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Finding the polluter AGB properties of a Barium stars with machine learning

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The use of machine learning techniques in astronomy is becoming more and more widespread. Here I present our results on using machine learning (ML) methods for the comparison of observed Barium (Ba) star abundances and the predictions of AGB nucleosynthesis codes. This way, we can provide an estimate of the progenitor mass and metallicity of the former polluter AGB star that in the past enriched the composition of a currently observed Barium (Ba) star via accretion.
For this task, we use the largest, homogeneous sample of Ba star abundances from de Castro et al. (2016), Roriz et al. (2021a,b) and the two most extended AGB nucleosynthesis models in the literature, the Monash and FRUITY models.

Cseh et al. (2022) published a method for this problem, where the dilution factor (namely the fraction of AGB material in the Ba star envelope) for each model was calculated based on the [Ce/Fe] value. However, the mass range of the models was selected manually using independent AGB mass estimates as initial values, which is available only for 28 stars out of the whole sample.
As an upgrade, we considered the dilution factor as a free parameter and used three differents classificators for this much more complex task –a neural network, a random forest and an analytical method based on the closeness of derived abundances to the models –to identify the pattern of polluter AGBs in the whole sample of Ba star spectra.

This approach allows us to have an insight to the behaviour of each element in each star, as well as to build statistics for the differences in the abundance patterns of all stars. We found that the mass distribution of the optimal polluter AGBs fall into the low-mass range and do not exceed 4 $M_\odot$, as expected by previous results. Also, a systematic underestimation occurs at some of the first s-process peak elements when comparing the model predictions to the observations –this may indicate a possible missing nucleosynthesis path from the models.

Session

Stellar nucleosynthesis

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