Nuclear Seminar

The nucleosynthesis of heavy elements in AGB Stars

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The aim of the stellar nucleosynthesis is to explain the origin of the elements studying the main processes responsible for the production of individual isotopes.

About half of the heavy elements from Sr-Y-Zr up to Pb-Bi are synthesized through the *s (slow)* neutron capture process, occurring in Asymptotic Giant Branch (AGB) stars during their thermally pulsing phase. The s-process abundances observed today in the Solar System are the result of a complex Galactic evolution mechanism, which accounts for the pollution of several AGB stellar generations (see review by Käppeler et al. 2011, Rev. Mod. Phys., 93, 157).

In this scenario, neutrons are released by two key reactions, $^{13}C(\alpha, n)^{16}O$ and $^{22}Ne(\alpha, n)^{25}Mg$.

In low mass AGB stars (M ~ 1.2 to 3 $M_{\odot}$), the $^{13}C(\alpha, n)^{16}O$ reaction burns radiatively at T ~ 0.9×10^8 K during the interpulse periods. It constitutes the major neutron source and provides more than 90% of the total neutron exposure. The $^{22}Ne(\alpha, n)^{25}Mg$ neutron source is partially activated during the recurrent convective thermal pulses, when the maximum temperature at the bottom of the He-burning shell reaches T ~ 3×10^8 K. This second reaction mainly affects the abundances close to the branching points that are sensitive to temperature and neutron density.

In intermediate mass AGB stars (M ~ 4 to 8 $M_{\odot}$), $^{22}Ne(\alpha, n)^{25}Mg$ is efficiently activated owing to the large temperature reached during thermal pulses (T ~ 3.5×10^8 K), while the contribution of $^{13}C(\alpha, n)^{16}O$ becomes marginal.

Theoretical predictions for AGB models with different initial masses, metallicities and s-process efficiencies will be discussed.

AGB models are computed with a full network, from hydrogen to bismuth, updated by the latest experimental results.

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