Researchers investigate mixing fraction in classical novae

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Recently, Ph.D. candidate Guo Yunlang and Prof. Wang Bo from Yunnan Observatories of the Chinese Academy of Sciences investigated the white dwarf (WD) mixing fraction in classical novae.

This work was published in *Astronomy & Astrophysics*.

Classical novae are powered by thermonuclear runaways occurring on the surface of accreting WDs in close binaries. In close binaries, the WD accrete matter from its companion and the thermonuclear runaway can be triggered once the accreted mass reaches a critical value.

During the novae outbursts, the luminosity increases dramatically, and most of the accreted envelope is ejected. Observationally, the enrichments of intermediate-mass elements (e.g., C, N, O, Ne, Na, Mg, and Al) have been detected in nova ejecta, indicating that the accreted shell is mixed with the outer layers of the underlying WD, called WD mixing.

In this study, the researchers investigated the WD mixing fraction and the ejected material systematically. By considering different WD masses and mixing fractions, they carried out a series of simulations of nova outbursts. They adopted the pre-mixed model in the simulations, in which the material accreted by WDs was assumed to be a mixture of the companion star material (solar abundances) and the outermost layers of the underlying WDs.

"The elemental abundance ratios that can be used to estimate the WD mixing fraction should be sensitive to the WD mixing degree but not affected by the WD mass," said Guo.

In addition, it is worth noting that these ratios cannot be affected by the He mixing that may occur in classical novae because the abundances of H and He in nova ejecta are sensitive to the He mixing fractions.

The researchers conducted a series of simulations for nova models and identified four elemental abundance ratios that can be used to estimate the WD mixing fraction in classical novae. "We estimated the WD mixing fraction in some representative classical novae by comparing the element abundance ratios in the observations and the simulations. And our simulations indicate that the WD mixing fraction in classical novae spans a relatively wide range," said Prof. Wang.

In addition, they suggested that higher WD mixing fraction may exist in nova systems with less massive WDs. This work can be used to constrain the mixing process in classical novae.

More information: Yunlang Guo et al, Mixing fraction in classical novae, *Astronomy & Astrophysics* (2022). DOI: 10.1051/0004-6361/202142163

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