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The SHADES Project: Underground Measurement of the Low Energy ^{22}Ne(α,n)^{25}Mg Cross Section

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Synthesis of neutron-rich isotopes is widely considered to occur via the slow neutron-capture processes (weak and main s-process). The reactions $^{13}\mathrm{C}(\alpha,\mathrm{n})^{16}\mathrm{O}$ and $^{22}\mathrm{Ne}(\alpha,\mathrm{n})^{25}\mathrm{Mg}$ are the main neutron sources for this process; the LUNA collaboration has measured the former reaction to high precision at energies relevant for AGB stars ($> 90\,\mathrm{MK}$). However, the latter reaction remains experimentally unconstrained at the astrophysically relevant temperatures for helium shell burning, 0.2–0.3 GK, or centre-of-mass energies 450–750 keV. In particular, the state-of-art reaction rate is represented only by an upper limit at energies below 680 keV. To address this knowledge gap, a recent campaign is ongoing using the LUNA-MV accelerator to directly measure the $^{22}\mathrm{Ne}(\alpha,\mathrm{n})^{25}\mathrm{Mg}$ cross section in the astrophysical energy range. This experiment will exploit the new neutron counter array SHADES installed downstream from a $^{22}\mathrm{Ne}$ gas target. Thanks to the very low natural neutron background at the Laboratori Nazionali del Gran Sasso and the innovative SHADES array, the rate is envisioned to have an improved sensitivity of > 2 orders of magnitude over previous measurements. This poster will present an overview of the SHADES array along with preliminary results collected at and above the important 704 keV resonance using the LUNA-MV accelerator.

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