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Do Intrinsically s-process Enriched Evolved Binaries Exist?

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Binary stars can display a diverse range of chemical signatures arising from strong yet poorly understood interactions with their companions. In observational studies focusing on low to intermediate-mass ($0.8 - 8\ \mathrm{M}_{\odot}$) binary stars, such as Barium stars, Carbon Enhanced Metal-Poor (CEMP-*s*) stars, and extrinsic s-stars, the observed enrichments in carbon and slow neutron capture (*s*-process) elements have conventionally been attributed to interactions with their evolved companions, particularly white dwarfs (WDs), suggesting an extrinsic nature to the enrichment process. However, we have assembled a chemically peculiar sample of post-Asymptotic Giant Branch (post-AGB) binary stars, whose high-resolution optical spectra from VLT+UVES revealed a carbon and *s*-process enrichment, contrary to the commonly observed photospheric chemical depletion (reaccretion of pure gas onto the star, devoid of refractory elements) in post-AGB binaries. This occurrence, for the very first time, is more inclined towards intrinsic enrichment rather than the usual extrinsic enrichment. In this talk, I will present our detailed investigation as to how we ruled out the possibility of extrinsic enrichment (from a WD companion). This includes data from orbital parameter analyses and the study of the jets launched from the circum-companion (thorough spatio-kinematic and radiative transfer models). Additionally, we also exclude the inherited *s*-process enrichment from the host galaxy as a plausible explanation for the observed overabundances. To validate the intrinsic enrichment nature of our targets, we incorporate predictions from dedicated ATON stellar evolutionary models. I will showcase the exciting results uncovering the first potential of intrinsically enriched evolved binaries and discuss their implications on our current understanding of binary star evolution and nucleosynthesis.

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