Measurement of ^{20}Ne(d,p)^{21}Ne for studies of s-process and neutron poisoning

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The s-process in massive stars is an important source of heavy elements at low metallicities. Massive stars with very low metallicity depend largely on rotation induced mixing to produce light nuclei, such as ^{22}Ne, which is the main source of neutrons for the s-process. Light nuclei are formed in the He burning phase and ^{16}O is formed through ^{12}C(α,γ). The ^{16}O absorbs neutrons forming ^{17}O and therefore competes with heavier s-process elements for available neutrons. The ratio of the subsequent ^{17}O(α,γ) and ^{17}O(α,n) dictates to what extent ^{16}O behaves as a neutron poison, determining how many neutrons are available for the s-process.

States in the region of 7.65-8.00 MeV in ^{21}Ne correspond to the Gamow window for the ^{17}O(α,n)^{20}Ne reaction in the temperature range 0.2-0.3 GK. The spin-parity and neutron width of some of the ^{21}Ne states in the Gamow window are unknown. Some of these states also have significant uncertainty in their energies.

We have conducted a measurement of the ^{20}Ne(d,p)^{21}Ne reaction populating states in the Gamow window using the Triangle Universities Nuclear Laboratory Split-pole Spectrograph. Using this ^{20}Ne(d,p)^{21}Ne reaction we have identified those states with significant neutron widths, hence those most relevant for ^{17}O(α,n). Details will be presented on the measurements that were made at 5 angles; preselected using DWBA calculations to maximise the selectivity of spin-parity assignments to ^{21}Ne states. Furthermore, we have determined the state energies in the astrophysically relevant excitation region and extracted their angular distributions. This work will ultimately lead to further information on ^{21}Ne states and as such a better understanding of the role ^{16}O has as a neutron poison for the s-process in massive stars.