

A Prototype Neutron Detector Array for s-process Measurements

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Neutron detection sometimes plays a vital role in direct studies of astrophysically important reactions. In particular, the reaction $^{22}\text{Ne}(a,n)^{25}\text{Mg}$ is undergoing study using the SHADES array at the Belotti Ion Beam facility at Laboratori Nazionali del Gran Sasso. This reaction, and $^{13}\text{C}(a,n)^{16}\text{O}$, is widely regarded to serve as a neutron fuel for the slow neutron capture (s-) process occurring in massive stars and asymptotic giant branch stars, which synthesise elements above $A = 60 - 90$ and $90 - 209$, respectively. Prior to constructing the full SHADES array, the neutron detection capabilities of its detectors were tested using a scaled-down prototype array and a neutron beam produced at the Goethe University Frankfurt's Van de Graaf accelerator facility "FRANZ". The prototype consisted of an EJ-309 liquid scintillator surrounded by six ^3He proportional counters. Under study was the neutron / gamma-ray discrimination performance of the EJ-309 using traditional and machine-learning techniques, the lower detection limit of the neutron energy, and the timing coincidence features between the EJ-309 and counters. In future, such coincidence is expected to improve the sensitivity of the full SHADES array via a novel anti-coincidence gate on background neutrons. This talk will summarise the measurement performed at Frankfurt and the determined characteristics of the prototype array.

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