p-capture nucleosynthesis in Low Mass Stars: effects of new reaction rates

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Evolved low and intermediate mass stars are important sites for the production of heavy nuclei (through slow n-captures) and of light and intermediate-mass isotopes (through p-captures). This was revealed by spectroscopy of evolved stars as well as by the chemical analysis of presolar grains of circumstellar origins. The observational basis for these issues has grown considerably over the years, confirming peculiar abundances of ^{3}He, ^{7}Li, CNO isotopes, ^{19}F and ^{26}Al. Many studies have been presented in the last thirty years suggesting that the above evidence can be accounted for by non-convective transport mechanisms (sometimes called deep mixing) that link the stellar envelope with the region where proton captures take place, during the red giant phases.

Nucleosynthesis in deep mixing episodes is made uncertain by two series of problems. On one side one has to identify the physical mechanism for the transport (thermohaline diffusion, rotational shear, gravitational waves, magnetic buoyancy). On the other, several reaction rates adopted in the calculations are still uncertain, mainly because hydrogen burning takes place in red giants at typical Gamov-Peak energies of a few tens of keV, where experimental measurements are extremely difficult. Most results present in the literature were obtained using reaction rates from either the [1] or the [2] compilations.

Here we want to discuss the effects of upgrades in the nuclear physics inputs occurred recently [3,4] on p-capture nucleosynthesis during extended mixing. We show how the use of more accurate reaction rates from new experiments induces considerable differences in the results as compared to previous studies. Among the most remarkable novelties we mention a possible higher production of ^{26}Al, changes in the ^{14}N/^{15}N ratio in stellar envelopes and an extremely precise account of the oxygen isotopic ratios in oxide grains, from which even the mass of the parent AGB stars can be unambiguously derived.

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