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Barium stars: Systematic deviations from the AGB models

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Barium (Ba) stars are peculiarly enriched in *s*-process elements, even though they have not yet reached the AGB evolutionary phase. This enrichment can be explained by contamination from a companion star when that was an AGB star. Ba stars preserve this material for a long time and are easy to derive their high-resolution spectra, making them objects ideal for testing models of AGB star nucleosynthesis. We had developed a method with which we could identify the best-matching polluter AGB model for each Ba star abundances.

By comparing the identified AGB models with the Ba star abundances, our aim was to derive systematic deviations between the observations and models. We found that there is a systematic underproduction of some elements in the AGB models compared to the observations: in particular for Nb, Mo and Ru, which are just beyond the first *s*-process peak. This may imply that there is a neutron capture process (e.g. the *i* process) not yet included in the AGB models, which contributes to the abundance of these elements.

We investigated the correlations between the abundances, the residuals between the observationally derived and modelled abundances and the metallicity of the stars. Some correlations may be noted between the residuals of these elements, indicating a common source for the inability to fit with the models. There is a weak dependence on metallicity, which is the strongest for Nb, Mo and Ru. The offset of these three elements are also increasing with higher s-process abundances.

We have also examined the relation between the Zr and Nb abundances of these stars, since this can be used as a thermometer for the *s* process, assuming local nuclear equilibrium. However, the vast majority of stars would require a temperature higher than 400 MK to explain their abundances within this framework - this may also indicate that Zr itself is not produced solely in the steady-state *s* process.

Primary author: VILÁGOS, Blanka (Konkoly Observatory (HUN-REN CSFK), Eötvös Loránd University)

Co-author: CSEH, Borbála (Konkoly Observatory (HUN-REN CSFK))

Presenter: VILÁGOS, Blanka (Konkoly Observatory (HUN-REN CSFK), Eötvös Loránd University)

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