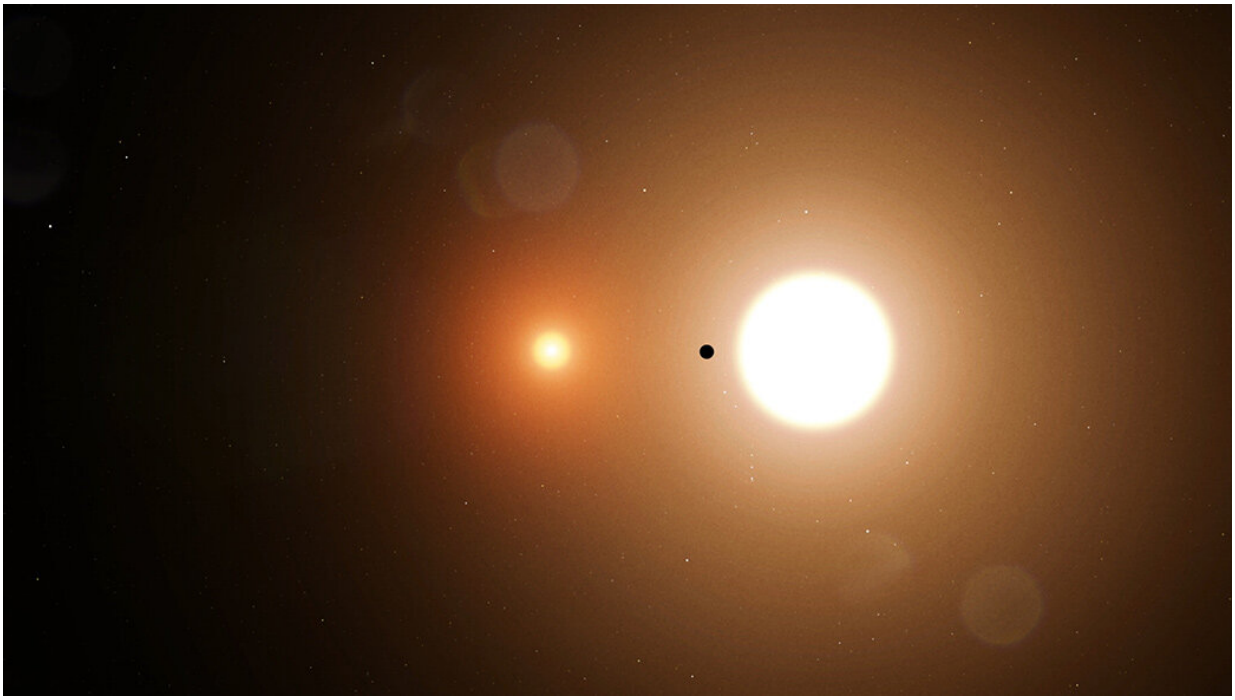
TESS mission uncovers its first world with two stars

January 7 2020, by Jeanette Kazmierczak



TOI 1338 b is silhouetted by its host stars. TESS only detects transits from the larger star. Credit: NASA's Goddard Space Flight Center/Chris Smith

In 2019, when Wolf Cukier finished his junior year at Scarsdale High School in New York, he joined NASA's Goddard Space Flight Center in Greenbelt, Maryland, as a summer intern. His job was to examine variations in star brightness captured by NASA's Transiting Exoplanet Survey Satellite (TESS) and uploaded to the Planet Hunters TESS citizen

science project.

"I was looking through the data for everything the volunteers had flagged as an eclipsing binary, a system where two stars circle around each other and from our view eclipse each other every orbit," Cukier said. "About three days into my internship, I saw a signal from a system called TOI 1338. At first I thought it was a stellar eclipse, but the timing was wrong. It turned out to be a planet."

TOI 1338 b, as it is now called, is TESS's first circumbinary planet, a world orbiting two stars. The discovery was featured in a panel discussion on Monday, Jan. 6, at the 235th American Astronomical Society meeting in Honolulu. A paper, which Cukier co-authored along with scientists from Goddard, San Diego State University, the University of Chicago and other institutions, has been submitted to a scientific journal.

The TOI 1338 system lies 1,300 light-years away in the constellation Pictor. The two stars orbit each other every 15 days. One is about 10% more massive than our Sun, while the other is cooler, dimmer and only one-third the Sun's mass.

TOI 1338 b is the only known planet in the system. It's around 6.9 times larger than Earth, or between the sizes of Neptune and Saturn. The planet orbits in almost exactly the same plane as the stars, so it experiences regular stellar eclipses.

TESS has four cameras, which each take a full-frame image of a patch of the sky every 30 minutes for 27 days. Scientists use the observations to generate graphs of how the brightness of stars change over time. When a planet crosses in front of its star from our perspective, an event called a transit, its passage causes a distinct dip in the star's brightness.

But planets orbiting two stars are more difficult to detect than those orbiting one. TOI 1338 b's transits are irregular, between every 93 and 95 days, and vary in depth and duration thanks to the orbital motion of its stars. TESS only sees the transits crossing the larger star; the transits of the smaller star are too faint to detect.

"These are the types of signals that algorithms really struggle with," said lead author Veselin Kostov, a research scientist at the SETI Institute and Goddard. "The human eye is extremely good at finding patterns in data, especially non-periodic patterns like those we see in transits from these systems."

This explains why Cukier had to visually examine each potential transit. For example, he initially thought TOI 1338 b's transit was a result of the smaller star in the system passing in front of the larger one—both cause similar dips in brightness. But the timing was wrong for an eclipse.

After identifying TOI 1338 b, the research team used a software package called eleanor, named after Eleanor Arroway, the central character in Carl Sagan's novel "Contact," to confirm the transits were real and not a result of instrumental artifacts.

"Throughout all of its images, TESS is monitoring millions of stars," said co-author Adina Feinstein, a graduate student at the University of Chicago. "That's why our team created eleanor. It's an accessible way to download, analyze and visualize transit data. We designed it with planets in mind, but other members of the community use it to study stars, asteroids and even galaxies."

TOI 1338 had already been studied from the ground by radial velocity surveys, which measure motion along our line of sight. Kostov's team used this archival data to analyze the system and confirm the planet. Its orbit is stable for at least the next 10 million years. The orbit's angle to

us, however, changes enough that the planet transit will cease after November 2023 and resume eight years later.

NASA's Kepler and K2 missions previously discovered 12 circumbinary planets in 10 systems, all similar to TOI 1338 b. Observations of binary systems are biased toward finding larger planets, Kostov said. Transits of smaller bodies don't have as big an effect on the stars' brightness. TESS is expected to observe hundreds of thousands of eclipsing binaries during its initial two-year mission, so many more of these circumbinary planets should be waiting for discovery.

Provided by NASA

Citation: TESS mission uncovers its first world with two stars (2020, January 7) retrieved 23 April 2024 from https://phys.org/news/2020-01-tess-mission-uncovers-world-stars.html