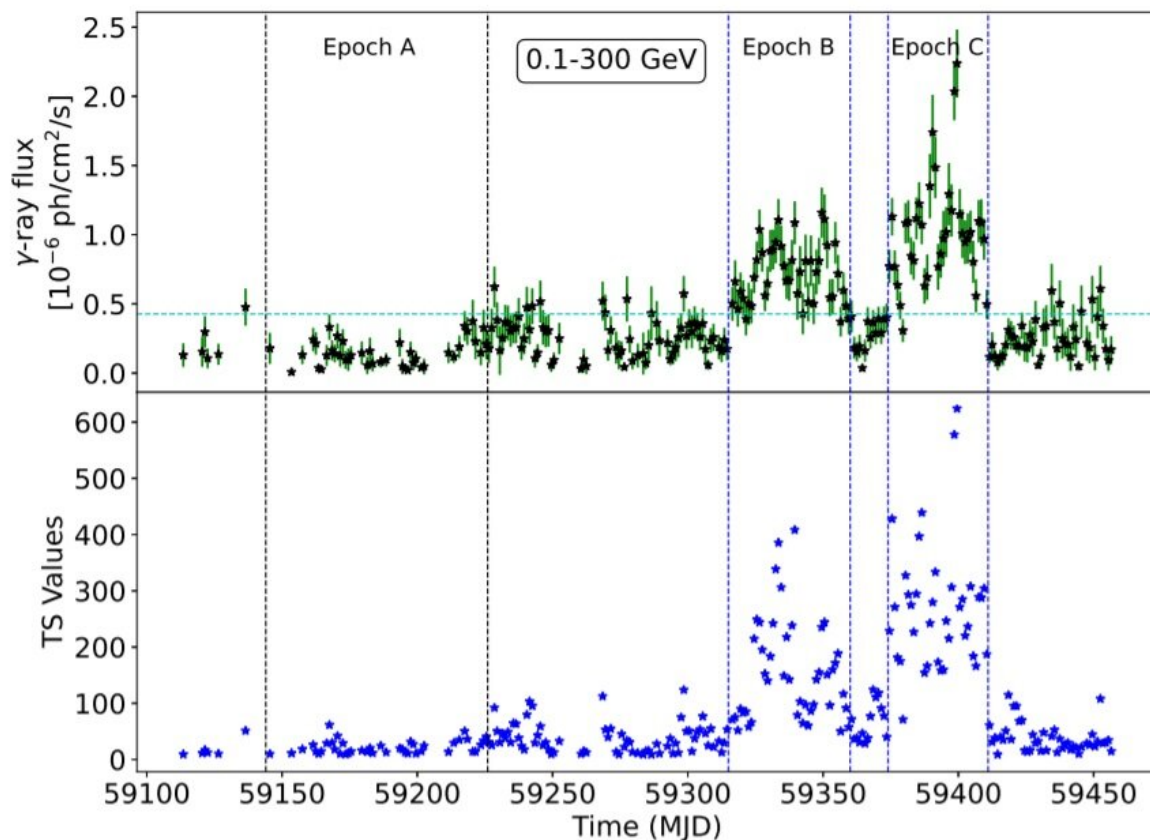


# Astronomers detect new brown dwarf orbiting an M-dwarf star

December 16 2021, by Tomasz Nowakowski



One-day binned  $\gamma$ -ray light curve of Ton 599 (upper panel) with the test statistics values corresponding to each flux value (lower panel). Credit: Cañas et al., 2021.

Astronomers from the Pennsylvania State University (Penn State) and elsewhere have detected a massive brown dwarf orbiting an M dwarf

known as TOI-2119. The newly found object is nearly 70 times more massive than Jupiter and orbits its host star on an eccentric orbit. The finding is reported in a paper published December 7 on arXiv.org.

Brown dwarfs are intermediate objects between planets and stars, occupying the mass range between 13 and 80 Jupiter masses. Although many [brown dwarfs](#) have been detected to date, such objects orbiting other stars are a rare find.

Observations have shown that massive brown dwarfs orbiting their hosts at a relatively close distance (less than 3.0 AU) are extremely rare and difficult to find. This so-called "brown dwarf desert" is constantly studied by astronomers using various techniques, aiming to find other examples of this peculiar type.

Now, a team of astronomers led by Penn State's Caleb I. Cañas, reports the finding of a new massive brown dwarf, apparently another representative of this desert. The newfound object, designated TOI-2119.01, was identified with NASA's Transiting Exoplanet Survey Satellite (TESS) and its brown dwarf nature was confirmed using a combination of ground-based and space-based photometry and high-precision velocimetry from the Habitable-zone Planet Finder.

"TESS observed TOI-2119 (Gaia EDR3 1303675097215915264) in short-cadence mode during Sectors 24 and 25 with data spanning 2020 Apr 16 through 2020 June 08. It has one transiting candidate, TOI-2119.01, identified by the TESS Science Processing Operations Center pipeline (SPOC)," the researchers wrote in the paper.

According to the study, TOI-2119.01 has a mass of about 67 Jupiter masses and its radius was measured to be approximately 1.11 Jupiter radii. These results yield a density at a level of  $60 \text{ g/cm}^3$ .

The brown dwarf circles TOI-2119 every 7.2 days on an [eccentric orbit](#) (with an eccentricity of 0.336) inclined 88.51 degrees, at a distance of about 0.064 AU from it. The brightness temperature of this [object](#) was found to be some 2,100 K.

The [host star](#) TOI-2119 is an M dwarf about half the size and mass of the sun. It has a rotation period of 13.2 days, metallicity at a level of 0.1, and its [effective temperature](#) is estimated to be 3,553 K. Based on the [rotation period](#), the astronomers assume that TOI-2119 is most likely between 700 million and 5.1 billion years old.

Summing up the results, the researchers underlined that high eccentricity of TOI-2119.01 may be the result of dynamical interactions with a long-period companion so far undetected. They added that the high mass of this brown dwarf points out to a formation scenario through gravitational instability in a disk.

"Simulations by Forgan et al. (2018) show that dynamical interactions and scattering between fragments in a gravitationally unstable disk can readily form brown dwarf systems in a variety of configurations," the authors of the paper explained.

**More information:** An eccentric Brown Dwarf eclipsing an M dwarf, arXiv:2112.03959 [astro-ph.SR] [arxiv.org/abs/2112.03959](https://arxiv.org/abs/2112.03959)

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