The elastic scattering of $^{40,42,44,48}Ca$ at 1.0 GeV in the framework of relativistic impulse approximation

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Introduction

The Nucleon- Nucleus interaction provides a wide source of informations to determine the nuclear structure including spin, isospin, momenta and densities. It is also gives a picture towards the formation of exotic nuclei in the laboratory. In this context the study of elastic scattering of Nucleon-Nucleus is more interesting than that of Nucleus-Nucleus at different energy. One of the theoretical method to study such types of reaction is "Relativistic Impulse Approximation" (RIA). The basic ingradients in this approach are the nucleon-nucleon (NN) scattering amplitude and the nuclear scalar and vector densities of the target nucleus. One useful applications of the RIA is to generate microscopic optical potential for studying the elastic and inelastic scattering of nucleons for stable and and the nuclei far away from β stability line.

Recent study of proton nucleus elastic scattering within modified (Coulomb) Glauber model [1] and the experimental measurement of differential cross-section of Ca-isotopes at 1.0 GeV [2] motivate us to study the elastic scattering observables for the respective nuclei using the RIA model.

1. Theoretical Framework

Our aim is to calculate the nucleon-nucleus elastic differential scattering cross-section ($\frac{d\sigma}{d\Omega}$) and other quantities, like optical potential (U_{opt}), analysing power (A_y) and spin observables ($Q-$value) taking input as relativistic mean field (RMF) and re-

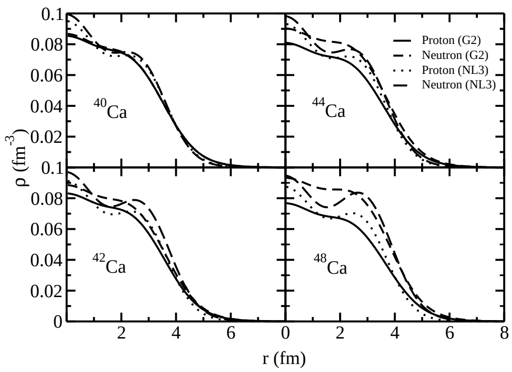

FIG. 1: The neutron and proton density distribution for $^{40,42,44,48}Ca$ in radial direction with NL3 and G2 parameter sets.

cently proposed effective field theory motivated relativistic mean field (E-RMF) densities. The RMF and E-RMF densities are obtained from the most successful NL3 [3] and the advanced G2 [4] parameter sets. Then we evaluate the scattering observables, which involves the following two steps: (i) in the first step we generate the complex NN-interaction from the Lorentz invariant matrix. This interaction is folded with the ground state target nuclear density for both the Relativistic-Love-Franey (RLF) and McNeil-Ray-Wallace (MRW) parametrisations [5] and obtained the nucleon-nucleus complex optical potential $U_{opt}(q, E)$. It is to be noted that pairing interaction is taken care using the Pauli blocking approximation. (ii) In the second step, we solve the wave function of the scattering state utilising the optical potential prepared in the first step by well known Numerov algorithm [6]. The result is approximated with the non-relativistic Coulomb scattering for a

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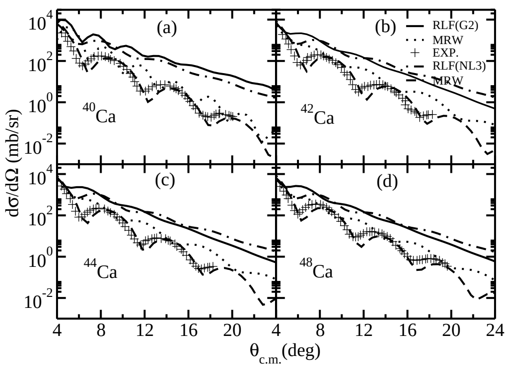

FIG. 2: The elastic differential scattering cross-section ($\frac{d\sigma}{d\Omega}$) as a function of scattering angle $\theta_{c.m.}$ (deg) for $^{40,42,44,48}Ca$ using both RLF and MRW parametrisations.

wide range of radial component which results the scattering amplitude and other observables [7].

2. Results and Discussion

FIG. 1 represents the calculated densities distribution of protons and neutrons of $^{40,42,44,48}Ca$ obtained from RMF (NL3) and E-RMF (G2) parameter sets. From the densities we evaluate the optical potential for $p +^{40,42,44,48} Ca$ composite system at laboratory energy E_{lab} 1.0 GeV using RLF and MRW parametrisations. Then looking to the availability of experimental data we examine the validity of our RIA predictions for describing scattering cross-section ($\frac{d\sigma}{d\Omega}$), analysing power (A_y) and spin obseravbles (Q-value) of the reaction. Our calculated results of $\frac{d\sigma}{d\Omega}$ compared with the experimental data [2] for $^{40,42,44,48}Ca$ in in FIG. 2. The scattering observables like A_y and Q-value are also evaluted, which will be reported at the time of Symposium.

3. Summary and Conclusion

A small difference at the central in the density distribution of proton and neutron are seen while comparing the densities obtained by RMF (NL3) and E-RMF (G2) parameter sets. This small difference in densities make a significant influence in the prediction of optical potential, elastic differential cross-section, analysing power and the spin observable for $p + Ca$ systems. The effect of kinematic parameters for reaction dynamics, RLF and MRW, are also highly sensitive to the predicted results. That means, the scattering observables are highly dependent on the input density and the choice of parametrisation.

Acknowledgments

This work is supported in part by UGC-DAE Consortium for Scientific Research, Kolkata Center, Kolkata, India (Project No. UGC-DAE CRS/KC/CRS/2009/NP06/1354).

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