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Elastic scattering of ^{9}Be+^{51}V near the Coulomb barrier

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Abstract

Elastic scattering angular distributions for the ^{9}Be+^{51}V system were measured at three near Coulomb barrier energies, E_{lab} = 16.35, 17.44 and 18.53 MeV. The data were analyzed by using a Semimicroscopic Optical Model. This combines a microscopic calculation of the mean-field double folding potential and a phenomenological construction of the dynamical polarization potential. The calculations reproduced the data very well and the total reaction cross sections were also calculated.

1 Introduction

Nuclear reactions induced by weakly bound projectiles have attracted much attention in the last few decades. The ^{9}Be nucleus, with a separation energy of 1.57 MeV, is an interesting case study. In the present work, angular distributions for the ^{9}Be+^{51}V system are measured and analyzed. A Semimicroscopic Optical Model, which combines microscopic calculations of the mean-field double folding potential (DFP) and a phenomenological construction of the dynamical polarization potential [1, 2], is used in the

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analysis. A comparison with recent data for ^{7}Be+^{58}Ni [3, 4] and other ^{9}Be systems is made [5–7].

2 Description of the experiment and analysis

The beam was produced by the 6 MV Tandem Van de Graaff Accelerator at ININ. The experimental setup consisted of six surface barrier detectors placed on a turntable that allowed measurement of particles scattered in a large angular range (35-165 degrees). The measurements were performed in two stages, measuring first the scattering in an initial configuration and then rotating the turntable by 30 degrees to complement the angular range.

Fig. 1 shows the elastic scattering angular distributions measured for the ^{9}Be+^{51}V system at energies E_{lab} = 16.35, 17.44 and 18.53 MeV with OM-model fits discussed below.

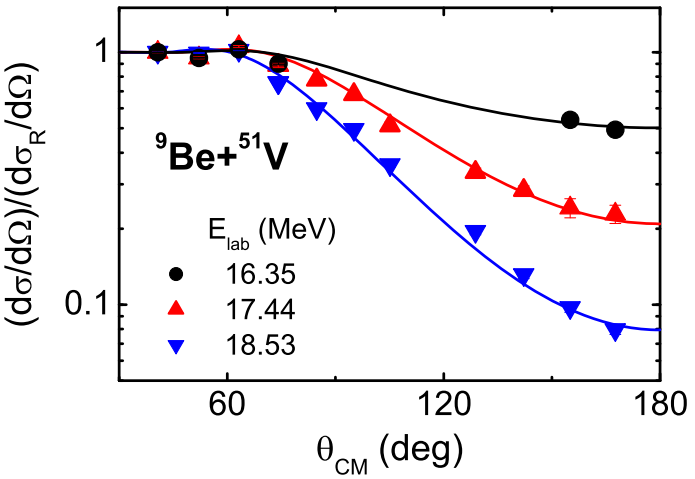

Figure 1: Elastic scattering angular distributions for ^{9}Be+^{51}V system at energies E_{lab} = 16.35, 17.44 and 18.53 MeV.

The data were analyzed with an optical model potential of the form $U = V_F + V_P + iW + V_C$, Ref. [1,2], where V_F is the double folding potential, V_C is the Coulomb potential, and V_P, W are given by

$$V_P(r,E) = \alpha(E)W(E)f(x_W) + \beta(E)\cdot 4W_D(E)\frac{df(x_D)}{dx_D}, \quad (1)$$

$$iW = -iW(E)f(x_W) + i\cdot 4W_D(E)\frac{df(x_D)}{dx_D}. \quad (2)$$

A fit to the data was made by using the computational codes Foldeg v2007 and Fresco, see Table 1. The results are shown with the curves in Fig. 1. Table 1 also shows the total reaction cross sections and the volume integrals obtained in the analysis.

Table 1: Parameters of the Optical Model Potential for the ^{9}Be+^{51}V system. The energy and depths of the potential are measured in MeV, $r_{W,D}$ y $a_{W,D}$ in fm. Total reaction cross sections (mb) and volume integrals (MeV· fm^3) also are included.

E_{lab}	α	β	W	r_W	a_W	W_D	r_D	a_D	σ_R	J_F
16.35	-0.62	-0.001	8.60	1.55	0.40	1.33	1.45	0.40	242	403.30
17.44	-0.53	-0.84	10.28	1.31	0.61	2.10	1.30	0.53	350	403.00
18.53	-0.83	-0.41	12.0	1.22	0.70	4.16	1.15	0.71	542	402.80

2.1 Comparison with other systems

In Fig. 2, our data are compared to total reaction cross sections reported previously for the ^{7}Be+^{58}Ni system [3], such comparison is made in reduced units as suggested in ref [8, 9] and the solid line corresponds to a Wong function fit [10].

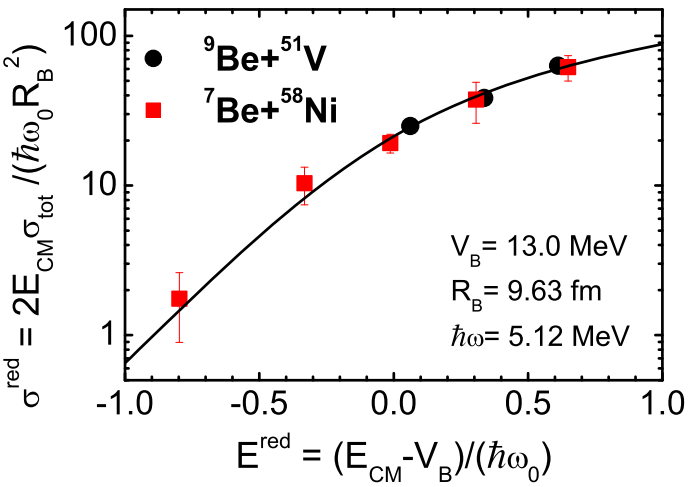

Figure 2: Comparison of the reaction cross sections for ^{9}Be+^{51}V and ^{7}Be+^{58}Ni [3] at different energies.

Fig. 3 shows a comparison with several systems having the same projectile, ^{9}Be. Previously reported data were taken from the literature [5–7]. All

experimental points seem to be clustered in a specific region, regardless of the mass number of the target.

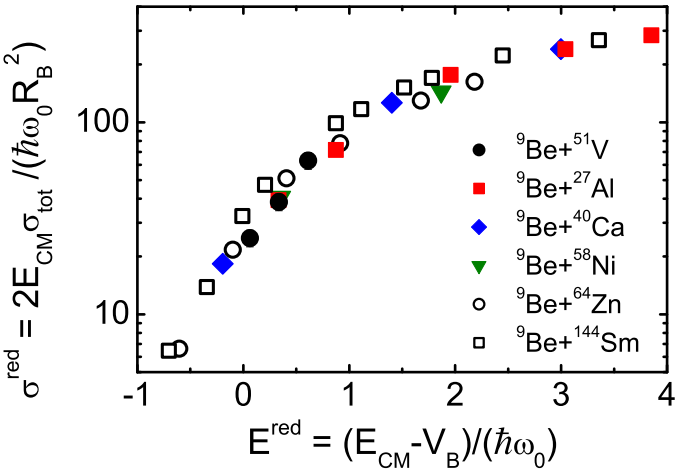

Figure 3: Comparison of the reduced reaction cross sections for ^{9}Be+^{51}V with data for different systems reported in the literature [5–7].

3 Summary

Elastic scattering angular distributions for ^{9}Be+^{51}V system were measured at bombarding energies E_{lab} = 16.35, 17.44 and 18.53 MeV. By doing a proper optical model analysis, the corresponding total reaction cross sections were obtained and compared with experimental results previously reported for other systems. The reduced total reaction cross sections obtained for different systems having the same projectile show perfect consistency. On the other hand, our results are consistent with the reduced total reaction cross sections obtained for the other system, which has the ^{7}Be isotope as a projectile.

Acknowledgments

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