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Elastic scattering of $^{17}O+^{208}Pb$ at energies near the Coulomb barrier.

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Abstract

Within the frame of the commissioning of a new experimental apparatus EXPADES we undertook the measurement of the elastic scattering angular distribution for the system $^{17}O+^{208}Pb$ at energy around the Coulomb barrier. The reaction dynamics induced by loosely bound

Radioactive Ion Beams is currently being extensively studied [4]. In particular the study of the elastic scattering process allows to obtain direct information on the total reaction cross section of the exotic nuclei. In order to understand the effect of the low binding energy on the reaction mechanism it is important to compare radioactive weakly bound nuclei with stable strongly-bound nuclei. In this framework the study of the ^{17}O+^{208}Pb elastic scattering can be considered to be complementary to a previous measurement of the total reaction cross section for the system ^{17}F+^{208}Pb at energies of 86, 90.4 MeV [5, 6]. The data will be compared with those obtained for the neighboring systems ^{16,18}O+^{208}Pb and others available in literature.

1 Introduction

In the last decades the study of the reaction mechanisms at energies around the Coulomb barrier for halo and weakly bound nuclei has attracted a large interest. The peculiar characteristics of these nuclei can affect deeply their reaction dynamics increasing or enhancing the total reaction cross section and/or specific reaction channels (for instance, breakup, transfer, fusion). Thus, it is quite important to have a large and reliable systematics of reaction cross section measurements for stable nuclei interacting with light, medium and heavy targets in order to compare the behavior of exotic nuclei with that of stable and strongly bound nuclei. We measured at the Laboratori Nazionali di Legnaro the elastic scattering process for the system ^{17}O+^{208}Pb in the energy range 80 - 87 MeV. This measurement, performed within the commissioning of the detection system EXPADES, is particularly interesting since, being ^{17}O the mirror nucleus of ^{17}F, the two projectiles have very similar nuclear structure and essentially differ by the binding energy of the valence nucleon (S_p =0.6 MeV for ^{17}F and S_n=4.3 MeV for ^{17}O).

2 The experimental setup

The elastic scattering angular distribution was measured by taking advantage of the detector array EXPADES (EXotic PArticle DEtection System) [1]. It is an apparatus aimed at studying the properties of exotic nuclei far from stability, since it has to deal with very small beam intensities requires high-efficiency detection set-ups and high granularity in order to obtain high angular resolution and to measure coincidences to characterize the final state of reactions. The array consist of 16 squared DSSSD arranged in 8 ΔE-E telescopes. Each detectors is 64×64 mm^2 wide and each side is

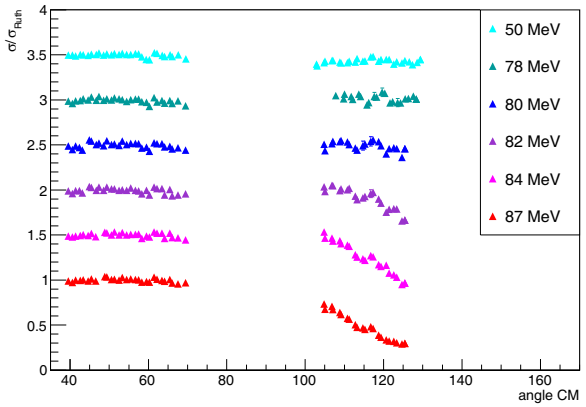

Figure 1: Elastic scattering angular distribution for system ^{17}O+^{208}Pb at different energies.

segmented in 32 strips per each side, being the strip of one side orthogonal to the ones of the opposite side. The ΔE thickness is 40 μm while the E thickness is 300 μm. Ionization chambers can be used as possible alternative ΔE stages. The detector signals are read by using standard electronic chains (developed in Milano and Napoli) both for the silicon ΔE layers and the ionization chambers, while 32-channel ASIC chips manufactured by IDEAS-GM are employed for the E stages. For the present experiment two single stage 300 μm thick DSSSD were placed at 50° and a DSSSD telescope was placed at 110°.

3 Results and conclusions

A preliminary optical model analysis of the experimental data has been performed. The fits were performed with the SFRESCO subroutine of the main coupled-channel code FRESCO [2]. We assumed all events as originating from a pure elastic scattering process, even if the experimental energy resolution did not allow to separate the events leading to the excitation of the ^{17}O first excited state at E_x=0.871 MeV.

The scattering process of the ^{17}O on a ^{208}Pb target has been measured in the energy range around the Coulomb barrier. The data have been analysed within the framework of the optical model to extract the reaction cross section and to investigate the relevance of direct reaction channels at near-barrier energies. Our measurements confirm that the trend of the two sys-

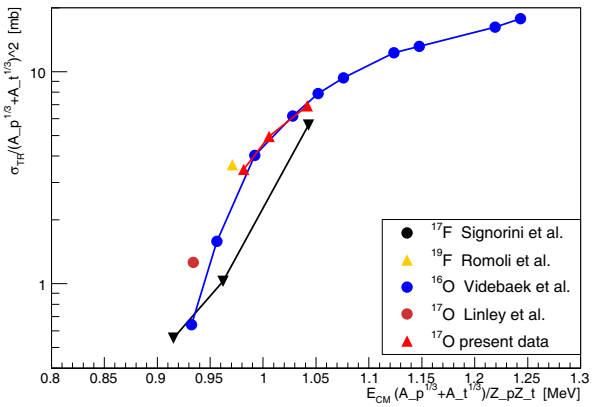

Figure 2: Total reaction cross section for different systems.

tems ^{17}O+^{208}Pb and ^{16}O+^{208}Pb, after the reduction that eliminate differences arising from system size and barrier height [3], do not show substantial differences. It also preliminary confirms that ^{17}F should have a reactivity very similar to those of the stable isotopes ^{16}O and ^{17}O, as stated in [3, 4] This outcome suggests that the low binding energy of the additional proton in ^{17}F has a rather small influence on the reaction dynamics at near-barrier energies. Coupled channel calculations are presently being performed to investigate the relevance of inelastic excitations and 1n-stripping for the reaction ^{17}O+^{208}Pb.

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