua

April 13, 2020
University of California - Santa Cruz

Since its discovery in 2017, an air of mystery has surrounded the first known interstellar object to visit our solar system, an elongated, cigar-shaped body named 'Oumuamua (Hawaiian for "a messenger from afar arriving first"). How was it formed, and where did it come from? A new study published April 13 in *Nature Astronomy* offers a first comprehensive answer to these questions. First author Yun Zhang at the National Astronomical Observatories of the Chinese Academy of Sciences and coauthor Douglas N. C. Lin at the University of California, Santa Cruz, used computer simulations to show how objects like 'Oumuamua can form under the influence of tidal forces like those felt by Earth's oceans. Their formation theory explains all of 'Oumuamua's unusual characteristics. "We showed that 'Oumuamua-like interstellar objects can be produced through extensive tidal fragmentation during close encounters of their parent bodies with their host stars, and then ejected into interstellar space," said Lin, professor emeritus of astronomy and astrophysics at UC Santa Cruz. Discovered on October 19, 2017, by the Panoramic Survey Telescope and Rapid Response System 1 (Pan-STARRS1) in Hawaii, 'Oumuamua is absolutely nothing like anything else in our solar system, according to Zhang. Its dry surface, unusually elongated shape, and puzzling motion even drove some scientists to wonder if it was an alien probe. "It is really a mysterious object, but some signs, like its colors and the absence of radio emission, point to 'Oumuamua being a natural object," Zhang said. "Our objective is to come up with a comprehensive scenario, based on well understood physical principles, to piece together all the tantalizing clues," Lin said. Astronomers had expected that the first interstellar object they detected would be an icy body like a comet. Icy objects like those populating the Oort cloud, a reservoir of comets in the outermost reaches of our solar system, evolve at very large distances from their host stars, are rich in volatiles, and are often tossed out of their host systems by gravitational interactions. They are also highly visible due to the sublimation of volatile compounds, which creates a comet's coma (or "tail") when it is warmed by the sun. 'Oumuamua's dry appearance, however, is similar to rocky bodies like the solar system's asteroids, indicating a different ejection scenario. Other researchers have calculated that there must be an extremely large population of interstellar objects like 'Oumuamua. "The discovery of 'Oumuamua implies that the population of rocky interstellar objects is much larger than we previously thought," Zhang said. "On average, each planetary system should eject in total about a hundred trillion objects like 'Oumuamua. We need to construct a very common scenario to produce this kind of object." When a smaller body passes very close to a much bigger one, tidal forces of the larger body can tear the smaller one apart, as happened to comet Shoemaker-Levy 9 when it came close to Jupiter. The tidal disruption processes can eject some debris into interstellar space, which has been suggested as a possible origin for 'Oumuamua. But whether such a process could explain 'Oumuamua's puzzling characteristics remained highly uncertain. Zhang and Lin ran high-resolution computer simulations to model the structural dynamics of an object flying close by a star. They found that if the object comes close enough to the star, the star can tear it into extremely elongated fragments that are then ejected into the interstellar space. "The elongated shape is more compelling when we considered the variation of material strength during the stellar encounter. The ratio of long axis to short axis can be even larger than ten to one," Zhang said. The researchers' thermal modeling showed that the surface of fragments resulting from the disruption of the initial body would melt at a very short distance from the star and recondense at greater distances, thereby forming a cohesive crust that would ensure the structural stability of the elongated shape. "Heat diffusion during the stellar tidal disruption process also consumes large amounts of volatiles, which not only explains 'Oumuamua's surface colors and the absence of visible coma, but also elucidates the inferred dryness of the interstellar population," Zhang said. "Nevertheless, some high-sublimation-temperature volatiles buried under the surface, like water ice, can remain in a condensed form."

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Observations of 'Oumuamua showed no cometary activity, and only water ice is a possible outgassing source to account for its non-gravitational motion. If 'Oumuamua was produced and ejected by the scenario of Zhang and Lin, plenty of residual water ice could be activated during its passage through the solar system. The resulting outgassing would cause accelerations that match 'Oumuamua's comet-like trajectory. "The tidal fragmentation scenario not only provides a way to form one single 'Oumuamua, but also accounts for the vast population of asteroid-like interstellar objects," Zhang said. The researchers' calculations demonstrate the efficiency of tidal forces in producing this kind of object. Possible progenitors, including long-period comets, debris disks, and even super-Earths, could be transformed into 'Oumuamua-size pieces during stellar encounters. This work supports estimates of a large population of 'Oumuamua-like interstellar objects. Since these objects may pass through the domains of habitable zones, the possibility that they could transport matter capable of generating life (called panspermia) cannot be ruled out. "This is a very new field. These interstellar objects could provide critical clues about how planetary systems form and evolve," Zhang said. According to Lin, "'Oumuamua is just the tip of the iceberg. We anticipate many more interstellar visitors with similar traits will be discovered by future observation with the forthcoming Vera C. Rubin Observatory." U.S. Naval Academy astronomer Matthew Knight, who is co-leader of the 'Oumuamua International Space Science Institute team and was not involved in the new study, said this work "does a remarkable job of explaining a variety of unusual properties of 'Oumuamua with a single, coherent model." "As future interstellar objects are discovered in coming years, it will be very interesting to see if any exhibit 'Oumuamua-like properties. If so, it may indicate that the processes described in this study are widespread," Knight said.

Materials provided by **University of California - Santa Cruz**. Original written by Tim Stephens.

UPCOMING EVENTS

All Abrams Planetarium, MSU Observatory and Fox Park Activities are on hold for now!

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