Cross section of the $^{13}C(\alpha, n)^{16}O$ reaction at low energies

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(Dated: June 11, 2019)

The $^{13}C(\alpha, n)^{16}O$ reaction is the main neutron source for the s process, which is responsible for the production of about half of the heavy elements in the universe. It operates in thermally pulsing low mass AGB stars at temperatures of about 90 MK. This translates to a Gamow window between 140 - 230 keV, far below the Coulomb barrier. Several direct measurements of the low energy cross section of $^{13}C(\alpha, n)^{16}O$ have been performed in the past, and while remarkable results have been achieved, ultimately the Earth surface environmental background has been a limiting factor. The LUNA collaboration has performed a measurement of $^{13}C(\alpha, n)^{16}O$ cross section in the low-background environment of the Laboratori Nazionali del Gran Sasso (LNGS), where the environmental neutron flux is reduced by over three orders of magnitude with respect to the surface. This unique location, combined with a high-efficiency low background detector based on ^{3}He counters, a highly stable intense alpha beam ($< I >= 200\ \mu A$) and a pulse shape discrimination technique for the suppression of the detector intrinsic background, permitted us to push the low-energy limit of cross section measurements 50 keV below the lowest point in literature, reaching the high energy edge of the Gamow window. Thanks to a novel and detailed analysis on the target modification during the beam irradiation and an experimental campaign on the detector efficiency, unprecedented overall uncertainties lower than 15% have been achieved.

An update on status of the analysis and cross sections results will be presented.