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 $^3$B, extremely loosely bound with $S_p$ =137 keV, 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 $\mu$A in time of flight technique. The light charged particles not problematic since each beam species was identified via the various ions detected by the electronics, whereas we used for the $^3$He$^+$,$^4$He, $^3$He, and protons (Fig. #1), confirming our preliminary estimates: namely, the existence of a consistent source had to be retuned twice owing to the total amount of transfer (p transferred with $^7$Be out) and breakup processes ($\rightarrow$ $^1$Be+p, and possible subsequent $^1$Be breakup $\rightarrow$3He+$^3$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.

In all the runs we were able to verify the good capabilities of the homemade electronics for identifying the various ions detected by the $\Delta E$ silicon via the built-in timing. The light charged particles produced in the reaction were detected and identified with six $\Delta E$-E telescopes, consisting of 40-50 $\mu$m + 300 $\mu$m double sided silicon strip detectors. The detectors were arranged symmetrically around the target at a distance of approximately 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 $\Delta E$ 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

Fig. 1. $\Delta E$-E$_{\text{rec}}$ identification of the different ions produced in the scattering of the cocktail $^8$B-$^7$Be-$^3$He beam onto a $^{208}$Pb target.

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

References