Interaction of ^{8}B, unstable and loosely bound, with ^{208}Pb: scattering and breakup

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The main motivation of this experiment was to investigate of the reaction dynamics induced by the radioactive ion-beam ^{8}B, extremely loosely bound with S_p =137keV, at Coulomb barrier energy: i.e., reaction cross section deduced from elastic scattering, as well as the transfer and/or breakup processes. The ^{8}B beam, provided by the CRIB facility, was produced via the inverse kinematics reaction ^{3}He(^{6}Li, n)^{8}B. The primary ^{6}Li beam intensity ranged from 1 to 3 eμA, resulting in a ^{8}B intensity of ~10^{4} Hz, with an energy of 50±1 MeV. The ^{6}Li ion source had to be retuned twice owing to the total consumption of the lithium material. This resulted in a beamtime loss of two days, allowing us to accumulate statistics for four days beamtime on target. As expected, the ^{8}B beam was contaminated by ^{7}Be, via the ^{3}He(^{6}Li,pn)^{7}Be reaction, by ^{3}He, recoiling from the ^{3}He material of the production gas target, and by some ^{6}Li halo (originating from the primary beam, that was around 10^{8} times more intense than the secondary one); thus, the ^{8}B beam purity achieved was approximately 20%. The contaminations were not problematic since each beam species was identified via a time of flight technique. The light charged particles produced in the reaction were detected and identified with six ΔE-E telescopes, consisting of 40–50 μm + 300 μm double sided silicon strip detectors. The detectors were arranged symmetrically around the target at a distance of pproximately 11 cm. All the detectors with the related electronics were brought from Italy, INFN[1]. For the E-detectors we utilized for the first time, ASIC digital electronics, whereas we used for the ΔE detectors low-noise electronics; these electronics were also fully developed in Italy[2,3]. The charged particles identified were ^{8}B, ^{7}Be, ^{6}Li, ^{4}He, ^{3}He, and protons (Fig. #1), confirming our preliminary estimates: namely, the existence of a consistent amount of transfer (p transferred with ^{7}Be out) and breakup processes (→^{7}Be+p, and possible subsequent ^{7}Be breakup →^{3}He+^{4}He). Preliminary data from the angular distribution of the ^{8}B elastic scattering confirm our expectations of a strong absorption occurring in the ^{8}B-induced reactions.

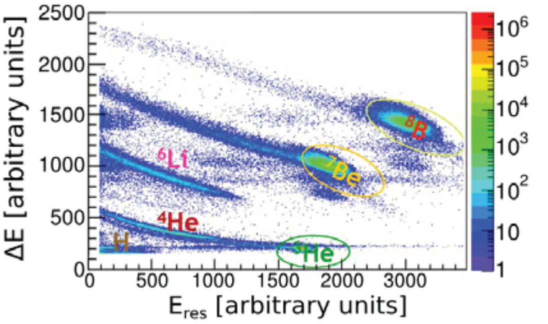

Fig. 1. ΔE-E_{res} identification of the different ions produced in the scattering of the cocktail ^{8}B-^{7}Be-^{3}He beam onto a ^{208}Pb target.

In all the runs we were able to verify the good capabilities of the homemade electronics[2,3] for identifying the various ions detected by the ΔE silicon via the built-in risetime detection. Fig. #2 shows a typical spectrum: signal rise time vs. ΔE, with the related ion identification.

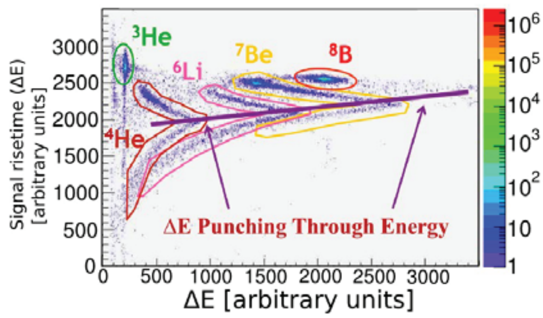

Fig. 2. Performances of the homemade electronics of the thin ΔE detectors. The measurement of the risetime signal vs. the energy loss allows for clear ion identification.

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