Microscopic Description of Elastic Scattering of Proton From ^{208}Pb

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In the present work, we have analyzed proton elastic scattering data at 30.3, 40, 65, 200, 300, 400MeV from ^{208}Pb using optical model potential calculated in first order Brueckner theory. As an input to the g matrix calculation we use Urbana V14 soft core inter nucleon potential [1].

Nucleon-Nucleus optical potential is obtained mainly in two steps. Firstly, one calculates the effective inter-nucleon interactions (g-matrices) at different incident proton energies. In the second step, the g matrices are folded over the ground state point proton & neuron densities of the target nucleus. For the target density of ^{208}Pb nucleus, we use two different prescriptions. These are experimental density (denoted as RAY) [2] and RMF density [3]).

We use relativistic kinematics for calculating momentum of both the incident and target nucleon. Further we use relativistic kinematics for calculating the energies with a continuous choice for intermediate states. In order to calculate direct part of spin orbit potential we avoid the normally used short range approximation and calculate the folding integral for the direct part without any approximation, as described in detail in our recent paper [4]. For the exchange part we use the equivalent local approximation [5,6].

The optical potentials calculated as described above are then used in a spherical optical model computer code to calculate the differential elastic scattering data and other observables at all the energies mentioned above.

The calculated potential have been scaled by overall normalization parameters λ_r , λ_i , λ_{sor} for the central real ,imaginary and real spin orbit parts to obtain best fit to data by minimizing χ^2/DF (DF stands for degrees of freedom). The imaginary spin-orbit potential was kept unchanged all these energies. The neutron and proton densities for ^{208}Pb are shown in Fig.1.

We see that Ray [2] density vary smoothly with the radial distance, where as RMF [3] shows oscillation in the interior region. Figures 2 and 3 show our results for the differential elastic scattering cross section and analyzing power. We find that we are able to get good agreement with the differential cross-section and a reasonable agreement with the analyzing power data for all incident energies using only three scaling parameters. At low incident energies 30.3 40, 65 MeV our values are λr=0.95, λ_i =0.65, λsor=1.2 for both densities. However at high incident energies 200,300 and 400 MeV our values are λr=0.75, λ_i=0.65(RMF), 0.72(Ray), λsor =0.85. Thus the microscopic optical model potential provides a satisfactory description of data for the scattering of p-208Pb from 30.3 MeV to 400 MeV.

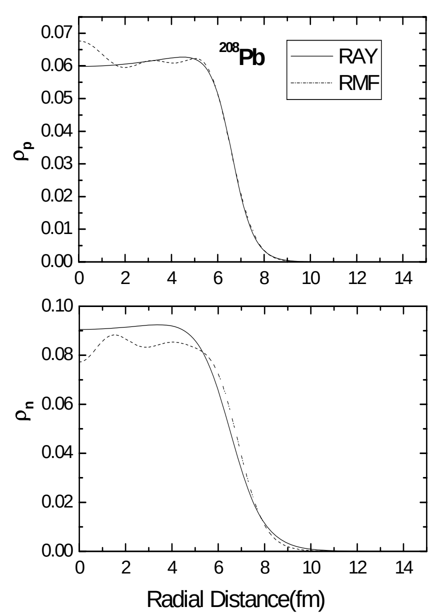

Fig.1. The neutron and proton distribution in ^{208}Pb as obtained by RAY [2] and RMF calculation [3].

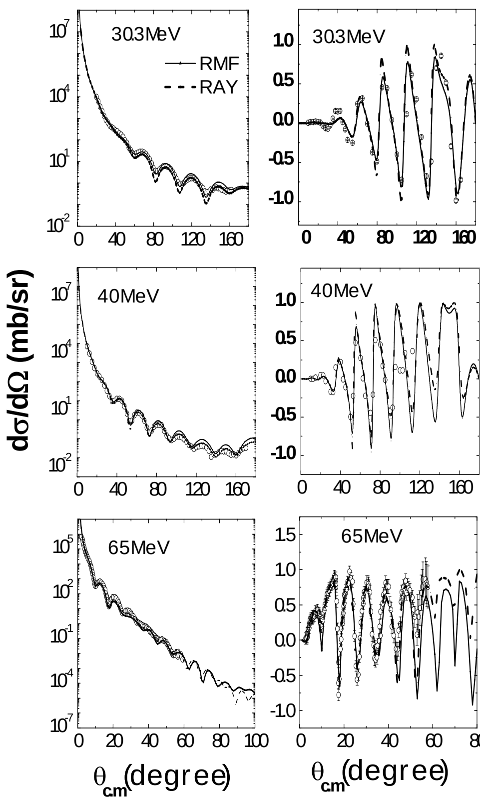

Fig.2.Differential cross-section and analyzing power for the scattering of p-^{208}Pb.

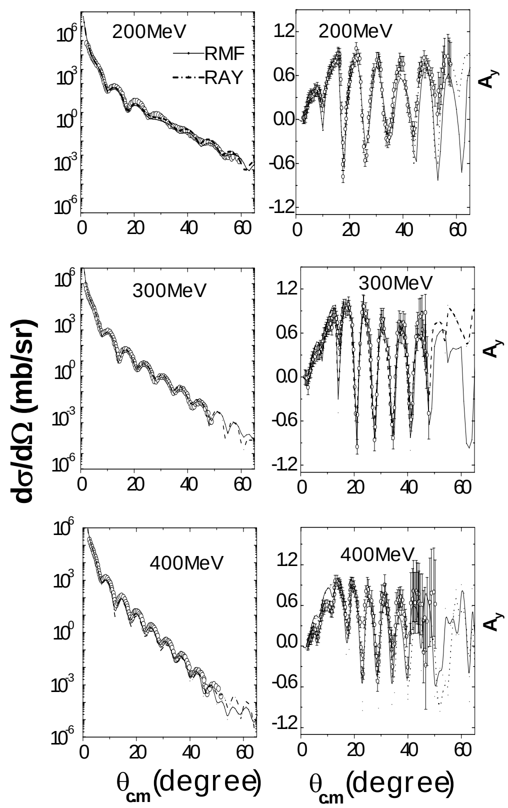

Fig.3. same as fig.2.

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