Regge pole analysis of elastic scattering of a particles by even isotopes of Ni target nuclei at incident energies above Coulomb barrier

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Abstract

Regge pole model is adopted to account for the angular distribution at backward angles for a set of elastic scattering processes of incident a-particles by different isotopes of nickel ions, Ni-58,Ni-60,Ni-62,Ni-64, at different laboratory energies above Coulomb barrier. The reproduction of cross-sections at backward angles is preceded by an attempt to fit the experimental data at forward angles of the scattering. Three-parameter McIntyre model which is based on concept of strong absorption parametrization of the scattering matrix elements, has been employed to analyze and reproduce the experimental data of angular distribution of different elastic scattering reactions at forward angles. The three parameters extracted from McIntyre model analysis are employed as fixed entries in the fitting process of the full angle-range of angular distribution where another four free parameters are employed using the Regge pole model. Diffractive features observed in the angular distributions are studied. The Fresnel-type diffraction pattern is found dominant for all investigated elastic scatterings where Coulomb interaction is strong. The interaction radius of elastic scattering is found decreasing and the total cross-section increasing when the incident projectile energy increases. Moreover, the interaction radius and total reaction cross-section are found increasing with the increase in the size of target ion. Such diffractive behavior is consistent with the prescriptions of strong absorption model (SAM). Furthermore, the explanation of the diffractive features of studied elastic scattering reactions is model-independent. The Regge pole analysis reveals the existence of a pole which has its location, width, amplitude and phase angle exhibiting a common peak at energy of 24.1 MeV with oscillatory behaviour at energies around this peak energy, for all elastic scattering of alpha particle on isotopes of Ni targets except that of Ni-58 target which exhibits extra peaks for energy larger than 24.1 MeV. We believe that the presence of poles is responsible for the oscillatory structure of the backward cross-sections. The variation of Regge pole parameters with both incident energy and size of target nucleus is illustrated.

Keywords

Author Keywords: Heavy-ion scattering; strong absorption model; McIntyre parametrization; Regge pole

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