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Chemical depletion in evolved binaries with second-generation protoplanetary discs

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Binary interaction is known to affect the chemical composition of low- and intermediate-mass (LIM) stars. In particular, post-AGB/post-RGB binary stars with circumbinary discs display photospheric chemical depletion with a notable underabundance of refractory elements in the stellar photospheres (e.g., Al, Fe, Ti, s-process elements) relative to volatile elements (e.g., S, Zn, Na, K). The exact mechanism behind this depletion is not yet fully understood, but it is believed to result from the chemical fractionation of gas and dust in the circumbinary disc, followed by the re-accretion of clean gas onto the primary star. Recent observational studies have shown that these circumbinary discs are similar to the protoplanetary discs (PPDs) around young stars in terms of infrared excess, keplerian rotation, and dust mineralogy. Moreover, it was recently confirmed that a subset of post-AGB/post-RGB binary stars hosts "transition"discs that have large inner cavities similar to those observed in PPDs, which could reflect the presence of a giant planet carving a hole in the disc. To further investigate these targets, we carried out a detailed chemical abundance study of all 12 transition disc systems known to date in both the Galaxy and the LMC (characterised by moderate-to-high mid-infrared excess and significant depletion efficiency [S/Ti] > 1.3 dex). We used high-resolution optical spectra from HERMES/Mercator and UVES/VLT to study the elemental abundances as a function of parameters from both the binary (e.g., photometric, orbital, pulsational) and the disc (orientation, size, morphology). We confirmed that depletion efficiency in transition disc systems is higher than in other evolved binary stars. Additionally, we found that the derived chemical depletion patterns in our evolved binary systems are matching those observed in young planet-hosting stars and are mostly in line with those observed in interstellar medium. We also found that the pulsation period of our targets is strongly anti-correlated with the infrared luminosity produced by the circumbinary disc. In this talk, I will present these interesting highlights of our study and also the implications of our results on possible planet formation in evolved binary stars.

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