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Evolution and nucleosynthetic gas yields of intermediate-mass primordial to extremely metal-poor stars

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In order to interpret the surface abundances of the most metal-poor stars detected, and infer the properties of the oldest stellar generations, it is crucial to develop models of stellar evolution and nucleosynthesis for primordial to extremely metal-poor (EMP) stars. Such models are also relevant in the context of Galactic Chemical evolution and Galactic structure formation.

We present models of intermediate-mass stars of initial masses Mini between primordial and EMP metallicity (Z=10-10, 10-8, 10-7, 10-6, and 10-5). Detailed evolution and nucleosynthesis (77 species) were computed till the late stages of the TP-(S)AGB phase.

Our models can be classified as follows, according to their evolution. The lowest mass cases (3 and 4 Msun) of Z=10-10 and 10-8, experience proton-ingestion episodes (PIEs) at the beginning of their TP-AGB. The high surface metal enrichment provided by such episodes allows them to undergo a 'normal'TP-AGB, and end their lives as CO-white dwarfs. Some models in a narrow mass and metallicity range (near 5 Msun and Zini ≤ 10-8) have an uncertain fate and might end their lives as SNeI1/2. Models of Mini ≥ 6 Msun, regardless of the initial metallicity within the considered range, and models of Mini ≥ 4 Msun for the Z=10 -7 and Z=10-8 cases, behave as normal TP-(S)AGB stars. SDU is particularly efficient for Mini above 6-7 Msun, and the base of the convective envelope reaches zones processed by He-burning (corrosive SDU).

The abundance pattern associated to the ejecta of our stars yields remarkably high CNO, with the characteristic [N/Fe]>[C/Fe]>[O/Fe]. The reasons for this pattern are the combined effects of SDU, efficient TDU, hot-bottom burning (HBB) and the activation of the NeNa-cycle and the MgAl-chains at the relatively high temperature nuclearly active regions of our models,

Our results differ substantially from other studies. Our analysis points to the treatment of convection as the main reason for these discrepancies and highlights the relevance of input physics uncertainties when considering the evolution of the most metal-poor stars.

Session

Stellar evolution

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