Structure of ^{12}N using ^{11}C + p resonance scattering

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We have measured the ^{11}C + p elastic scattering in the excitation region of ^{12}N from 2.2 up to 11 MeV by the thick target inverse kinematics method. Measurements were made using both solid (Lawrence Berkeley National Laboratory) and gas targets (Texas A&M University). This combination gave us also the possibility of studying the importance of inelastic scattering. The data were analyzed in the framework of the **R** -matrix approach, also using known data on ^{12}B levels and the predictions of the shell model(s). Sixteen levels (several of them are new) were analyzed in ^{12}N, and data on their spin-parities, excitation energies, and widths were determined. For the four levels above 5.45 MeV excitation, only suggested parameters are proposed. A narrow state with a tentative low spin assignment was found about 200 keV below the astrophysically interesting ^{8}B + α threshold (8.008 MeV) in ^{12}N.

Conventional **R** -matrix calculations generated cross sections at the highest energies which were too large (at excitation energies > 8.2 MeV). We related this effect to the increasing role of direct reactions and took their influence into account by adding imaginary parts (parameterized by a simple expression) to the phase shifts generated by the hard sphere scattering. Generally, the shell model predictions were a good guide for the analysis of the lowest excited states. However, at higher excitation energies, the spread of the $d_{3/2}$ strength appeared to be underestimated and the predicted dominant $d_{3/2}$ levels appeared to be shifted to lower energies. As an example of the quality of the experimental data and the obtained **R** -matrix fit, Fig. 1 presents our results from 2.2 to 8.2 MeV in excitation energy. Complete results of this work are in press as a regular article in Physical Review C.

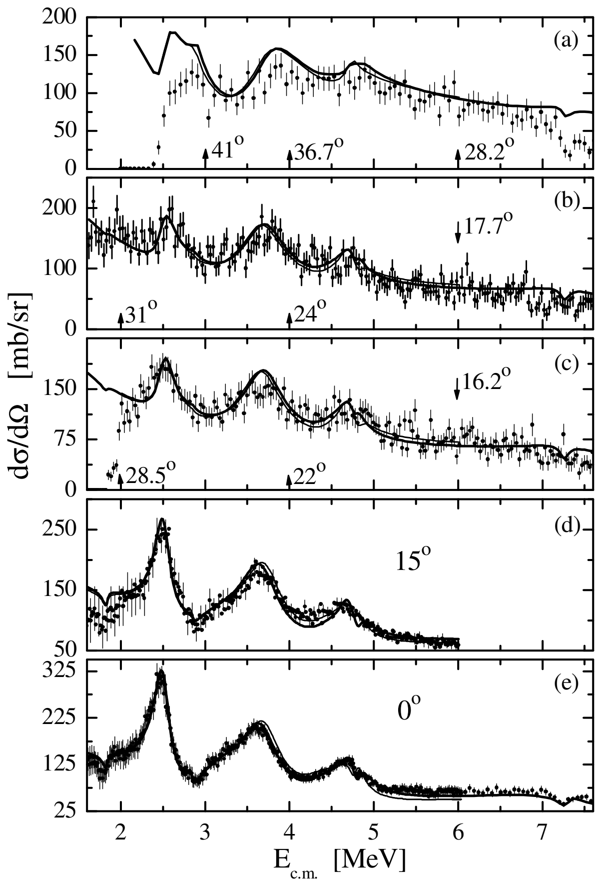

Fig. 1. The c.m. excitation functions for the ^{11}C + p elastic resonance scattering from 2.2 to 8.2 MeV. **R** –matrix fits were calculated based on the 0° data (bold line) and on the 15° data (thin line) and the parameters of these fits were used to calculate excitation functions at the other angles. a) +16.5° gas target data; b) -12.5° gas target data; c) +11.5° gas target data; d) 15° solid target data; and e) 0° solid target data. To convert the E_{cm} energy scales to excitation energies, 0.601 MeV should be added to them. Note that in the case of the gas target data, the actual detection angle changes as a function of the ^{11}C beam energy.