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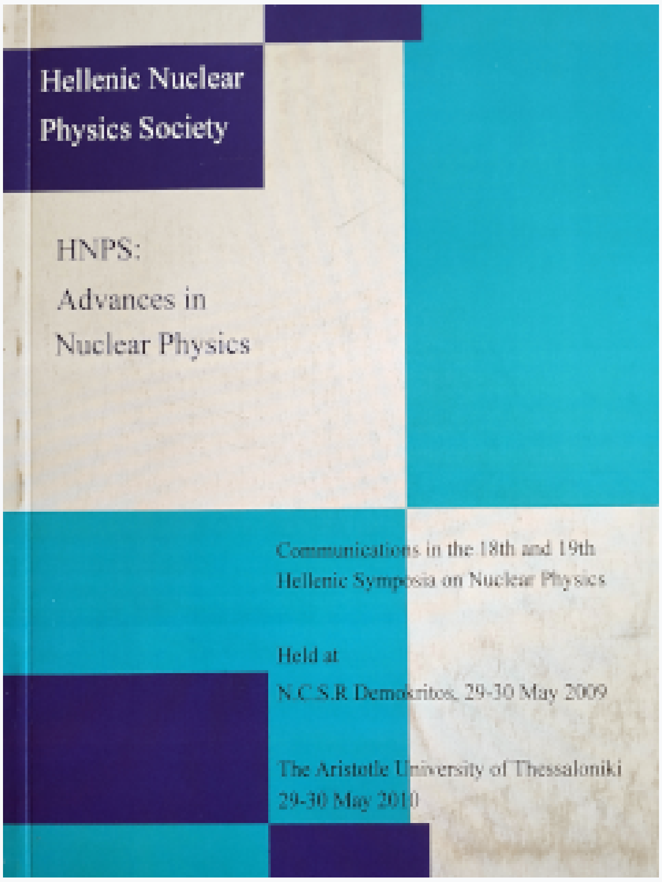

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Elastic backscattering measurments for ^{6,7}Li+^{58}Ni, ^{6,7}Li+^{116,120}Sn, ^{6,7}Li+^{208}Pb at near barrier energies

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Abstract

We have performed, elastic backscattering measurements for the weakly bound nuclei ^{6,7}Li on the medium and heavy mass targets ^{58}Ni, ^{116,120}Sn, ^{208}Pb at sub- and near-barrier energies (0.6 to 1.3 $E_{C.b.}$). Excitation functions of elastic scattering cross sections have been measured at 160^{O} and 170^{O} and the corresponding ratios to Rutherford scattering and relevant barrier distributions have been extracted. These measurements will complement recent work on a ^{28}Si target for probing the potential at sub- and near barrier energies and relevant reaction mechanisms.

1. Introduction

As it is well known in heavy ion reactions, approaching the vicinity of the Coulomb barrier, couplings between various channels increase in importance. Describing elastic scattering, either these couplings have to be taken into account through coupled channel theories, or the energy dependence of the various optical model parameters has to be considered explicitly. In well bound nuclei, the term "threshold anomaly" was invoked to describe a rapid variation of such model parameters appeared as a sudden increase of the real part of the potential approaching the barrier, which is connected via dispersion relations with a decrease of the imaginary part. Moving to weakly bound nuclei the situation becomes more complicated due to the influence of breakup and/or transfer effects leading to a new type of anomaly [1-5]. In principle, the lack of sensitivity for obtaining the energy dependence of optical potential parameters, at energies below and near the coulomb barrier, leads occasionally to vague conclusions. Therefore, to improve our understanding on the energy dependence of the optical potential especially at sub-barrier energies and the relevant processes involved in the threshold anomaly, other complementary means should be adopted. We have shown in [6] that a very promising method to probe the potential and relevant reaction mechanisms is that of elastic backscattering. Into this context we will describe below our measurements on ^{6,7}Li+^{58}Ni, ^{6,7}Li+^{116,120}Sn, ^{6,7}Li+^{208}Pb.

2. Experimental details and results

Beams of ^{6,7}Li ions were delivered by the SMP Tandem accelerator of LNS Catania at 0.5 energy steps in the energy range 0.6 to 1.3 $E_{C.b.}$. Beam currents were of the order of 5 to 20 nA depending on energy. The beams impinged on 200 μg/cm2 thick self-supporting ^{58}Ni, ^{116,120}Sn, ^{208}Pb targets with the target frame fixed perpendicular to the beam direction. Excitation functions of (Quasi)-elastic backscattering events were recorded in four telescopes consisting of 10 μm and 2000 μm silicon detectors, set at 160 and 170 degrees. The beam flux was estimated via a measurement of the Rutherford scattering in two silicon detectors set at 20 degrees. Cross sections were extracted via the relation

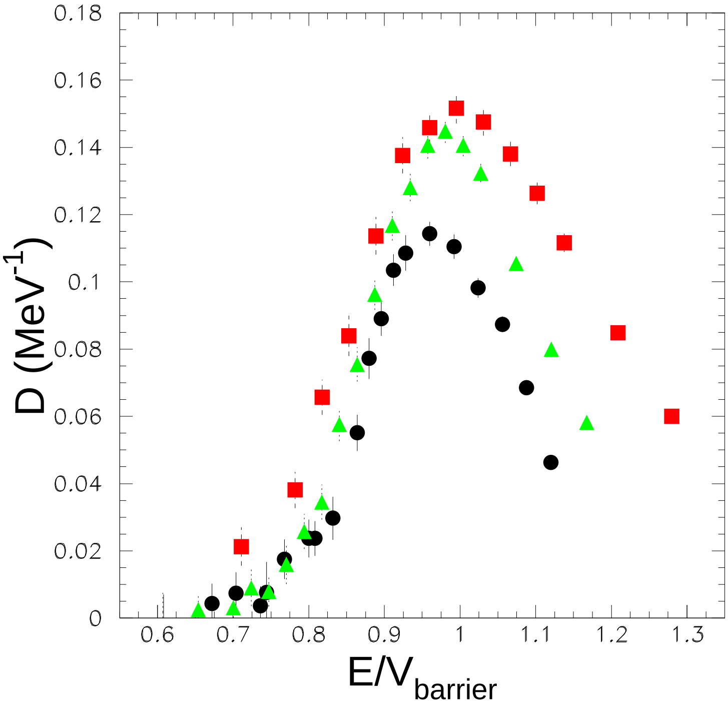

Figure 1: Barrier distributions for ^{6}Li on ^{208}Pb (solid circles) ^{120}Sn (triangles) and ^{58}Ni (solid boxes).

$$\sigma_{q170} = \frac{N_2}{N_1}\frac{\Omega_1}{\Omega_2}\sigma_{R30} \tag{1}$$

where N_2 and N_1 are the yield on the backward and forward detectors respectively while Ω_1 and Ω_2 are the solid angles of the forward and backward detectors respectively. The ratio of the solid angles was determined from the data at the lowest energies where the scattering is Rutherford for both forward and backward detectors eliminating most of the assigned error in the above relation. Barrier distributions were formed by using the relation for elastic scattering[7]

$$D(E) = \frac{d}{dE}\left[\sqrt{\frac{d\sigma_{el}}{d\sigma_{ruth}}(E)}\right] \tag{2}$$

Preliminary results of barrier distributions are compared for ^{6}Li on the the three targets ^{58}Ni, ^{120}Sn, ^{208}Pb in Figure 1, while for ^{7}Li on the four targets ^{58}Ni, ^{116,120}Sn, ^{208}Pb in Figure 2. From the above systematic it is seen that the barrier heights are larger for the lower mass targets than for the heavier ones and this variation is more obvious for the ^{6}Li projectile. Additionally to that the barrier distribution widths and heights are larger for the lighter targets and larger for the ^{6}Li projectile than the ^{7}Li one. Another interesting result is that there is no isotopic target dependence as sought for ^{7}Li+^{116,120}Sn, since the barrier distributions are almost identical for the two targets. The above results will be further explored in the future via theoretical calculations in order to probe any relation with the reaction mechanisms involved. Also theoretical anlysis is under way to probe and map till very low energies the optical potential.

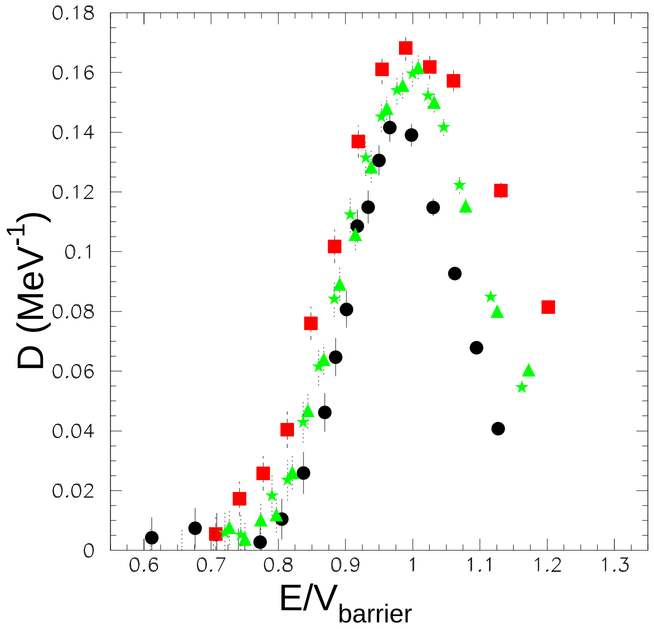

Figure 2: Barrier distributions for ^{7}Li on ^{208}Pb (solid circles), ^{116}Sn (stars), ^{120}Sn (triangles) and ^{58}Ni (solidboxes).

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