

^{17}F scattering and breakup below the Coulomb barrier with the EXODET array

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The study of Radioactive Ion Beams (RIBs) features requires the design of detector arrays with large solid angle coverage and with high energy and position resolution. These requirements brought us to the development of the EXODET (EXOtIC DETector) array [1]. EXODET consists of 16 solid-state Silicon detectors arranged in 8 two-stage ΔE -E telescopes. The total solid angle covered by the whole array is $\sim 75\%$ of 4π sr. Each detector is segmented in 100 strips. The ΔE strips are mounted orthogonally to the E strips allowing a detection accuracy of $0.5 \text{ mm} \times 0.5 \text{ mm}$ for particles passing through the first stage. The readout of the positional information was carried out using an ASIC chip.

A first experiment with the EXODET apparatus was performed at the Argonne National Laboratory studying the ^{17}F scattering from a ^{208}Pb target [2] and the breakup process $^{17}\text{F} \rightarrow ^{16}\text{O} + p$ at 90.4 MeV beam energy. Fig. 1 shows the ^{17}F elastic scattering cross section at backward angles. The experimental data have been analyzed in the framework of the optical model using the code FRESKO [3]. The results of this analysis are shown in Fig. 1 and they are also compared with those obtained for similar mass systems at about the same E_{cm}/V_c (~ 0.96) ratio: $^{16}\text{O} + ^{208}\text{Pb}$ [4] ($S_p = 12.127 \text{ MeV}$), $^{17}\text{O} + ^{208}\text{Pb}$ [5] ($S_n = 4.143 \text{ MeV}$) at 78 MeV and $^{19}\text{F} + ^{208}\text{Pb}$ [6] ($S_p = 7.994 \text{ MeV}$) at 91 MeV. One can see that the behaviour of the ^{17}F angular distribution is much more similar to that of the Oxygen isotopes rather than to the ^{19}F cross section. This is quite surprising, since the radioactive ^{17}F is a very weakly-bound nucleus ($S_p = 0.601 \text{ MeV}$). Therefore, we conclude that at Coulomb barrier energies it is easier to excite collective structures (even in a well-bound nucleus, like ^{19}F) rather than to breakup a very loosely-bound nucleus as ^{17}F .

A first direct measurement of the breakup process $^{17}\text{F} \rightarrow ^{16}\text{O} + p$ cross section at energy below the Coulomb barrier was also performed. An average value of $2.6 \pm 1.2 \text{ mb/sr}$ was estimated at backward angles. If this value holds also at forward angles, the cross section for the “two-body” breakup (*i.e.* with two fragments in the exit channel) is small. In analogy with what already observed

for the system $^6\text{Li} + ^{208}\text{Pb}$ [7] and also for the system $^{17}\text{F} + ^{208}\text{Pb}$ at much higher beam energies [8, 9], we can conclude that also for the ^{17}F case the strongest breakup channel at Coulomb barrier energies has only one outgoing fragment.

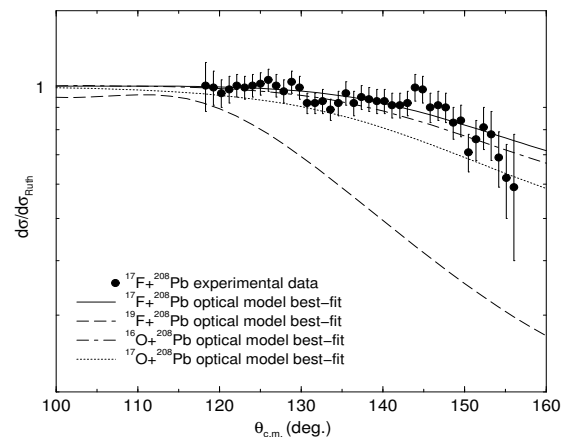


FIG. 1: Comparison of the optical model analysis of the experimental elastic scattering angular distributions for 4 similar mass systems.

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