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Elastic scattering of ^{6}He and ^{7}Be on a ^{9}Be target

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Abstract. The elastic scattering data for the ^{6}He+^{9}Be and ^{7}Be+^{9}Be reactions, measured at E_{lab} =16.2 MeV and E_{lab} =23.7 MeV respectively, are presented and analyzed using the optical model and coupled-channels formalisms.

Keywords: Measured elastic scattering. Optical model. Coupled channels. CDCC calculations.
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INTRODUCTION

Recent experiments with reactions induced by weakly bound nuclei on heavy targets have revealed very interesting phenomena, such as the anomalously large values of the reaction cross sections [1], and long range absorption effects [2]. It remains to investigate to what extent these effects show up also with lighter targets, for which the Coulomb breakup is expected to be small. For this purpuse, we present an analysis of the elastic scattering of the ^{6}He+^{9}Be and ^{7}Be+^{9}Be reactions.

EXPERIMENTAL DATA AND CALCULATIONS

The ^{6}He+^{9}Be was measured at the RIBRAS facility of the Institute of Physics of the University of Sao Paulo, Brazil, using a secondary ^{6}He beam with a E_{lab}=16.2 MeV and intensity of 2.4×10^{4} pps. The ^{7}Be+^{9}Be measurements were performed at the CRC Radioactive Beam Facility at Louvain-la-Neuve, Belgium, using a secondary ^{7}Be beam with 3×10^{7} pps intensity on the target, and E_{lab}=23.7 MeV. Besides the elastic data, several angular distributions for the ^{9}Be(^{7}Be,^{8}Be($g.s.$))^{8}Be channel, populating several states of the ^{8}Be system, were also extracted. The analysis of these channels will be presented in a separate publication.

The ^{6}He+^{9}Be and ^{7}Be+^{9}Be elastic scattering angular distributions were analyzed within the optical model. An optimal fit analysis was carried out in order to reproduce the experimental data using as inicial parameters for these fits, optical potentials reported for the similar systems ^{6}Li,^{7}Li+^{9}Be [3, 4]. These calculations were done with the subroutine SFRESCO, that it part of the FRESCO code. In both cases, the projectile–target nuclear interaction was parametrized using a standard Woods-Saxon (WS) form for the real part, and a derivative (surface) WS shape for the imaginary part.

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In the ^{7}Be+^{9}Be case, it was not possible to obtain experimentally the absolute normalization of the data. Hence, this normalization was included as an extra adjustable parameter. In Fig. 1 (left) we present the experimental data with the normalization obtained with this procedure. The parameters of the fit using the OM formalism are: V_0=48.6 MeV, R_0=2.66 fm, a_0=0.88 fm, W_i=13.13 MeV, R_i=3.87 fm, a_0=0.78 fm.

The ^{7}Be nucleus is only bound by 1.59 MeV, and hence this nucleus may have a significant probability to breakup in the nuclear and Coulomb field of the target nucleus. In order to study the relevance of this channel we performed CDCC calculations, in which the ^{7}Be was treated as a two-body system (^{4}He+^{3}He) and the coupling to continuum (unbound) states were included explicitly. Since experimentally it was not possible to separate the elastic data from the inelastic scattering to the bound excite state of ^{7}Be, this state was also included in the calculation and added to the elastic cross section. The calculated quasielastic cross section is shown by the solid line in Fig. 1. It can be seen that the shape and magnitude are in very good agreement with the OM calculation. Also, we find that the effect of the continuum is very small for the angles of interest.

For the ^{6}He+^{9}Be system the best fit parameters obtained with the OM formalism are: V_0=45.33 MeV, R_0=4.53 fm, a_0=0.20 fm, W_i=4.55 MeV, R_i=3.31 fm, a_0=1.27 fm. A coupled-channel study of this reaction is in progress.

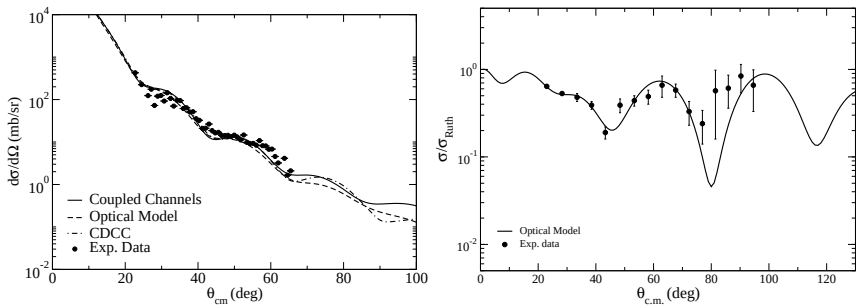

FIGURE 1. ^{7}Be+^{9}Be (left) and ^{6}He+^{9}Be (right) elastic differential cross section. See text for details.

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