Beamtime proposals for the Pelletron beam cycle May-July 2024

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2. Institution : BARC, Mumbai

3. Name of Local Collaborator : N/A

a) Consent of Local collaborator : **N/A**

4. Name of Collaborator: S. K. Pandit, Prabhat Mishra, A. Shrivastava, K. Mahata, K. Ramachandran, Vineet Kumar, L. S. Danu, S. Mukhopadhay, P. Patale, A. Kumar, Prasanna M., S. Kaur, P. K. Nayak

Title of Experiment: Exploring breakup probabilities in ^{11}B induced reaction

Beam Time Requirement (in number of shift): 18 shifts (6 days)

Beam, Energy(MeV) & Current (pnA): ^{11}B beam, 55 MeV, 5 pnA

Beam port and Experimental setup: Hall 1, 30 D

If any hazardous or safety related material will be used in the experiment (eg Gas etc): N/A

Motivation of Experiment:

We have done several exclusive breakup studies with weakly bound as well as α cluster nuclei like ^{6,7}Li [1-4], ^{9}Be[5], ^{12}C[6] etc. using BARC-TIFR Pelletron LINAC facilty so far. Several interesting observations and feature related to breakup have been studied. In continuation with this, couple of years back we have focussed our attention with ^{10,11}B projectiles which again can be considered as α cluster nuclei with fairly higher separation energies compared to weakly bound ^{6,7}Li and ^{9}Be nuclei.

We had performed experiment with ^{10}B projectile on ^{159}Tb, ^{197}Au and ^{209}Bi targets where CF data was available [7-9]. We had extracted the inclusive cross section data [10] and now are in a process of extracting the exclusive cross sections. Preliminary analysis confirmed the presence of α–α correlation in that data.

In the present beam time, we plan to carry out measurements with ^{11}B projectile on various targets for inclusive and exclusive breakup measurements. In the inclusive, we will get PLF along with light particles alpha (α), triton (t), deuteron (d) and proton (p) particles. In the exclusive, we will be measuring charge particle coincidences e.g, ^{7}Li–α, ^{9}Be-d, α–α–t etc. over a wide angular range. From the angular distribution and the integrated cross sections, we will infer the relative importance of these channels on reaction mechanism. We plan to measure the breakup fragments using silicon strip detector telescope array covering a wide angular range from 20 – 160 deg. Theoretical calculations like continuum couplings, optical models will be used for understanding the data. We plan to establish systematics for breakup probabilities with ^{11}B projectile.

References

1. S. K. Pandit *et al.*, Phys. Rev. C 93, 061602(R) (2016), Phys. Rev. C 100, 014618 (2019)
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3. A. Shrivastava *et al.*, Phys. Lett. B 633, 463 (2006)
4. S. Santra *et al.,* Phy. Lett. B 677,139 (2009)
5. Satbir Kaur *et al.* Proc. of the DAE Symp. on Nucl. Phys. 66, 383 (2022), Proc. of the DAE Symp. on Nucl. Phys. 67, 385 (2023)
6. Abhijit Baishya *et al.,* Phys. Rev. C 104, 024601 (2021), Phys. Rev. C 108, 065807 (2023)
7. A. Mukherjee et al., Phys. Lett. B 636, 91, (2006)
8. M. Aversa, et al., Phys. Rev. C 101, 044601, (2020)
9. L.R. Gasques, et al., Phys. Rev. C 79, 34605, (2009)
10. Prabhat Mishra *et al.*, Proc. of the DAE Symp. on Nucl. Phys. 67, 439 (2023)

Description of Experiment:

^{209}Bi, ^{197}Au, ^{159}Tb targets will be used in the experiment. Seven strip detector telescope array covering a range of 90 deg and few Si surface barrier detector telescopes will be used for detection of charged particles. Mesytek electronics and VME based data acquisition system will be used. We will be doing software coincidence to look for ^{7}Li-α and α–α-t and ^{9}Be-d events.

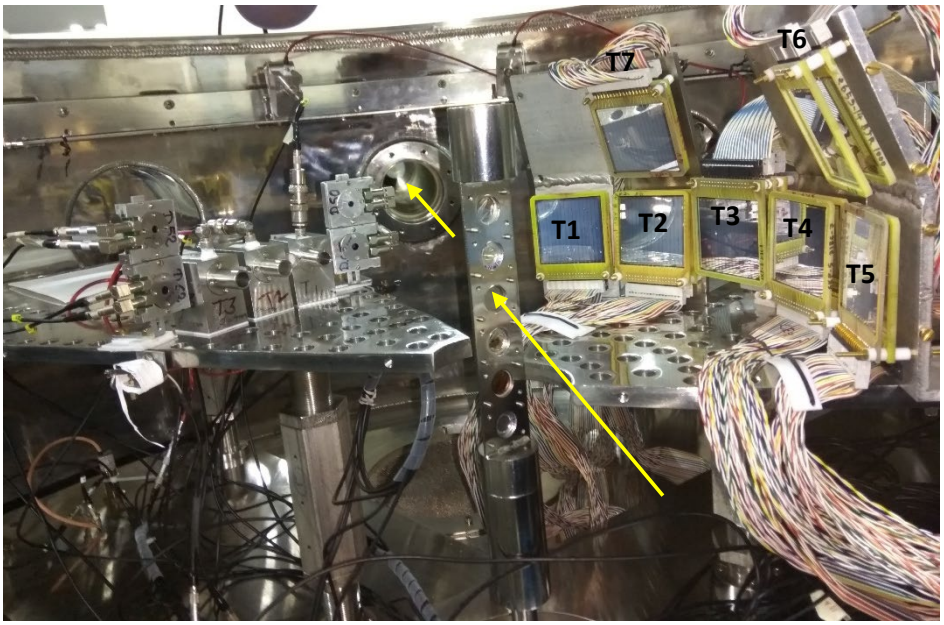

Figure 1 : Experimental Setup for inclusive and exclusive breakup study

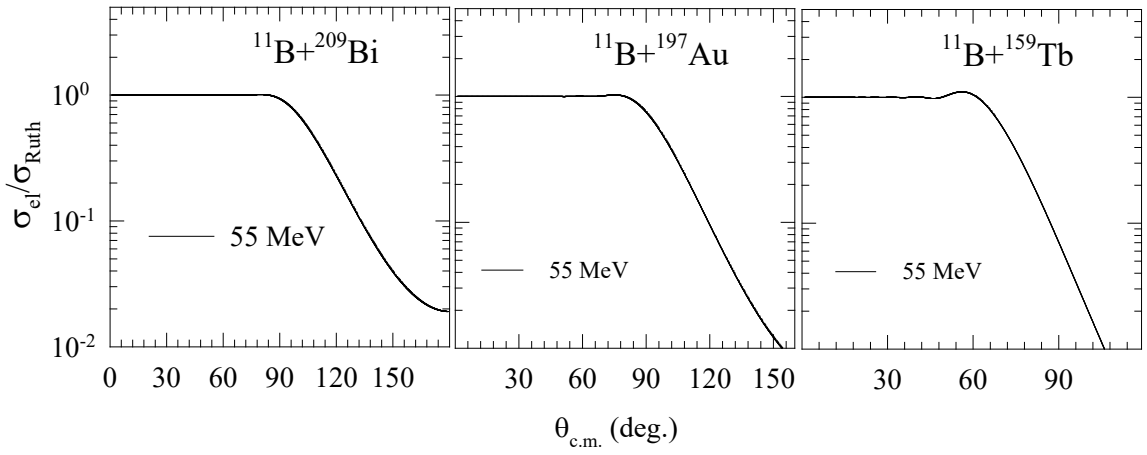

Figure 2: Elastic scattering angular distributions using Sau-Paulo potentials

Count Rate estimation:

Typical exclusive breakup cross sections are in the range of 0.1-20 mb, populating resonant states.

For ^{11}B beam 5 pnA, ^{209}Bi Target 1000 ug/cm^2 thick

Vb = 50 MeV
Ebeam = 55 MeV (5 shifts) + 1 shift for electronic setup

For ^{11}B beam 5 pnA, ^{197}Au Target 1000 ug/cm^2 thick

Vb = 48 MeV
Ebeam = 55 MeV (6 shifts)

For ^{11}B beam 5 pnA, ^{159}Tb Target 1000 ug/cm^2 thick

Vb = 41 MeV
Ebeam = 55 MeV (6 shifts)

Total: 18 shifts

List of publication from previous experiments:

1. Prabhat Mishra *et al.*, Proc. of the DAE Symp. on Nucl. Phys. 67, 439 (2023)
2. Satbir Kaur *et al.* Proc. of the DAE Symp. on Nucl. Phys. 66, 383 (2022),
Proc. of the DAE Symp. on Nucl. Phys. 67, 385 (2023)

3. V. V. Parkar *et al.*, Phys. Rev. C 109, 014610 (2024)
4. Satbir Kaur *et al.*, Nucl. Phys. A 1046, 122864 (2024)