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INTERPRETATION OF $^{16}O(D, \alpha)^{14}N$-REACTION'S MECHANISM AT E_D = 1.876 - 40 MEV

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ABSTRACT

The experimental differential cross-sections data for the lower four ^{14}N-states, measured at different twenty deuteron's incident energies ranged from 1.876 to 40 MeV, are used to interpret the mechanism of the $^{16}O(d, \alpha)$-reaction. The zero-range Distorted Wave Born Approximation (DWBA)-Theory with the help of the Cohen-Kurath's spectroscopic factor amplitudes for two-nucleon transfer are used to analyze the experimental data. The experimental angular distributions for the lower two ^{14}N-states G. S. (1^+; 0) and 3.948 MeV (1^+; 0), at lower incident energies (E_d from 1.876 to 18.1 MeV), are incident energy dependent. While those for the four ^{14}N-states G. S. (1^+; 0); 3.948 (1^+; 0); 7.029 (2^+; 0) and 11.05 MeV (3^+; 0), at higher incident energies $E_d \geq 18.8$ MeV, are incident energy independent and they show satisfactory fits with the corresponding theoretical predictions for both the two methods of analysis. On other hand, the experimental forward integrated cross-sections [σ_{exp} (0°-90°)], for the same lower four ^{14}N-states at E_d = 40 MeV, show excellent fits with the bare Cohen-Kurath's SU(3) spectroscopic factors (S) and also with the corresponding theoretical forward integrated cross-sections [σ_{DW-4} (0°-90°) for both semi-microscopic and microscopic]. These satisfactory fits serve as tests for the accuracy of the target and final-nucleus wave functions used in the calculation of spectroscopic-factors. In addition, the experimental forward integrated cross-sections for the lower three ^{14}N-states G. S.; 3.948 and 7.029 MeV, decreases exponentially with increased incident energy and provide good fits with the corresponding theoretical forward integrated cross-section curves. Such fits support the fact that the reaction mechanism, at the higher incident energies ($E_d \geq 18.8$ MeV), is primarily direct. The Cohen-Kurath's theoretical excitation-energies for the lower four ^{14}N-states G. S.; 3.948; 7.029 and 11.05 MeV, can predict and are in excellent agreement with the corresponding experimental values. The accurate prediction for the lower ^{14}N-states is a success of the Cohen-Kurath's wave functions to describe the 1p-shell nuclei and for their model of calculation.

KEYWORDS: Spectroscopic-Factor Amplitudes, Transferred Pair Nucleons,Semi-Microscopic and Microscopi DWBA-Theoretical Analysis