

Study of stellar Twins reveal secrets of evolution and future of stars

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A study of a type of stellar twin called W Ursae Majoris–type contact binaries that orbit each other closely gives new insights into how binary stars evolve and their eventual fate.

W Ursae Majoris (W UMa) stars are short-period, dumbbell-shaped binaries in which the two stars are in contact. They are so close, in fact, that they share a single outer atmosphere and they orbit around each other. These stars act as "natural laboratories" as they assist in precise determinations of fundamental stellar parameters such as masses, radii, and temperatures, crucial for testing theories about how stars evolve over time.

Astronomers from Aryabhata Research Institute of Observational Sciences (ARIES), an autonomous research institute under the Department of Science & Technology (DST), Government of India and Physical Research Laboratory (PRL), Ahmedabad used data from ARIES's 1.3m Devasthal Fast Optical Telescope (DFOT) and NASA's TESS (Transiting Exoplanet Survey Satellite) space telescope to create detailed light curves of the stars. The light curves essentially show how the total amount of light emitted by the system varies with time.

The team led by Yogesh Chandra Joshi from ARIES and Alexander Panchal from PRL explored four W Ursae Majoris-type (W UMa) contact stars. Their study revealed important features like changes in the stars' orbits, how mass is transferred between the stars and evidence of surface activity like star spots.

Detailed modeling of the light patterns from the stars showed that the stars share their outer layers, their orbits shift slightly over time, as if tugging and pulling on one another and that some stars appear lopsided —brighter on one side than the other.

The uneven brightness points at dark magnetic star spots similar to sun spots. These spots rotate in and out of view, creating bumps in the light curves. This also suggests the stars have strong magnetic activity. In one of the binary systems, scientists also found specific light signals (called H-alpha and H-beta) that clearly show activity in the star's outer layer, which is linked to magnetic events like star spots and stellar flares.

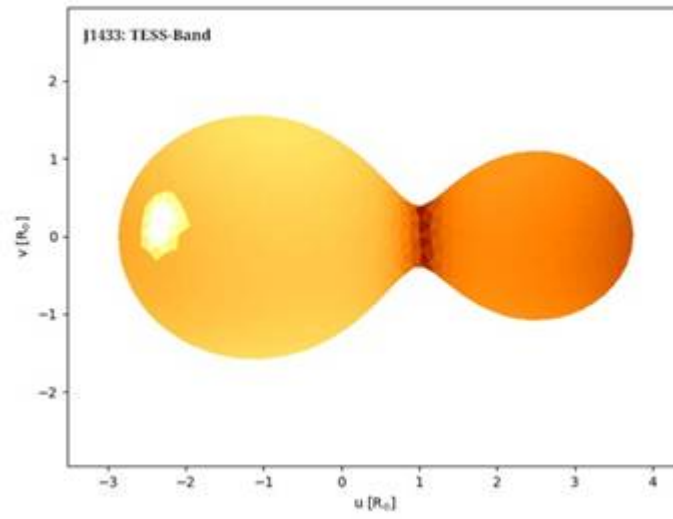


Fig: The spot distribution in binary star J143358.7+053953

By combining state-of-the-art photometric monitoring with light signatures (spectral diagnostics), the study published in *Astrophysical Journal* not only provided new insights into how binary stars evolve and their eventual fate, but also helped improve our understanding of empirical calibrations of the mass–radius relation of low-mass stars. This research is important and has far-reaching applications, particularly in exoplanet transit studies.

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(रिलीज़ आईडी: 2211818) आगंतुक पटल : 769
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