Core excitation effect on longitudinal momentum distribution width

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Introduction

The discovery of halo or exotic nuclei in last three decades explored the exotic features of atomic nuclei along the drip lines. Because of extremely different features lot of experiments had been performed using the RIB beam around the globe [1-4]. The main emphasis of these experiments remains to understand the structural configuration of extremely neutron or proton rich nuclei. The outcome of these experiments play a key role in various Astrophysical processes.

The breakup reactions involving neutron rich nuclei have been studied extensively and they are fairly well understood while the proton rich nuclei lying close to drip line are still under intensive investigations. Therefore, in this conference contribution we presents the analysis of 9Be(26P,25Si)X reaction. As the longitudinal momentum distribution(LMD) of core fragments coming out from breakup of projectile has been a efficient tool to diagnose the nuclear configurations and provides the clear structural information about the projectile.

Here, In the light of our earlier work [5] we have analyzed the core excitation effects on the longitudinal momentum distribution of 25Si residue nuclei in the single proton removal reaction of 26P on ^{9}Be target at 65 AMeV energy using the MOMDIS code which is based on Glauber eikonal approximation [6].

In the calculations the major ingredient required is the relative motion wave function of core and valence proton in projectile (see fig 1). The projectile (^{26}P) being very loosely bound (Sp=0.14 MeV) is assumed as two-body object whose radial wave function is obtained by numerical solution of the Schrodinger equation in the Woods-Saxon potentials with depth adjusted to reproduce the experimental proton separation energy. The radius parameter of the Woods-Saxon potential has been taken as 1.25 fm and the diffuseness as 0.6 fm. The core target s-matrix and Proton target s-matrix are calculated using the $t\rho\rho$ approximation.

In the present calculations, we have focused on the nuclear breakup of 9Be(26P,25Si)X reaction. In particular, here we have examined qualitatively the effect of consideration of core excited states on the total reaction cross section and the width of LMD. The obtained results corresponding to ground and different excited states of core(25Si) of the projectile(26P) are presented in Table and Fig 2. The results presented in table revels that the inclusion of higher excited state of the core decreases the magnitude of total cross section and increases the corresponding FWHM of LMD which may be understood via the well known uncertainty principle that an increment in total binding energy of the projectile reduces its spatial extension which eventually increases the width of momentum distribution.

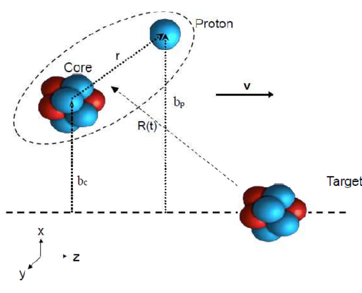

Fig: 1 Geometry of the problem

Further, for the clear understanding, we have also plotted the normalized LMD spectrum in Fig. 2

Table: Calculated cross section and width of Longitudinal momentum distribution(LMD) of core for 9Be(26P,25Si)X reaction

Core excitation Energy (Ex)	Nuclear Breakup cross section (in mb)	FWHM of LMD width (MeV/C)
0.0	56.70	62
0.04	55.95	65
0.815	45.32	76
1.963	36.32	86
2.373	34.08	90
2.606	32.95	92

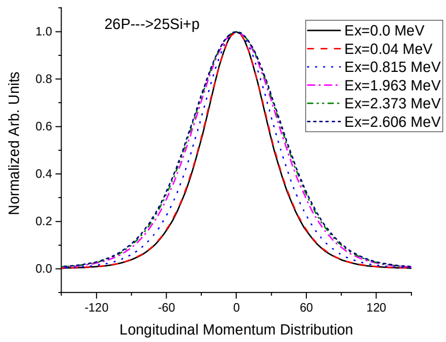

Fig. 2. (Color online) Calculated normalized longitudinal momentum distribution(LMD) corresponding to the different core excitation energies.

Conclusion

In this study we have analyzed the 9Be(26P,25Si)X reaction within Glauber eikonal reaction model at 65 AMeV energy. The result of present work provides a qualitative idea on the consideration of higher excited states of core of projectile while analyzing the experimental data of nuclear breakup reactions involving proton rich nuclei.

References

[1] I. Tanihata, H. Hamagaki, O. Hashimoto, Y. Shida, N. Yoshikawa, K. Sugimoto, O. Yamakawa, T. Kobayashi and N. Takahashi, *Phys. Rev. Lett.* **55**, 2676 (1985).
[2] N. A. Orr, *Nucl. Phys. A* **616**, 155 (1997).
[3] J. H. Kelley *et al.*, *Phys. Rev. Lett.* **74**, 03 (1995).
[4] A Navin, Phys Rev Lett. 81, no 23, (5089) 1998 and references therein.
[5] Ravinder Kumar, Pardeep Singh and Rajiv Kumar, Mod. Phys. Lett. A 32,No. 6, 1750021(2017).
[6] C.A.Bertulani, A.Gade, Comp. Phys. Comm., Vol. 175, issue 5, 372(2006).