# Analysis of angular distributions of $^{8}B+^{208}Pb$ system using CDCC approach at 170.3 MeV

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## Introduction

Nuclear reactions initiated by loosely bound projectiles such as $^{8}Li$, $^{9,11}Be$, $^{8}B$ have been examined both experimentally and theoretically around the globe with a motive to explore their unusual characteristics [1-4]. Low binding energy and the possibility of halo structure enlarge the variety of nuclear reaction mechanisms which may be triggered through these projectiles.

Particularly, being weakly bound, these projectiles breakup easily in the vicinity of Coulomb and nuclear fields of the target or one of its constituent fragments may be transferred or fuses with target.

However, when we consider only the collective excitations of projectile and/or target without consideration of breakup couplings to continuum, the calculations differs from experimental results significantly. Further, now it is evident that due to lower breakup threshold of halo nuclei the influence of coupling to breakup channels is significant. Thus, it becomes imperative to consider the breakup couplings to continuum for explaining the enhancement or suppression of reaction cross sections. Therefore in this conference contribution we have performed CDCC calculations for $^{8}B+^{208}Pb$ system at 170.3 MeV using code FRESCO [6].

Fresco code is a general-purpose code for calculating various reaction observables entangled with coupled channel reactions mainly including breakup, transfer and capture.

In present calculations $^{8}B$ is considered to have -$^{7}Be+p$ structure with proton separation energy ($S_p$) = 0.137 MeV [7] while $^{208}Pb$ is treated with normal nuclear density. In order to include the breakup couplings, the continuum is discretized into a number of bins up to a maximum threshold energy ($E_{max}$ )= 9.51 MeV. Further, different wave functions are considered for ground and higher excited states of the continuum. Furthermore, two sets (OMP-1 & OMP-2) of optical model potential parameters are used and the values for OMP-2 are listed in table.

**Results and Discussion**

The calculated angular distribution for $^{8}B+^{208}Pb$ system through code FRESCO is presented in figure along with experimental results taken from ref. [10].

It becomes evident from figure that the difference in cross sections corresponding to different OMPs shows the impact of fitting the parameters at particular energies and for reaction systems. By incorporating bins up to $E_{max}$= 9.51 MeV and spin= 1/2 and 3/2, we have shown that not every bin contributes equally to the angular distribution. Rather inclusion of bins either overestimates or underestimates the experimental results. Further it can be clearly seen that dashed (blue) line corresponding to s=1/2 ($l$=0, j=1/2) better represent the experiment data. Further

**Table: I Best fit real and imaginary optical model parameters (OMP-2)**

| **Reaction system** | V (MeV) | $r_V$ (fm) | $a_V$ (fm) | W (MeV) | $r_w$ (fm) | $a_w$ (fm) |
|---|---|---|---|---|---|---|
| $^{7}$**Be+**$^{208}$**Pb** | 134.3 | 1.326 | 0.811 | 14.42 | 1.534 | 0.884 |
| **p+**$^{208}$**Pb** | 64.0 | 1.17 | 0.78 | 0 | 1.40 | 0.66 |
| $^{7}$**Be+p** | 51.037 | 2.198 | 0.602 | $v_{so}$=9.719 | $r_{so}$=2.964 | $a_{so}$= 0.602 |

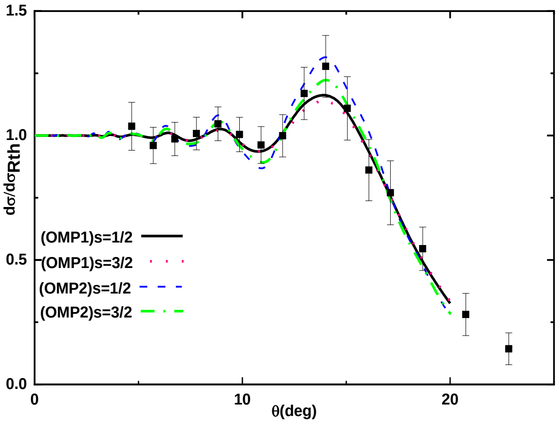


**Figure** (color online) Angular distribution for $^{8}B+^{208}Pb$ at beam energy 170.3MeV. The states up to (spin) s=1/2 and s=3/2 are considered. For case of OMP-1, the dotted (red) line represents the angular distributions with inclusion of states up to s=1/2 and the solid (black) line shows the same for s=3/2. The dashed (blue) and dot-dashed (green) line represent the angular distributions using best fit OMP-2 corresponding to binning up to s=1/2 and s=3/2 respectively. The experimental data taken from ref. [10]

inclusion of bin with s=3/2 underestimates the experimentally measured results. However, in the present calculations other couplings such as transfer and capture are not considered. By incorporating these couplings better prediction of experimentally observed cross sections may be done. Moreover, here we considered $^{8}B$ as a two-body system ($p+^{7}Be$) with $^{7}Be$ core as inert one.
In conclusion the angular distribution of $^{8}B+^{208}Pb$ system at 170.3 MeV have been calculated by using two sets of potential parameters with binning up to s=1/2 and 3/2. It has been found that the measured angular distribution is reproduced well by considering binning up to s=1/2 with OMP-2.

## References

[1] R. Kumar, et al., Phys. Rev. C 89, 027601 (2014)
[2] L.F. Canto et al., J. Phys. G: Nucl. Part. Phys. 36, 015109 (2009).
[3] L.F. Canto et al., Nucl. Phys. A 821, 51 (2009)
[4] P.R.S. Gomes et al., Nucl. Phys. A 834, 151 (2010)
[5] Y. Sakuragi et al. Prog. Theor. Phys. Suppl. 89, 136 (1986)
[6] I.J. Thompson, Comput. Phys. Rep. 7, 167 (1988)
[7] M. Mazzocco et. al., Phys. Rev. C 100, 024602 (2019).
[8] R. W. Finlay et. al., Phys. Rev. C 39, 804 (1989).
[9] P. Navrátil et. al., Phys. Lett. B 634, 191 (2006).
[10] Y.Y. Yang et al., Phys. Rev. C 87, 044613 (2013).