Determination of the ANC and spectroscopic factor for ^{15}C from neutron transfer reactions ^{14}C(d,p)^{15}C and ^{13}C(^{14}C,^{15}C)^{12}C

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The neutron capture rate of ^{14}C is of interest in both inhomogeneous big bang nucleosynthesis and also in CNO cycles that can take place in the neutron-rich environment found in the helium burning region of post main sequence stars [1,2]. The ^{14}C(n,γ)^{15}C reaction serves as the limiting reaction in this process. Furthermore, ^{14}C(n,γ)^{15}C is being used as a test case for the indirect determination of neutron capture rates at low energies on neutron-rich nuclei using neutron-transfer reactions at laboratory energies. Our approach combines information from the peripheral reaction of 12 MeV/u ^{14}C on a thin ^{13}C target and the non-peripheral reaction of 60 MeV deuterons on a thin ^{14}C target.

^{13}C(^{14}C,^{15}C)^{12}C:

This reaction is peripheral and is being used to determine the ANC for ^{15}C. The experiment was performed using a radioactive ^{14}C beam accelerated by the K500 cyclotron which reacted with a thin ^{13}C target. The reaction products were analyzed by the MDM spectrometer and the MDM detector. A gold target of known thickness was used for calibration. Both the elastic and transfer reactions of ^{14}C on ^{13}C were measured. The reaction products are identified by their position in the focal plane of the MDM detector (Fig 1).

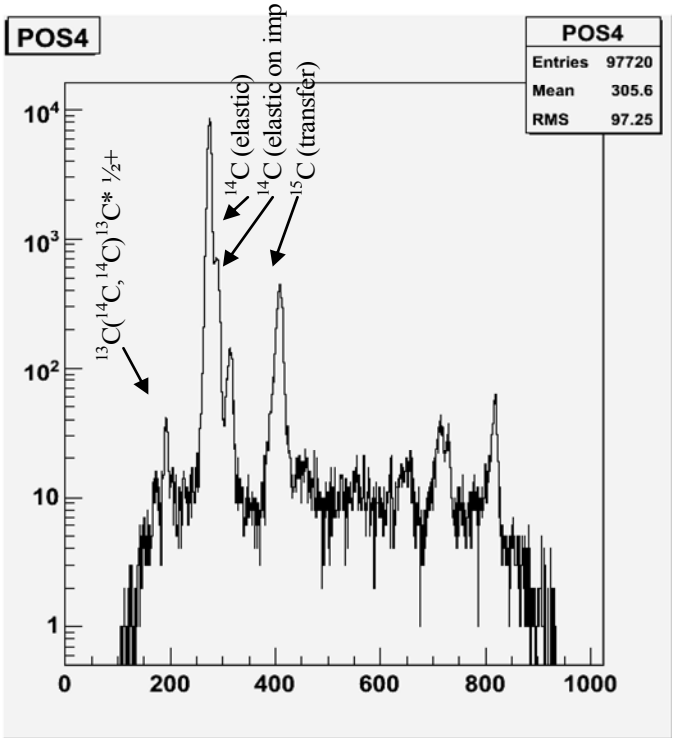

Figure 1. Particle identification in the focal plane

^{14}C(d,p)^{15}C:

This experiment, performed with a deuteron energy of 60 MeV, will be combined with the previous experiment to determine the spectroscopic factor since at this energy the reaction is not peripheral. The reaction products were analyzed using the MDM spectrometer and the repaired Oxford detector. It was the first (d,p) measurement at this large energy, and detecting the proton with the Oxford

detector was a challenge due to the small energy loss signal. Again both elastic and transfer reactions were measured and elastic scattering on a gold foil was used for calibration. A summary of the preliminary results is shown in Fig. 2. Very good angular and energy resolution were obtained.

[1] A Horvath *et al.*, Astrophys. J. **570**, 926 (2002).

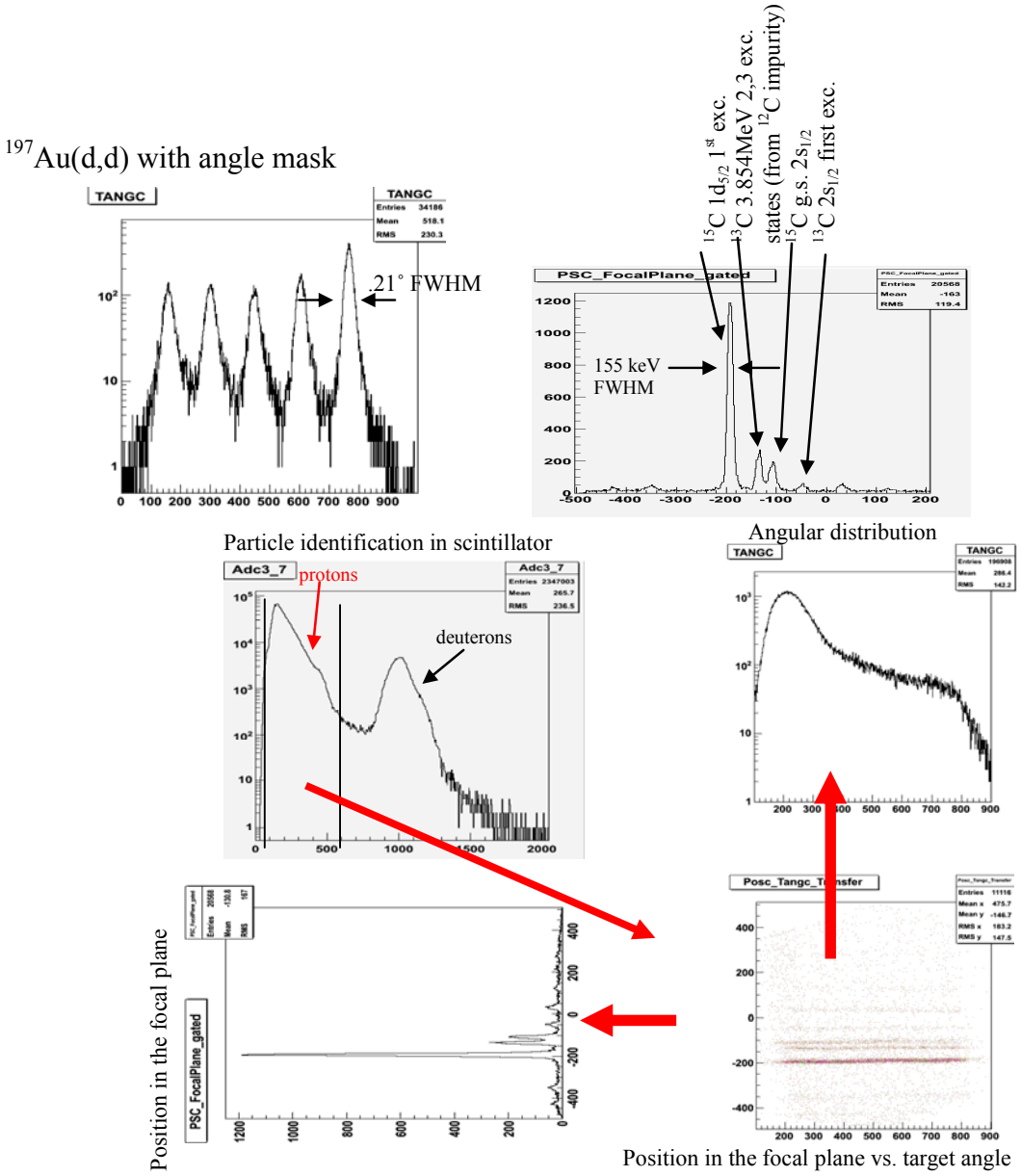

Figure 2. Summary of the results of the ^{14}C(d,p) experiment.

[2] M Wiescher *et al.*, J. Phys. G **25**, R133 (1999).