LABORATÓRIO ABERTO DE FÍSICA NUCLEAR
PAC 2018

Proposal	N°
Title: Elastic scattering measurements of ^{8}Li beam on several targets	
Responsable: Rubens Lichtenthäler Filho	e-mail: rubens@if.usp.br
Participants: O.C.B. Santos, Rubens Lichtenthäler Filho, K.C.C.Pires, S. Appannababu, U.U. Silva, M. Assunção, A. Serra, E.O.N. Zevallos, Michel S.C. Pontes, João P. Pichetti, Cristiane S. Oliveira, Daniel M. Martini, V. Guimarães, V. Scarduelli, J. Alcantara-Nunez, A.L. Lara, A. Lépine-Szily, V. Morcelle, R. Linares, V.A.B. Zagatto, Juan Carlos Zamora, J.M.B. Shorto, P.N. de Faria, M.C. Morais, A. Barioni, and the RIBRAS collaboration	
Spokeperson: Osvado C. B. Santos	e-mail: osvaldo.santos@usp.br
Telephone: 3091-6961	Skype:
Number of days for experiment: 14	
Period planned for the experiment (are the setup ready for beam time?):	

Technical information

Ion source			Accelerator			Experimental Area	
Beam	Cathode	$I_{mínima}$	V_{min}	V_{max}	Bunched beam?	Beam line	Target
^{7}Li	LiO	600nA (Cup 3)	5	8		45B	^{9}Be
#	#	#	#	#		#	^{58}Ni
#	#	#	#	#		#	^{120}Sn

Experiment Proposal to PAC
Pelletron Laboratory - IFUSP

Elastic scattering measurements of ^{8}Li beam on several targets

Osvaldo C. B. Santos, Rubens Lichtenthäler Filho, K.C.C.Pires, S. Appannababu, U.U. Silva, M. Assunção, A. Serra, E.O.N. Zevallos, Michel S.C. Pontes, João P. Pichetti, Cristiane S. Oliveira, Daniel M. Martini, V. Guimarães, V. Scarduelli,J. Alcantara-Nunez, A.L. Lara, A. Lépine-Szily, V. Morcelle, R. Linares, V.A.B. Zagatto, Juan Carlos Zamora, J.M.B. Shorto, P.N. de Faria, M.C. Morais, A. Barioni, and the RIBRAS collaboration

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1 Abstract

This research project consists in the study of ^{8}Li collision on several targets. The measurements will be performed at the 8 MV Pelletron accelerator of the Institute of Physics of the University of Sao Paulo, Brazil, using the RIBRAS facility [1, 2, 3]. The main objective is to study the nuclear potential of the ^{8}Li collision with different targets and to study the isospin dependence when ^{8}Li and ^{6,7}Li are compared. For light targets such as ^{9}Be, the effect of nucleon transfer reactions such as elastic transfer ^{9}Be(^{8}Li,^{9}Be)^{8}Li will be also considered. Elastic transfer and nucleon transfer reactions are important to provide spectroscopic factors of nucleons in states involving exotic nuclei. This will be the PhD project of Osvaldo Camargo Botelho dos Santos.

2 Introduction

The study of nuclei out of the stability valley has been one of the main fields of research in low energy nuclear physics [4]. Light exotic nuclei such as ^{6}He, ^{7}Be, ^{8}Li, ^{8}B and others have been produced in laboratory [5] and new interesting phenomena such as the Borromean structure and the neutron and proton halos have been observed [4]. Nuclei such as ^{7}Be and ^{8}Li are not so exotic, however, they may have interest in both, nuclear structure and astrophysics. The synthesis of heavy elements in stars, has to overcome the mass gaps A=5 and A=8 for which there are no stable elements. For

A=8 there are two bound nuclides, ^{8}Li and ^{8}B, which are mirror nuclei, and have half-life around 800 ms. The presence of A=8 nuclei in stars could affect the nucleosynthesis of heavier elements up to ^{12}C. Moreover, nucleon transfer reactions such as the elastic transfer ^{9}Be(^{8}Li,^{9}Be)^{8}Li or the neutron transfer ^{9}Be(^{8}Li,^{9}Li)^{8}Be are very important and could provide important spectroscopic informations.

In addition to the astrophysical interest, nuclear data involving A=8 nuclei are very scarce and, the determination of the nuclear potential for A=8 systems will be useful in further calculations for fusion and nucleon transfer reactions.

3 Materials and Methods

The experiment will be performed using the 8UD Pelletron accelerator of the Institute of Physics of the University of São Paulo and the RIBRAS facility. RIBRAS consists of two superconducting solenoids to focus and select the secondary beams, produced by the interaction of the Pelletron primary beam and a primary target. RIBRAS consists of two superconducting solenoids which are able to produce secondary beams of light unstable nuclei such as ^{6}He, ^{8}Li, ^{8}B, ^{7}Be and others. The secondary beam intensities are of the order of 10^{5-6} pps and, the ^{8}Li beam in particular, presents the highest intensities and best energy resolution. The detector system consists of four ΔE-E Si telescopes, with 25μm and 1000μm thickness. The ^{9}Be (1.9 mg/cm^2), ^{58}Ni (2.1 mg/cm^2), ^{120}Sn (3.8 mg/cm^2) and ^{197}Au (4.6 mg/cm^2) targets are already available. A ^{197}Au target is used for normalization purposes.

4 Elastic Scattering Measurements

We have already performed, in the scope of this project, several experiments of ^{8}Li elastic scattering on different targets. The measurements were performed using ^{9}Be, ^{58}Ni and ^{120}Sn targets. The ^{8}Li laboratory energies were in the range from 24 to 30 MeV. The angular distributions can be seen in the figures 1.

Presently we have only one angular distribution with ^{9}Be target and there are indications that the elastic transfer could be important at backward angles. We intend to measure at least two more angular distributions for ^{9}Be+^{8}Li. We ask 14 days to perform these measurements.

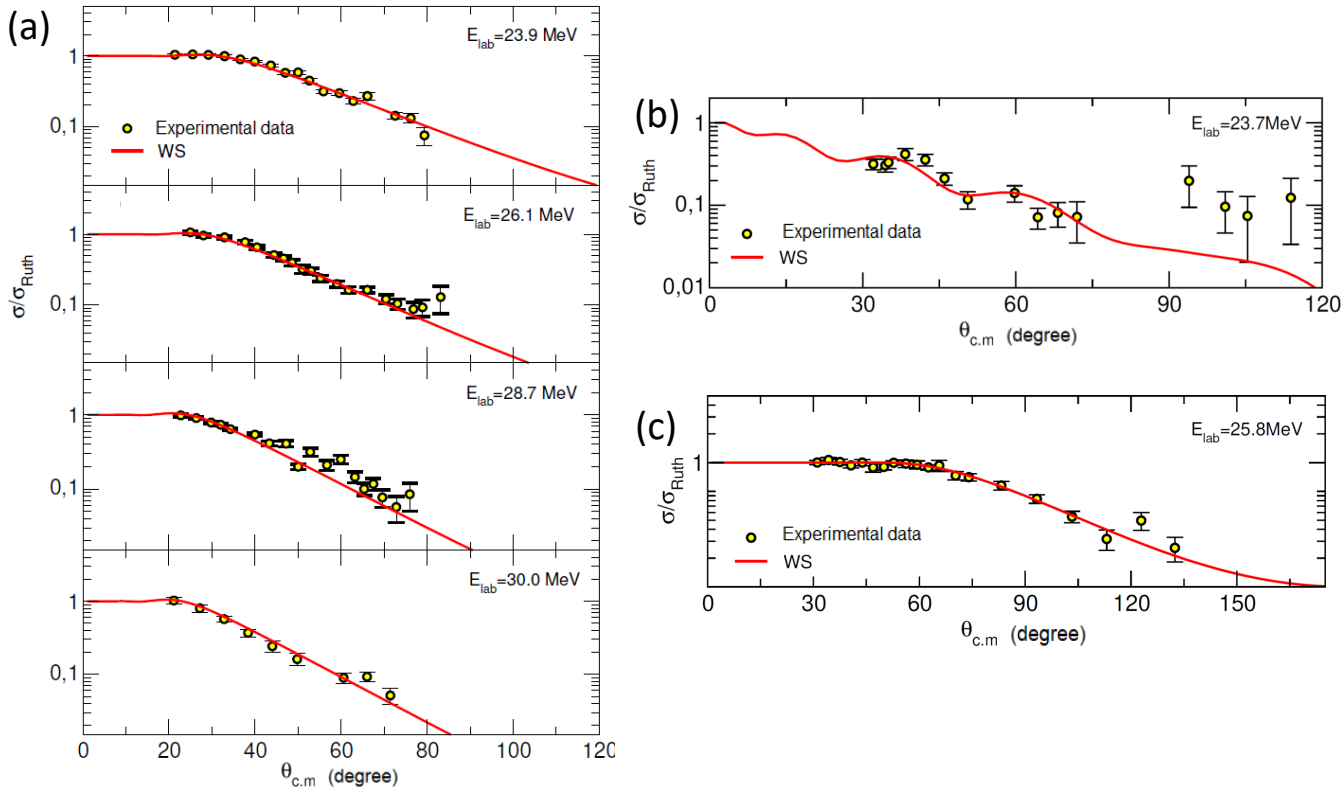

Figura 1: Elastic scattering angular distributions for (a)^{8}Li+^{58}Ni, (b)^{8}Li+^{9}Be and (c) ^{8}Li+^{120}Sn compared with Optical Model calculations.

Referências

[1] A. Lépine-Szily, R. Lichtenthäler, and V. Guimarães, Eur. Phys. J. A. 50, 128 (2014).

[2] R. Lichtenthäler et al, The Europ. Phys. Jou. A 25, Suppl. 1, 1733 (2005).

[3] R. Lichtenthäler et al, Few-Body Systems, vol 57, 157-163 (2016).

[4] A. Lépine-Szily, R. Lichtenthäler, and V. Guimarães, Eur. Phys. J. A. 50, 128 (2014).

[5] R. Lichtenthäler et al, Few-Body Systems, vol 57, 157-163 (2016).