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DWBA of the Reaction ^{0}Be(p, α)^{6}Li at E_P = 18.6\sim 50 MeV

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Abstract: The compound nucleus produced in the reaction ^{9}Be(p, α)^{6}Li in the incident energy range E_p = 18.6 \sim 50 MeV is mainly occurred when its excitation energy is greater than the α -particle threshold separation energy by about 20 MeV, strongly suggesting the reaction mechanism is a direct one-step process. To understand this phenomenon, we employ semi-microscopic zero-range distorted-wave Born approximation (DWBA) theory to analyse experimental data obtained in this energy range for the lower three ^{6}Li-states: ground state (1^+; 0); 2.186 MeV (3^+; 0); and 3.563 MeV (0^+; 1). The Kurath-Millener spectroscopic-factor amplitudes for the triton-cluster transfer are used in the analysis. Both the experimental angular distributions and the absolute values of the differential cross-sections are found to have good correlation with corresponding theoretical predictions. Good coincidence is obtained between the theoretically predicted spectroscopic factors $S_{JT}^{(p, \alpha)}$ and both experimental and theoretical integrated cross-sections (0°--90°) for E_p = 22.5, 31 and 45 MeV. Further, the experimental integrated cross-sections for the investigated ^{6}Li-states agree well with the corresponding theoretical values at E_p \ge 22.5 MeV. In addition, a suitable coincidence is obtained between the calculated and the experimental excitation energies. The agreement between experimental and theoretical data of this reaction can be attributed to the use of the Cohen-Kurath wave functions and the model of calculations. The present study shows that, the incident energy at which the reactions begin to proceed via the direct-component mechanism (i.e., the critical incident energy) varies from state to another.

Key Words: Direct mechanism; Differential Cross-sections; Spectroscopic-factor amplitudes; Dependence of the integrated cross-sections on energy.

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