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Neutron-capture signatures in a large sample of Ba stars

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Barium (Ba) stars belong to binary systems where a former asymptotic giant branch (AGB, now a white dwarf) star polluted the less evolved companion, which became enriched with material produced through the slow neutron capture process (s process). The currently observed Ba star preserves the abundance pattern of the AGB, allowing us to test the imprints of the s process. Comparing different AGB nucleosynthetic models and Ba star abundances based on high-resolution spectra, we are able to constrain, for example, the effect of the initial rotation velocity and the nature of the neutron source. When comparing AGB models to the extended list of heavy element abundances available for a large homogeneous observational sample of 180 Ba stars, we could confirm that the polluting AGBs are of low mass (< 4 MSun). Most of the matching AGB models require low accreted mass, but a few systems with high accreted mass are needed to explain the observations. However, approximately 25% of the sample stars show anomalous abundance patterns, mainly at the first s-process peak (with higher Nb, Mo and/or Ru than the models), along with high W. The high W value is comparable to some post-AGB stars, and might indicate that we can identify different subgroups among the Ba star sample. The s-process temperatures derived with the [Zr/Fe] - [Nb/Fe] thermometer have an unrealistic value for the majority of our stars. The most likely explanation is that at least a fraction of these elements are not produced in a steady-state s process, and instead may be due to processes not included in the AGB models. Additional measurements could reveal the cause for these overabundances and can help to identify the underlying processes.

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