Reaction Cross Sections and Density Distributions of Neutron-Rich Halo Nuclei

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The production of unstable nuclei far away from the stability line has added a new dimension to the field of nuclear physics with a view of extracting information about the nuclear radii and matter density distributions of such nuclei. One of the most striking features of some of these nuclei, the so-called *Exotic Nuclei*, is the neutron halo which is considered as the characteristic of very small neutron separation energy of one or two valence neutrons and demonstrates a large spatial extension of neutron distribution far beyond the nuclear core. Moreover, a loosely bound nucleon may also be responsible for giving rise higher values of the interaction cross section ($\sigma_{\rm I}$) for such nuclei. Such a feature was first noticed in ^{11}Li by Tanihata et al. [1], who observed a sudden increase in $\sigma_{\rm I}$ as compared to its neighboring isotopes. It was found [2] that one requires a remarkably large radius for ^{11}Li in order to explain the $\sigma_{\rm I}$ data, suggesting a large deformation or a long tail in the matter distribution. As a matter of fact, one, therefore, requires the accurate treatment of the asymptotic behavior (($r \rightarrow \infty$)) of neutron distribution in loosely bound neutron rich-nuclei, as it plays a crucial role in the theoretical calculations specially for observables of the scattering and reaction processes.

In this work, we analyze the reaction cross sections of some of the loosely bound neutron rich nuclei ((^{11}Li, ^{11}Be, ^{14}B, $^{19-22}$C) on ^{9}Be and ^{12}C targets at $\sim$ 800 MeV/nucleon in the framework of Glauber model. The calculations involve descriptions of nuclei based on Slater determinants using harmonic oscillator single-particle wave functions. For the tail part of the loosely bound neutron, we employ the analytic expression as proposed by Bhagwat et al. [2]. The calculated cross sections are found to be in close agreement with the experimental values. The extracted matter radii are also consistent with those reported earlier.

References

[1] I. Tanihata et al. *Phys. Rev. Lett.* **55** (1985) 2676-2679.

[2] A. Bhagwat, Y. K. Gambhir and S. H. Patil *Euro Phys. J. A* **8** (2000) 511-520.