Isospin dependence of the Microscopic Optical potential for Neutron rich isotopes of Be.

Mariyah Siddiqah ,Syed Rafi, Manjari Sharma and W. Haider
Department of Physics Aligarh Muslim University, India - 202002, INDIA

Introduction

Nucleon density in nuclei is a property of fundamental importance in nuclear physics. Experimentally, the charge (and hence proton) density can be measured to a high degree of accuracy through electron scattering. A number of such measurements have been carried out in the past, and the corresponding model independent charge densities have been reported.

The point nucleon density distribution is one of the two basic inputs for calculating reaction matrices in Brueckner Hartee Fock (BHF) theory which involves solving the Bethe Goldstone integral equation. The numerically calculated effective interaction is then folded over the proton and neutron densities which are calculated independently.The required nuclear density distributions employed here are obtained using the semi phenomenological model for nuclear density distributions [1].
Recent experiments with radioactive nuclear beams provide an opportunity to study nuclei with large neutron excess close to the neutron drip line. Further, the long isotopic chains with increasing neutron excess provide an excellent laboratory for investigating the isospin dependence of various nuclear properties. The nuclear shell effects for these exotic nuclei are non-negligible and hence the spin–orbit part of the nuclear potential is expected to play an important role, and may even lead to the existence of new magic numbers. Theoretical studies [2] based on the mean-field models have suggested that an increasing excess of neutrons may lead to a steady decrease in the strength of the spin–orbit interaction and this may contribute to a radical change in the ordering of the single particle energy levels.
In this paper we study the sensitivity of the Brueckner–Hartree–Fock (BHF)-based microscopic proton–nucleus optical potential (OP) with increasing neutron excess in the isotopic chain of Be isotopes.

We present our results for real central potential and spin orbit potential calculated using BHF with Argonne v18 [3] basic NN interaction.

Results and Discussion

The phenomenologically calculated nucleon density distributions both for neutrons and protons of Be isotopes ranging from A = 8 to 14 is displayed in figure 1. We conclude that as we add more neutrons, the tail becomes extended and ^{11,12,14}Be show considerable extension.
In Fig.2 we present our results for the central potential for the scattering of protons on Be isotopes at 42 MeV calculated using BHF. We observe that as the neutron number increases the real central potential decreases mildly.
Fig. 3 shows our results for calculated spin orbit potential for isotopes of Be at 42MeV. The addition of more units of isospin again leads to a significant decrease in the spin orbit potential.
Both the central potential and the spin-orbit term play an important role in the calculation of the spin observables such as analyzing power and spin rotation function in the polarized proton-nucleus scattering.

In view of this, we are searching the available experimental data for the observables so that we can compare our calculated results. Availability of such scattering data would further confirm our conclusion and would greatly help in the further understanding of nuclear structure.

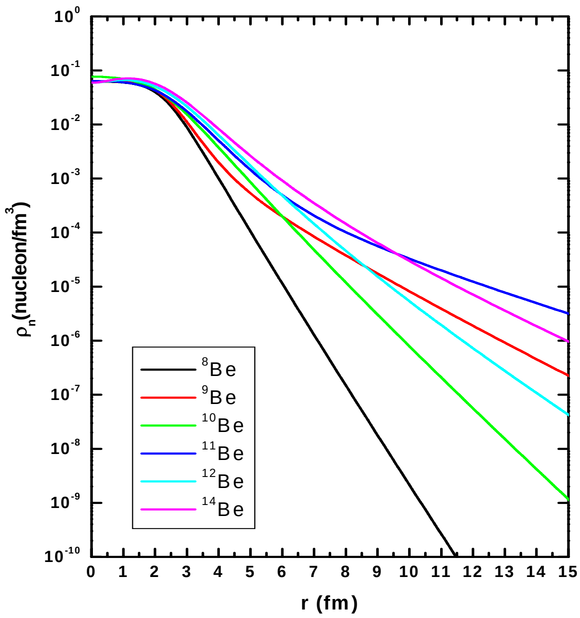

Fig. 1 Semi-phenomenological neutron density distributions of Be isotopes.

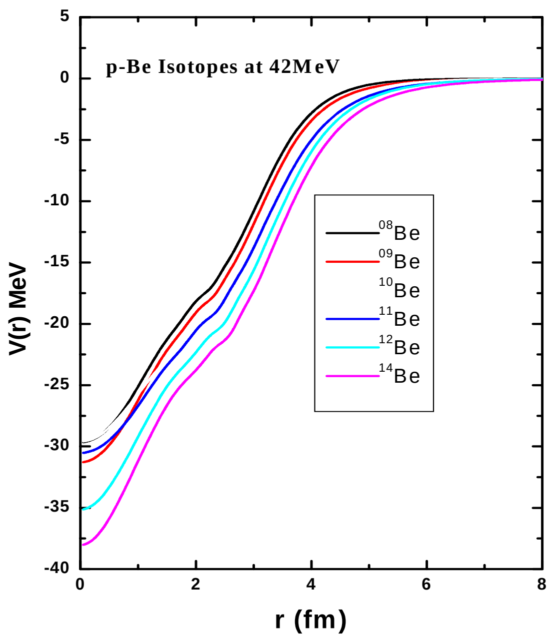

Fig. 2 Calculated Real central potential for Be isotopes at 42 MeV.

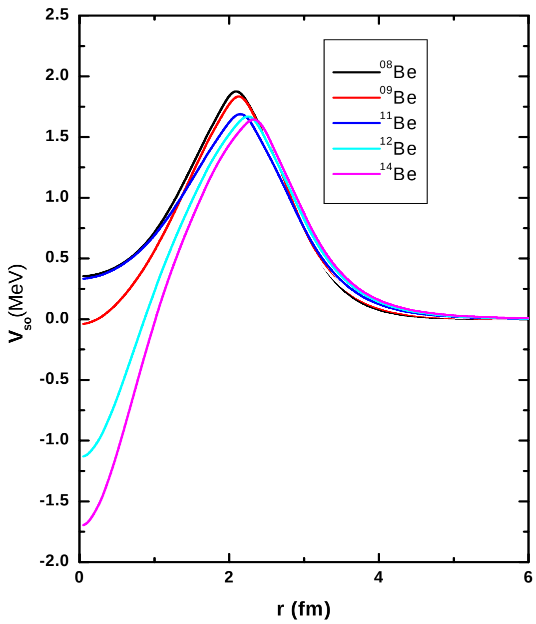

Fig. 3 Calculated Real spin orbit potential for Be isotopes at 42 MeV.

References

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