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Deep underground laboratory measurement of $^{13}\text{C}(\alpha, n)^{16}\text{O}$ in the Gamow windows of the s- and i-processes

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The $^{13}\text{C}(\alpha, n)^{16}\text{O}$ reaction is the main neutron source for the slow-neutron-capture (s-) process in Asymptotic Giant Branch stars and for the intermediate (i-) process. Direct measurements at astrophysical energies in above-ground laboratories are hindered by the extremely small cross sections and vast cosmic-ray induced background. We performed the first consistent direct measurement in the range of $E_{\text{c.m.}} = 0.24$ MeV to 1.9 MeV using the accelerators at the China JinPing underground Laboratory (CJPL) and Sichuan University. Our measurement covers almost the entire i-process Gamow window in which the large uncertainty of the previous experiments has been reduced from 60% down to 15%, eliminates the large systematic uncertainty in the extrapolation arising from the inconsistency of existing data sets, and provides a more reliable reaction rate for the studies of the s- and i-processes along with the first direct determination of the α -strength for the near-threshold state.

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