Detached double-lined eclipsing binary detected in the star forming region NGC 2264

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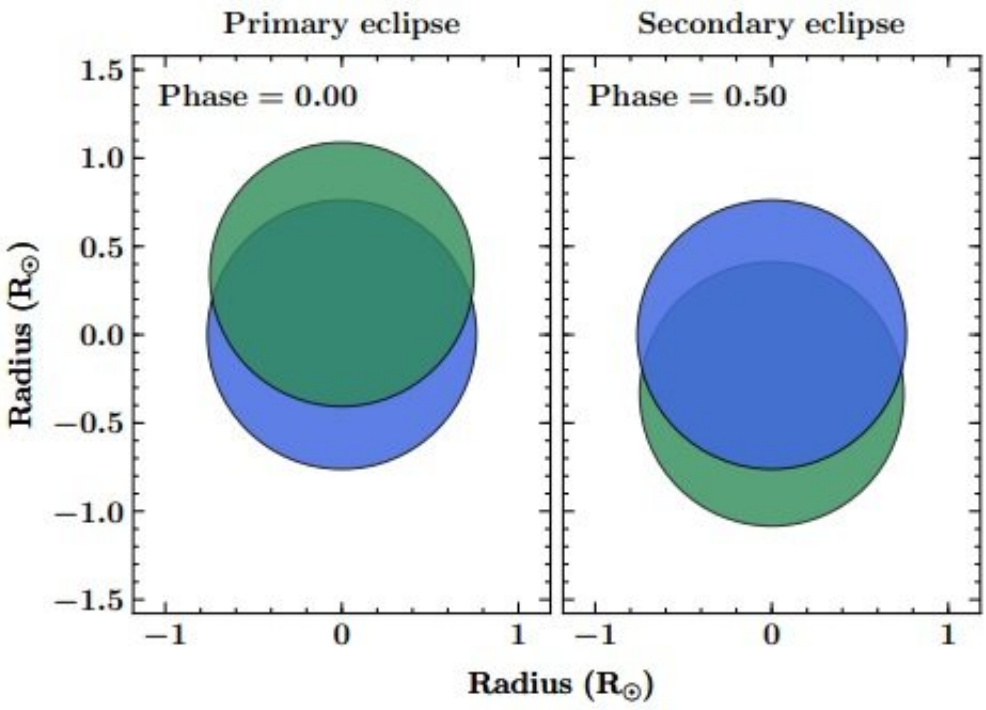

System geometry of Mon-735, to scale, as observed at primary and secondary eclipse (left and right, respectively). In both cases, the primary star is shown in blue and the secondary in green. The fraction of each star occulted during eclipse is significant, which results in deep eclipses, yet they are still grazing due to the similar sizes of the two stars. Credit: Gillen et al., 2020.

Astronomers have performed a photometric and spectroscopic monitoring campaign of the star-forming region NGC 2264. As a result, they found that this region hosts a detached double-lined eclipsing

binary, which comprises two pre-main sequence M dwarfs. The finding is reported in a paper published April 9 on the arXiv pre-print server.

Detached, double-lined, eclipsing spectroscopic binaries are crucial for astronomers testing stellar models. This is due to the fact that the masses and radii of both stars can be directly measured from the light and radial velocity curves of the system.

Located some 2,500 light years away, NGC 2264 is a young galactic cluster and star forming region (about 3 million years old) within the local spiral arm. It is a well-studied cluster due to its relative proximity, well-defined membership and low foreground extinction.

To date, several tens of eclipsing binaries (EBs) have been detected in NGC 2264, and one of them is Mon-735, identified by observations with NASA's Spitzer spacecraft. A team of astronomers led by Edward Gillen of the Cavendish Laboratory at the University of Cambridge, UK, took a closer look at Mon-735 in order to get more insights into the nature of this system. For this purpose, they re-analyzed the archival Spitzer data and conducted follow-up observations of this binary using the Keck HIRES spectrograph.

"We simultaneously model the Spitzer light curves, follow up Keck/HIRES radial velocities, and the system's spectral energy distribution to determine self-consistent masses, radii and effective temperatures for both stars," the astronomers wrote in the paper.

The study found that Mon-735 is a detached, double-lined pre-main sequence (PMS) eclipsing binary. The system displays relatively equal eclipses and its orbital period was measured to be approximately 1.975 days.

According to the paper, Mon-735 consists of PMS M dwarfs with

masses of about 0.29 and 0.26 solar masses, radii of 0.76 and 0.75 solar radii, and effective temperatures of 3,260 and 3,213 K. The system is estimated to be between 7 and 9 million years old.

Summing up the results, the researchers noted that Mon-735, together with other known low-mass eclipsing binary in NGC 2264, designated CoRoT 223992193, could be crucial to better understand the evolution of PMS stars.

"CoRoT 223992193 and Mon-735 are the first two low-mass EBs to come out of the CoRoT and Spitzer observations of NGC 2264, with more systems in preparation. These will form a powerful sample of near-coeval EB systems, formed from the same parent molecular cloud, with which to test PMS stellar evolution theory and better understand both the age of, and age spread within, the NGC 2264 region," the authors of the paper concluded.

More information: Mon-735: A new low-mass pre-main sequence eclipsing binary in NGC 2264, arXiv:2004.04753 [astro-ph.SR] arxiv.org/abs/2004.04753