Microscopic optical model potential for *p-C* scattering at 40*A*MeV

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Introduction

The structure of carbon isotopes has recently attracted much attention. New measurements [1] of reaction cross section (σ_R) for ^{19,20,22}C on proton target at 40*A* MeV shows a large enhancement in σ_R for ^{22}C compared to those for the neighboring isotopes. Also large increase in reaction cross section for ^{12}C scattering from ^{16}C target at 83*A* MeV has been observed experimentally [2]. Both these experiments suggest the formation of neutron halo in these nuclei.

Here we report the preliminary study of σ_R for chain of carbon isotopes with A = 10 – 24 on proton target for 40*A* MeV. We adopt the same prescription as our previous work as reported in Ref. [3]. The densities are employed in the semi-microscopic optical model (MOM) to determine the proton optical potentials for the different carbon isotopes. For this purpose, the densities are folded with the extended Jeukenne, Lejeune, and Mahaux (JLM) energy and density dependent nucleon-nucleon interaction using the code MOM. This yields both the real and imaginary parts of the respective optical potentials. In the final step, this optical potential is used to compute the reaction and the differential cross sections for 40*A* MeV even mass number C isotopes, both stable and unstable, scattering from proton target. The point proton and neutron densities used here are obtained [4,5] in the relativistic mean field framework [6].

The normalisation factor for the real part of the MOM potential is fixed to be λ_V = 1. The spin-orbit part of potential has not been included\ in the preliminary calculations reported here. A search on the imaginary part of the MOM potential was carried out for ^{12}C to determine the best fit and was found to be λ_W = 1. The values of λ_V and λ_W were fixed and calculation of cross section were carried out for even isotopes of C with A = 10 – 24. Thus the results shown in this work are the predictions of our model. These potentials were used to calculate the cross sections for p-^{10,12,14,16,18,20,22,24}C at 40A MeV.

Results:

The differential cross section calculated using MOM potentials for proton scattering from different isotopes of C are shown in Fig. 1. The experimental data for the same is available only in the case of ^{12}C and is also shown in the figure. The figure indicates that as neutron number is increase, the differential cross section for larger angles (> 120^o) decreases. There is a dip observed in $d\sigma/d\Omega$ around θ = 150^o and the dip increases with the addition of neutrons. For ^{12}C, the agreement between experiment and our calculation is good up to about θ = 100^o and beyond this angle where there is a dip, the calculations and experiment do not agree. This indicates that the spin-orbit part of the MOM potential need to be included.

The calculated total reaction cross section σ_R for elastic scattering of 40A MeV even isotopes of C, with A = 8 – 24, incident on proton target are shown in Fig. 2. The experimental data, where available, for the same are plotted in Fig. 2. We find that the calculations in case of ^{12}C does not agree with that of the data. We expect that better agreement would be obtained for σ_R for ^{12}C by introduction of normalisation for the real and imaginary part of the MOM potential. Moreover it is observed that calculated σ_R for ^{20}C agrees well with the corresponding data while the experimentally

obtained large value of σ_R for ^{22}C is not reproduced by our calculations. Further calculations to reproduce this enhancement in σ_R for ^{16}C and ^{22}C is being carried out.

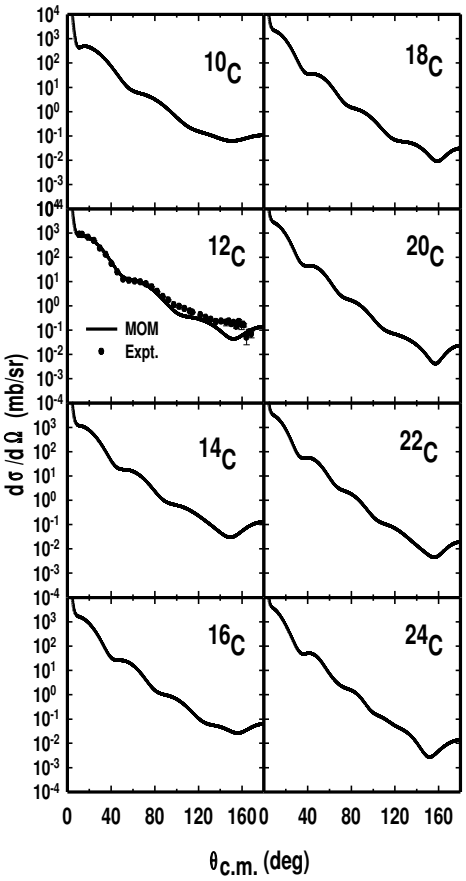

Fig. 1 Differential cross section for p-^{10,12,14,16,18,20,22,24}C calculated using MOM potentials. Data are taken from Ref. [1,7].

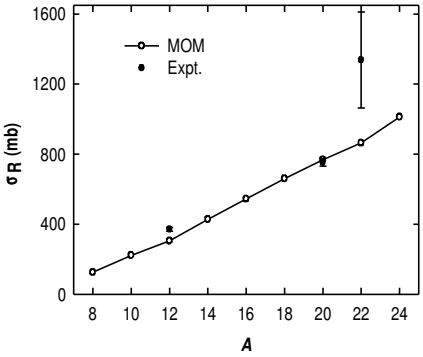

Fig. 2 The total reaction cross section obtained from our analysis of elastic scattering by ^{8,10,12,14,16,18,20,22,24}C isotopes. The solid line is guide to the eye.

References

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