



Contribution ID: 42

Type: **Oral**

Direct measurement of $^{13}\text{C}(\alpha, n)^{16}\text{O}$ reaction towards its s-process Gamow peak

Monday, 5 September 2022 15:00 (15 minutes)

The $^{13}\text{C}(\alpha, n)^{16}\text{O}$ reaction is the prevalent neutron source for the main s-process, taking place in thermally pulsing low mass AGB stars. The direct measurement of this reaction at stellar temperature (~ 90 MK), corresponding to a Gamow window between 140 - 230 keV, has so far not been possible due to the very low cross section at these energies.

The LUNA collaboration performed the measurement of the $^{13}\text{C}(\alpha, n)^{16}\text{O}$ 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 compared to the surface laboratories.

The deep underground location, combined with a high-efficiency low intrinsic background detector based on ^3He counters, a highly stable intense alpha beam with 200 μA and a pulse shape discrimination technique for the rejection of the intrinsic detector background, for the first time allowed to reach the high-energy edge of the s-process Gamow window with direct measurement. The new data in the $E_{c.m.}=230\text{-}300$ keV range with drastically reduced uncertainties compared to previous measurements contribute to the better understanding of the dynamics of mixing episodes in AGB stars.

In this talk the experimental techniques and the final results of the LUNA experiment will be presented, together with the astrophysical impact of our revised reaction rate.

Field of work

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Session Classification: Monday - Session 3