Asymptotic normalization coefficient from the $^{14}C(d, p)^{15}C$ reaction

A. M. Mukhamedzhanov, V. Burjan,[1] M. Gulino,[2] Z. Hons,[1] V. Kroha,[1] J. Mrazek,[1] J. Novak,[1] S. Piskor,[1] S. Romano,[2] M. L. Sergi,[2] C. Spitaleri,[2] L. Trache and R. E. Tribble

[1] *Nuclear Physics Institute, Czech Academy of Sciences, 250 68 Rez-Prague, Czech Republic*

[2] *Universita di Catania and INFN Laboratori Nazionali del Sud, Catania, Italy*

The measurement of the differential cross section of the $^{14}C(d,p)^{15}C$ reaction was carried out at the U-120M cyclotron isochronous cyclotron at the Nuclear Physics Institute of the Czech Academy of Sciences. The deuteron beam with the energy of 17.06 MeV was led into a target chamber with ^{14}C and mylar targets. At all angles we alternately measured spectra from both these targets. In this way we were able to determine exact contents of the ^{14}C isotope in ^{14}C targets. Reaction products were measured by four $\Delta E-E$ telescopes assembled from thin surface barrier silicon and thick Si(Li) detectors with thickness about 200 μm and 4 mm respectively. One telescope serving as a monitor of the target was fixed at the angle of 15°. All telescopes were mounted at 160 mm distance from the center of the irradiated target and were provided with 2 mm x 3 mm rectangular collimators.

The angular distributions of deuterons from the reaction $^{14}C(d,p)^{15}C$ corresponding to the two bound states in ^{15}C calculated with different combinations of the optical model parameters are shown in Fig. 1. The angular distribution of the transition to the ground state of ^{15}C is best described by the

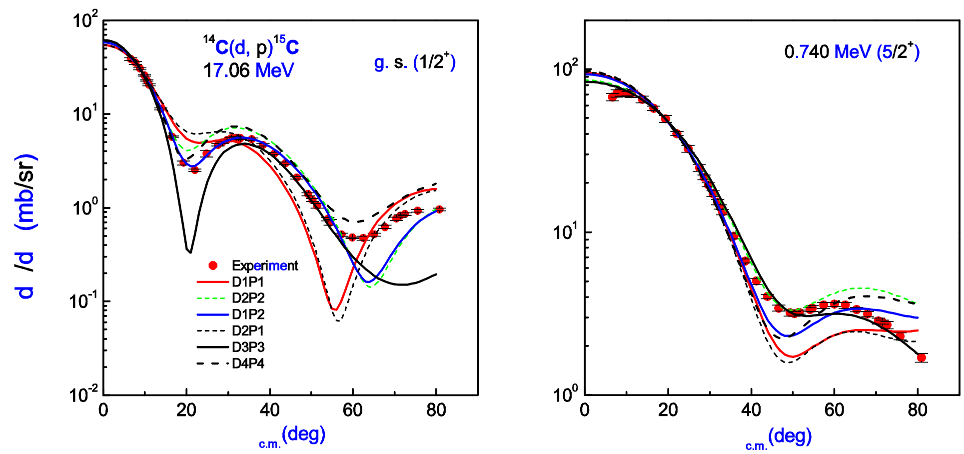

FIG. 1. Angular distributions from the $^{12}C(d,p)^{15}C$ reaction for the transitions leading to the ground and 0.740 MeV states in ^{15}C. DWBA calculations were made with optical model parameter sets given in Tables 1 (input chanel) and 2 (output channel): D1-P1, red solid curve; D1-P2, blue solid curve; D2-P1, red dotted curve and D2-P2, black dashed curve. D1 (fit of Cole seed data [1]) and D2 (fit of seed data taken from [2])- optical potentials in the initial channel, P1 [3] and P2 [2] - optical potentials in the final channel.

combination of optical model potentials D1-P2. For the transition to the 0.740 MeV state of ^{15}C the optical model parameters D2-P2 are the best. By normalization of the differential cross section calculated within the DWBA to the experimental one we determine the ANC. In Table I the deduced values of the ANCs are given. The spectroscopic factors are calculated from the relation Slj = C_{lj}^2/b_{lj}^2 , where blj is the single- particle ANC determined for the bound state potential with parameters r_o = 1.25 fm and a = 0.65 fm.

TABLE I. Di(Pj) is the optical potential in the initial (final) state of the reaction $^{14}C(d,p)^{15}C$, *C* is the neutron ANC in ^{15}C, *S* is the spectroscopic factor.

	Potential	C^2(fm^{-1})	*S*
gr. state (1/2+)	D1-P1	1.390	0.675
	D1-P2	1.551	0.754
	D2-P1	1.545	0.751
	D2-P2	1.818	0.884
	D3-P3	1.635	0.794
	D4-P4	1.888	0.917
	Mean value	1.638 ± 0.170	0.796

[1] W.S. Cole, T. Mo, H.R. Weller, and J.J. Ramirez, Nucl. Phys. **A213**, 107 (1973).
[2] C.M. Perey, F.G. Perey, At. Data and Nucl. Data Tables **17**, 1 (1976).
[3] T.H. Curtis, H.F. Lutz, D.W. Heikkinen, and W. Bartolini, Nucl. Phys. **A165**, 19 (1971).