

Probing the $^{10}\text{B} + \alpha$ pathway for primordial stars at LUNA: Experimental techniques and preliminary results

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The $^{10}\text{B} + \alpha$ reactions have been proposed as part of potential pathways, alongside the triple-alpha process, to synthesise CNO elements in massive Primordial Population III stars. However, current astrophysical models rely on reaction rates that are poorly constrained at the relevant stellar energies. This talk presents preliminary results from experimental campaigns currently underway at the Laboratory for Underground Nuclear Astrophysics (LUNA) to constrain these rates.

I will discuss the experimental challenges and detection techniques associated with these low-rate reactions and how the deep underground environment of LNGS is exploited to achieve the necessary sensitivity. The presentation details the detection setup, which employs a near 4π segmented BGO array to study the $^{10}\text{B}(\alpha, n)^{13}\text{N}$ reaction via activation technique, and to directly measure gamma-ray emission from the $^{10}\text{B}(\alpha, \text{pg})^{13}\text{C}$ reaction channels. Attention is also devoted to the production and characterisation of the solid $^{10}\text{B}_4\text{C}$ targets, focusing on their durability under intense alpha-beam currents.

Finally, I will report on the current status of the data analysis, focusing on results for the $^{10}\text{B}(\alpha, n)^{13}\text{N}$ reaction and the $^{10}\text{B}(\alpha, \text{pg})^{13}\text{C}$ channels. I present preliminary cross-section data and outline prospective plans to extend the energy range of these measurements.