

The Ursa Minor Report



Newsletter of the Kutztown University Planetarium &
C. R. Chambliss Astronomical Observatory

Volume 5, Issue 1

Fall 2023

We're Back!

We're excited to bring *The Ursa Minor Report* back! You can catch up on the latest news from the Planetarium & Observatory here or browse the newsletter archive on the Planetarium's website (<https://www.kutztown.edu/planetarium>).

Here Comes the Sun!

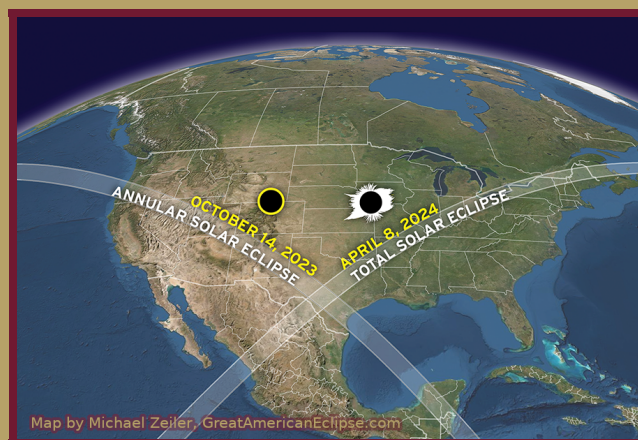


We focus on the Sun this year with the upcoming annular solar eclipse (Saturday, 14 October 2023) and total solar eclipse (Monday, 8 April 2024), and the ongoing approach toward maximum magnetic activity on the Sun.

While the center of the October eclipse will pass through the American Southwest, the KU community will have the opportunity to visit the C. R. Chambliss Astronomical Observatory (CRCAO; atop the Grim Science Building) and view the Sun through specialized telescopes and glasses as the moon passes in front of and partially blocks the Sun on October 14. Kutztown will be in the shadow of the moon on that day from 12:05 pm until 2:34 pm, with the maximum of the partial eclipse (25.8° obscuration) occurring at 1:19 pm.

The upcoming pair of "great American eclipses" might prove to be even more exciting than the solar eclipse that recently captured the

nation's attention in 2017. The reason is that in 2023-2024 the Sun is entering a dynamic stage of its magnetic activity cycle. This means that we can expect to see spots, flares, and prominences on the Sun's surface while observing the eclipse. With a frequency of approximately every 11 years, the Sun undergoes periodic outbursts of surface activity that are driven by the twisting of its magnetic fields. How do these outbursts affect us? Are they dangerous? Does the Sun's activity contribute to global warming? Join us this year at the KU Planetarium to view the *Solar Superstorms* planetarium show (narrated by Benedict Cumberbatch) and discuss answers to these questions.



Public Planetarium Shows: Fall 2023 Schedule

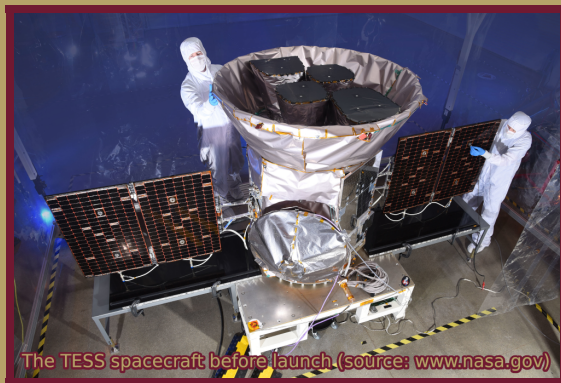
Everyone is welcome to join us for the Fall 2023 series of public planetarium shows. Admission is free. Tickets are not required, and seating is on a first-come-first-served basis.

Doors open at 6:30 pm. The planetarium is located on the ground floor of the Grim Science Building.

Date	Time	Title	Cost
Thu. Sept. 21	7:00 pm	 <p><i>Solar Superstorms</i> Planetarium Show</p>	FREE
Thu. Oct. 12	7:00 pm	 <p><i>Eclipse: The Sun Revealed</i> Planetarium Show</p>	FREE
Thu. Oct. 26	7:00 pm	 <p><i>The Sun: Our Living Star</i> Planetarium Show</p>	FREE
Thu. Nov. 16	7:00 pm	 <p><i>Solar Superstorms</i> Planetarium Show</p>	FREE
Thu. Dec. 14 Wed. Dec. 20	7:00 pm 7:00 pm	 <p><i>Season of Light</i> Holiday Planetarium Show</p>	FREE

Exoplanet Discoveries

Launched in April of 2018, the Transiting Exoplanet Survey Satellite (TESS) set out to continue the search for new exoplanets in our Galaxy, with a focus on finding Earth-size planets orbiting other stars. The basic method is to detect a slight dimming as the planet transits (or passes in front of) the host star. KU astronomers support this NASA mission as part of the TESS Follow-up Observing Program (TFOP) using the C. R. Challis Astronomical Observatory (CRCAO) at KU. Students are introduced to this research in the *Exoplanets* course and might be selected to participate in KU's Planet-hunting Around the World with Students (PAWS) project, which is funded by a grant from the National Science Foundation (NSF). The NSF PAWS participants work as research assistants at the University of Southern Queensland's MINERVA-Australis observatory in Australia during the (northern) summer.



The TESS spacecraft before launch. (source: www.nasa.gov)

The TESS mission divided the sky into 26 observable sectors for its two-year primary mission. TESS covered the Southern hemisphere in the first year and the Northern in the second, completing the primary mission in July 2020. The first extended mission lasted another two years (until September 2022) and covered sectors 27 through 55, which observed in the gaps between the original 26 sectors. As of the writing of this article, TESS is currently on sector 69 finishing another run in the South. Starting this Fall, TESS will return to the North and observe targets accessible to CRCAO again.

TESS observes each sector for 27 consecutive days looking for a repeating drop in brightness due to transits of planets in front of any

star within its wide field of view. Since TESS was designed to look at large sections of the sky and the individual stars' light is blended, we cannot identify which star the signal is coming from using TESS data alone. As TFOP members in the Seeing-Limited Photometry subgroup, we perform targeted follow-up observations using CRCAO's high resolution and narrow field of view to determine if the signal is coming from the expected source (which is typically the brightest star in the area). When the signal is not coming from the expected source, we often find that indicates that a nearby fainter star is instead a binary star system. In this case, we identify a false-positive signal in the TESS data and retire the exoplanet candidate as spurious. When we confirm that the signal is originating from the expected source, we submit to TFOP our analysis that includes the precise timing of the transit and our measurement of the exoplanet's radius.

Akin to the planets in our solar system, exoplanets range greatly in size and composition, so we categorize them using names such as Gas giants, Neptunian planets, Super-Earths, and Terrestrial planets. Interestingly, a subset of gas giants, known as hot-Jupiters, form relatively far away from their host stars (as Jupiter did), but have migrated inward over time and are now located closer to their host stars than even Mercury is to the Sun. Although we believe they are relatively rare, hot-Jupiter exoplanets are the easiest to find with the transit method and therefore are abundant among the first to be discovered.



Astronomers representing KU at AAS in Seattle WA:
Zach Raup, Emelly Tiburcio, Kylee Smith, Lauren Murphy, Phill Reed

Since the start of the TESS mission, dozens of KU students have actively engaged in exoplanet

discovery. Their contributions have resulted in several peer-reviewed publications and many professional conference presentations. Most recently, KU astronomers coauthored a paper announcing the discovery of six new hot-Jupiters¹, and KU was well-represented with the NSF PAWS project at the 241st meeting of the American Astronomical Society (AAS) in Seattle, WA, in January 2023.^{2 3 4 5}

“The Green Comet”

Comet C/2022 E3 was discovered by the Zwicky Transient Facility (ZTF) at the Palomar Observatory on 2 March 2022. It came from the outer reaches of the solar system and will not return for millions of years, if ever.

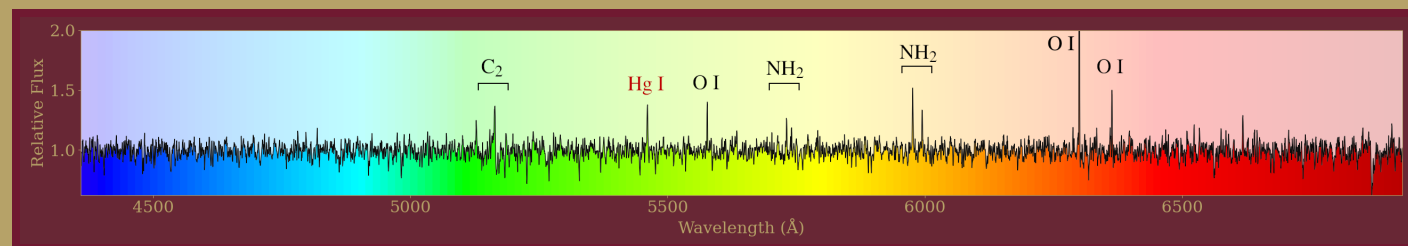
The comet made its closest approach to Earth (just 26 million miles away) on 1 February 2023. On that night, the comet was tracked and observed by the C. R. Chambliss Astronomical Observatory (CRCAO) at Kutztown University.

A series of wide-field photometric data images were taken in alternating B (blue), V (visual; yellow-green), and R (red) filters using CRCAO’s Bright Star Monitor telescope. We measured the apparent visual magnitude of the comet’s nucleus to be +5.5, and the data images were stacked to

produce a composite colorized view of the comet with the background stars appearing as trails of dots.



The comet’s visible spectrum (shown at the bottom of this page) was detected with CRCAO’s spectrograph on the 0.6-meter research telescope. It appears as the absorption spectrum of reflected sunlight with additional emission lines that were emitted by the comet and reveal the composition of the gaseous cometary coma. The spectrum shows emission from atomic oxygen (O I), diatomic carbon (C₂), and the NH₂ molecule. The C₂ emission results from the breakdown of organic molecules and gives the comet its green glow. The mercury (Hg) emission is unfortunate contamination from sources such as unshielded outdoor lighting on campus.



Prepared by: Lauren Murphy (Planetarium Assistant) and Phill Reed (Planetarium Director)

More Information: <https://www.kutztown.edu/planetarium> & <https://www.kutztown.edu/observatory>

¹Another shipment of six short-period giant planets from TESS, (2023) *MNRAS* Volume 521, Issue 2, pages 2765-2785.

²Lauren G. Murphy, TESS Follow-up Observations to Confirm Transits of TOI-1516 b, TOI-2025 b, and TOI-2152 b, (2023) *BAAS* Vol.55, No.2, id.266.05

³Zachary Raup, Follow-up Observations Toward the Confirmation of TESS Transiting Exoplanets Candidates TOI-3645, TOI-3660, TOI-4153, (2023) *BAAS* Vol.55, No.2, id.266.06

⁴Rain Czine, Photometric Follow-up Observations of New TESS Exoplanet Candidates, (2023) *BAAS* Vol.55, No.2, id.266.07

⁵Kylee Smith, Ephemeris Refinement of TESS Objects for Future Observations, (2023) *BAAS* Vol.55, No.2, id.266.09