Remeasurement of $^{14}\text{N}+^{7}\text{Be}$ for the astrophysical $S_{17}(0)$ factor

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The first experiment where we have used the new detector assembly described in detail in reference [1] was performed to check the asymptotic normalization coefficient (ANC) for the $^{7}\text{Be}+p \rightarrow ^{8}\text{B}$ using the transfer reaction $^{14}\text{N}(^{7}\text{Be},^{8}\text{B})^{13}\text{C}$. Two improvements were made to our earlier experiment [2]: a better monitoring of the secondary beam intensity and extension of the angular range for the detection of the products from elastic scattering and transfer reaction. In the earlier experiment, monitoring of the beam intensity was done by measuring the primary beam intensities with a Faraday cup (FC) placed in the Momentum Achromat Recoil Spectrometer’s (MARS) coffin. In experiments following [2], a drop of isotope production rate per nA beam current was observed when the intensity of the beam was increased, presumably due to a “tunneling” effect in the gas target. We suspected that this problem had an influence on the results obtained in [2]. The new beam monitoring system [1] consisted of a screen to reduce the $^{7}\text{Be}$ beam intensity by 88% and a scintillator coupled with a photo-multiplier. The advantage of this system is the direct counting of the beam secondary particles at the back of MARS.

The primary beam used was $^{7}\text{Li}$ at 18.6 MeV/A from the K500 cyclotron. The beam was transported to the H$_2$ liquid nitrogen cooled primary target at the MARS target chamber. The pressure of the H$_2$ in the cooled cell was 2.0 atm and the cooling of the cell was done with an LN$_2$ Dewar refilled automatically by means of a valve - filling sensor system. Vertical and horizontal slits were used in order to remove any impurities and to define the emittance of the secondary $^{7}\text{Be}$ beam. Details of the $^{7}\text{Be}$ beam production can be found in reference [2]. The final energy of the radioactive $^{7}\text{Be}$ beam was 12.6 MeV/A with intensities $\approx$150 - 200 kHz.

The position and spot size of the $^{7}\text{Be}$ beam were adjusted using a 900 mm position sensitive Si detector which was then removed and replaced by the secondary target 1.5 mg/cm$^2$ melamine. $^{7}\text{Be}$ elastic scattered events were detected by the new detector assembly. One of the most important results of this experiment is presented in Fig. 1, the extended angular distribution for the reaction $^{14}\text{N}(^{7}\text{Be},^{7}\text{Be})^{14}\text{N}$. We observe that we cover nearly four maxima which will be very important for future data analysis in order to obtain better agreement between the theoretical calculations and experimental data since elastic scattering provides a better check of the optical model potentials used for the calculation of the transfer reaction cross section.

References