NEW CALCULATIONS OF THERMAL PULSES AND s–PROCESS NUCLEOSYNTHESIS IN AGB STARS

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A set of thermal pulse models was computed, for initial stellar masses extending from low (M=1.5, 3 $M_\odot$) to intermediate (M=5, 7 $M_\odot$), using the FRANEC evolutionary code and assuming standard mass loss and solar metallicity. The main features are: i) the third dredge–up is naturally found, even for core masses below 0.7 – 0.8 $M_\odot$; ii) before the dredge–up occurrence, the main characteristics of the models (convective shell mass, interpulse duration, overlapping between adjacent pulses) are determined solely by the core mass M_H, well reproducing a behaviour which is typical in the current literature (see e.g. Schonberner, 1979): in particular, the shell mass is a decreasing function of M_H; iii) after dredge–up is started, the evolutionary track is modified and the strength of the pulses is enhanced; iv) the amount of dredge–up increases in time, from $\simeq 10^{-4}$ $M_\odot$ to $\simeq 10^{-3}$ $M_\odot$.

The *s*–process nucleosynthesis in the He–shell was computed using for the 3 $M_\odot$ model, assuming that a few 10^{-6} $M_\odot$ of ^{13}C are formed by proton mixing from the envelope after each pulse (see discussion in Busso et al., 1992). As the core mass M_H grows with time, for any amount of ^{13}C burnt per cycle the decreasing convective shell mass leads to increasing neutron exposures per pulse, $\Delta\tau$. In the meantime, the pulse shape also changes: in particular, the *dilution factor*, D (ratio between the shell mass at ^{13}C ingestion and that at maximum convective expansion) decreases monotonically. The combined effects of increasing $\Delta\tau$ and of decreasing D cause the *effective* neutron exposure, τ_0, to reach an asymptotic limit which depends only on the amount of ^{13}C burnt. This improved scenario does not modify the general results we obtained so far using average thermal pulse conditions. In particular, we confirm our previous suggestions that thermal pulses in low mass stars are the astrophysical site that simultaneously accounts for the *main* *s*–process component in the Solar System (Käppeler et al., 1990), for the abundance observations of *s*–enriched AGB stars (Busso et al., 1992) and for *s*–process anomalies in meteoritic SiC grains (see e.g. Gallino et al., 1992).

References

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