New lithium-rich Cepheid discovered in the Milky Way

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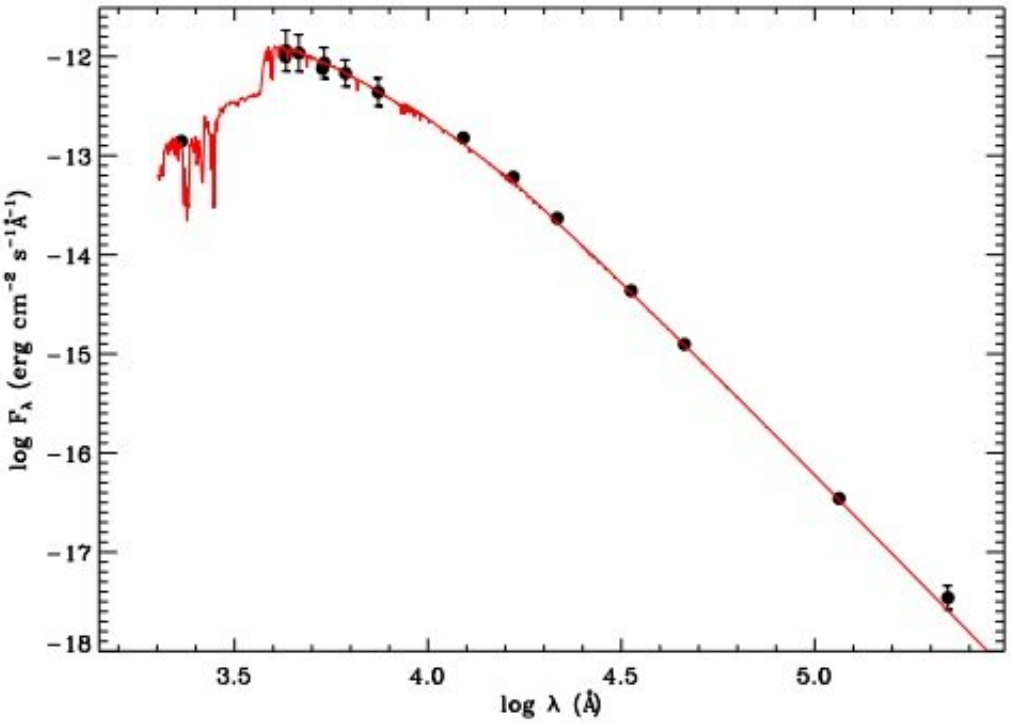

Spectral energy distribution of V363 Cas. Credit: Catanzaro et al., 2020.

Italian astronomers have reported the discovery of a new lithium-rich galactic Cepheid star, identified by high-resolution spectroscopic observations. The newfound object, designated V363 Cas, is the fifth lithium-rich classical Cepheid in our Milky Way galaxy. The study detailing the finding was published June 5 on arXiv.org.

Cepheid variables (or Cepheids) are luminous, yellow, horizontal branch stars changing their brightness with time as a result of regular stellar pulsations. Given that their periods of variation are closely related to their luminosity, astronomers use them to measure interstellar and intergalactic distances.

Classical Cepheids (DCEPs), also known as Population I Cepheids, undergo pulsations with very regular periods on the order of days to months. Given that their pulsation and stellar parameters are strictly connected, DCEPs are also used as a testbed for stellar evolution theories.

Of special interest are lithium-rich DCEPs, as lithium is expected to be depleted by proton capture after the first dredge-up occurring at the beginning of the red giant branch (RGB) phase. These objects are extremely rare; to date, only four DCEPs with enhanced lithium abundance have been detected in our galaxy.

A team of astronomers led by Giovanni Catanzaro of Catania Astrophysical Observatory in Italy has recently discovered a new addition to the short list of this rare Cepheids. Using the 3.5-meter Telescopio Nazionale Galileo (TNG), they found that V363 Cas, a star initially identified as a RR Lyrae variable more than 20 years ago, turns out to be a multi-mode DCEP exhibiting an overabundance of lithium.

High-resolution spectroscopic observations of V363 Cas with TNG allowed Catanzaro's team to derive its key stellar parameters and chemical abundances. The researchers found that the star has a mass of around 3.2 solar masses, effective temperature of about 6,650 K, and solar-like abundances of carbon and oxygen, but is significantly more lithium-rich than our sun.

According to the paper, V363 Cas has a lithium abundance at a level of

about 2.86 dex, along with iron, carbon and oxygen abundances of approximately –0.30, –0.06, and 0.00 dex, respectively. The astronomers noted that the star's lithium abundance is 1.8 dex over the average value found for DCEP population.

Moreover, the study found that the period of V363 Cas (about 0.54 days) is increasing. The researchers calculated that its period increases at a rate of about 0.00008 days in 100 years.

They concluded that the increasing period of V363 Cas, together with its lithium-rich nature and solar-like abundances of carbon and oxygen, suggest that the star is during the first crossing of the so-called instability strip of the Hertzsprung–Russell diagram. This, according to the authors of the paper, provides some hints on the evolution of lithium-rich DCEPs in general.

"Our results favor the scenario in which the five galactic Li-rich DCEPs are first crossing the instability strip, having had slowly rotating progenitors during their main sequence phase," the researchers wrote.

More information: Catanzaro et al. V363 Cas: a new lithium rich galactic Cepheid, arXiv:2006.03299 [astro-ph.SR]. arxiv.org/abs/2006.03299