

# Low energy nuclear reactions with double-solenoid based RNB

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Many new facilities have been installed or upgraded to produce beams of radioactive nuclei. The main purpose of these facilities is to investigate nuclei at extreme conditions in terms of density, temperature, angular momentum and isospin. The possibility of using radioactive (exotic) nuclear beams (RNB) has opened an exciting field of investigation in nuclear physics with strong implications in areas such as nuclear astrophysics.

To produce low energy RNB, the University of Notre Dame, USA [1] and later the University of São Paulo, Brazil [2] decided to use a system based on superconducting solenoids. The two superconducting solenoids, in these systems, act as thick lenses to collect, select, and focus the secondary beam into a scattering chamber. They have large air-core (30 cm clear warm bore) and 6T and 6.5T maximum magnetic field, respectively. With this large bore it is possible to reach large angular acceptance,  $2^\circ < \theta < 15^\circ$ , i.e., 30 msr, in comparison with about 5 msr which can be obtained from dipoles based system. The radioactive nuclear beams produced so far are  $^6\text{He}$ ,  $^7\text{Be}$ ,  $^8\text{Li}$ ,  $^8\text{B}$  and  $^{10}\text{Be}$ . The intensities of these beams are between  $10^4$ pps to  $10^6$ pps for 1- $\mu\text{A}$  of primary beam for  $^8\text{B}$  and  $^6\text{He}$ , respectively. Many experiments with these light particles radioactive beams have been performed at these two facilities. These experiments are related to low energy reactions such as elastic scattering, transfer and breakup reactions, which can provide useful information on the structure of light nuclei near the dripline and astrophysics.

In this talk I will show how these low energy radioactive beams are produced and give some samples of what kind of experiments can be performed with this solenoids based system. In particular I will talk about recent experiments performed with  $^8\text{Li}$  and  $^8\text{B}$  beam on light targets, where elastic scattering and transfer reactions have been investigated. Total reaction cross section have also been investigated for these light system as a function of energy and the role of breakup of weakly bound and exotic nuclei is discussed.

## References

- [1] F. D. Becchetti, M. Y. Lee, T. W. O'Donnell, D. A. Roberts, J. J. Kolata, L. O. Lamm, G. Rogachev, V. Guimarães, P. A. DeYoung and S. Vincente. Nucl. Instr. and Methods in Res. A 505, 377 (2003).
- [2] R. Lichtenthaler, A. Lepine-Szily, V. Guimarães, C. Perego, V. Placco, O. Camargo jr., R. Denke, P. N. de Faria, E. A. Benjamim, N. Added, G. F. Lima, M. S. Hussein, J. Kolata and A. Arazi. Eur. Phys. J. A 25, S-01, 733 (2005).

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