Contribution ID: **2** Type: **not specified**

Direct Measurement of 13C(α,n)16O cross section at LUNA

Thursday, 22 February 2024 10:00 (30 minutes)

The 13C(α,n)16O reaction is the main neutron sources for the weak s-process, responsible for the nucleosynthesis of about half of the elements heavier than iron. It takes place in thermally pulsing low mass AGB stars at about 90 MK, corresponding to a Gamow window between 140 - 230 keV. These energies are well below the Coulomb barrier. In last decades several direct and indirect measurements of the low energy cross section of 13C(α, n)16O have been performed. Going down in energy, the environmental background strongly hampers direct measurement, important also for the normalization of indirect measurements.
The LUNA collaboration has performed a measurement of the 13C(α,n)16O cross section in the low-background environment of the Laboratori Nazionali del Gran Sasso (LNGS), where the natural neutron background is reduced by over three orders of magnitude with respect to the surface laboratories. This unique location, combined with a high-efficiency low background detector based on 3He counters, a highly stable intense alpha beam (< I >= 200 μA) and a pulse shape discrimination technique for the rejection of the intrinsic detector background, allowed to cover the energy range 230-300 keV, with drastically reduced uncertainties over previous measurements and for the first time reaching the high-energy edge of the s-process Gamow window with a direct measurement.
In this talk the experimental techniques and the final results of the recent LUNA campaign will be presented, together with the astrophysical implication of our revised reaction rate. In particular, for stars of nearly solar composition, we find sizeable variations of some isotopes, whose production is influenced by the activation of close-by branching points that are sensitive to the neutron density, such as, the two radioactive nuclei 60Fe and 205Pb, as well as 152Gd.

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Session Classification: Main s-process