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Numerical methods for AGB evolution

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Asymptotic Giant Branch stars are of paramount importance in several fields of modern astrophysics. Their interiors are characterised by a rich nucleosynthesis, deeply connected to their surface via the recurring third dredge-up events. Nevertheless, full stellar evolution models in this phase are still plagued by uncertainties of both numeric and physics nature. The main processes that regulates the TP-AGB phase (convection, overshoot, stellar winds) are treated with parametrizations. These facts cause a wide heterogeneity of predictions across stellar models. In particular, full stellar evolution calculations of TP-AGB are known to be time consuming and often numerically unstable, which prevents an extensive exploration and calibration of the input physics parameters. Even if modern computers are getting more powerful and faster, numerical methods aimed at increasing the computational speed may be the key to produce large sets of TP-AGB tracks without losing on the accuracy side. I will present results of a ongoing analysis, performed with the PAdova and tRieste Stellar Evolution Code (PARSEC), aimed to implement numerical techniques based on shell shifting, that allow to gain in computational agility during the interpulse periods. Timestep choice is a critical aspect: it will be investigated in a framework where the energy conservation is the basic constraint to be fulfilled. Alongside the numerical studies, I will discuss the stability of the methods against different overshooting prescriptions, mixing efficiency, and low-temperature opacities linked to the variations of hydrogen and CNO elements.

Session

Stellar evolution

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