Analysis of ^{124}Sn+^{112,124}Sn at 26*A* MeV reaction data taken on NIMROD

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The analysis of the data set coming from ^{124}Sn beam at 26*A* MeV on ^{112}Sn and ^{124}Sn targets acquired by the NIMROD heavy ion detector [1] is now underway. These data will be used to perform isotopic study of the reaction products and thus the emission sources [2] in order to better characterize the reaction dynamics and the asymmetry term in the nuclear equation of state [3].

This data set is composed of 33 runs combining 26 000 000 events. To protect the silicon detectors from the heaviest fragment produced by this very heavy system, 229 μm thick aluminum foils were placed in front of the super telescopes in rings 2 to 5 and every other silicon in rings 2 to 7 had a 178 μm thick foil in front of them. There was no foil at all in front of rings 8 and 9.

The linearization of those data is now completed and particle identifications have been generated for every detector. We first performed the linearization of the CsI(Tl) for which a graphical interface has been used to draw four lines per spectra: one for the protons, one for the tritons, another for the alphas and a final one for the heaviest elements in order to make the Z=2 identification cleaner. Once the lines are set, the distance between those and the data points is calculated [4] and used to project the data for each element on the x axis to gives a visual evaluation of the isotope separation. At that point, limits are manually set to separate the isotopes. A lower limit is also set to cut the noise and the mixed line part at the very bottom of the slow vs fast spectra. An example of those identification plots is shown in Fi8g. 1. The lines and limits are then used by the particle identification program to generate PID files. This method allows us to discriminate mass up to Z=2 in the case of the CsI(Tl) detectors.

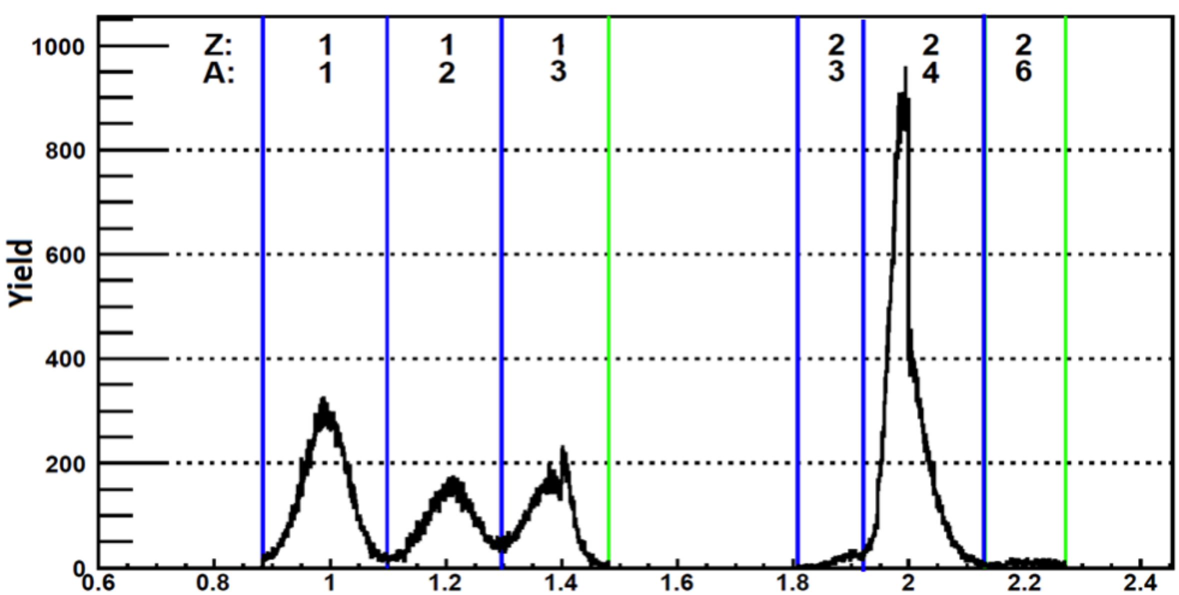

FIG. 1. Linearization plot and identification limits for CsI(Tl) number 54 (ring 6). Isotopic identification is achieved for Z=1 and 2 particles.

The same procedure has been used for the Si-Si super telescopes and Si-CsI(Tl) telescopes. The only difference is that we set a line for each visually separable element (that can goes up to Z=42 in the case of the super telescopes). In both cases, isotopic identification is achievable up to Z=9 for the best detectors and all the charges are well separated if there are enough statistics. Fig. 2 shows the identification plot and limits for particles with a charge from Z=3 to 9 for the Si-Si super telescope 56-58.

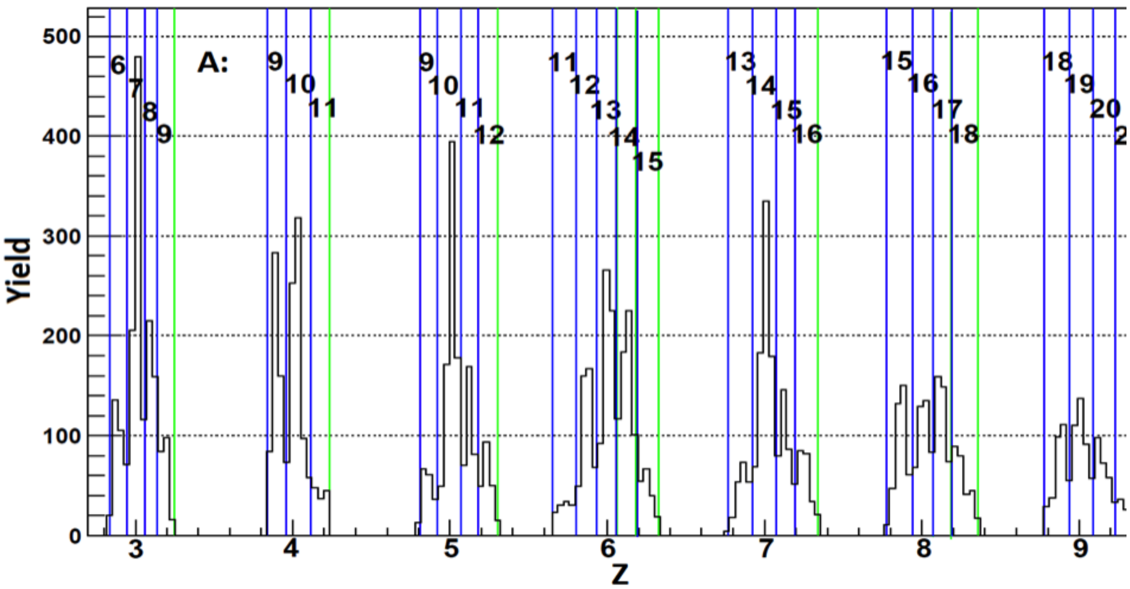

FIG. 2. Linearization plot and identification limits for Si-Si super telescope number 56-58 (ring 5). Isotopic identification is achieved up to Z=9.

As indicated above, the linearization is now completed and we are calibrating the Si-Si telescopes. Since we do not have any calibration data, we are using SRIM stopping power calculations [5] to establish the energy. The punch through being equal to the total energy, we can calculate the energy lost into the ΔE. The energy deposited into the E stage is then the total minus ΔE. Since we don't know the mass of the fragments with Z>9, we use a N/Z mass attribution factor for SRIM calculations and we compare the calibrated spectra with the energy loss lines calculated by the software.

We can see on Fig. 3 that the procedure is working well for the Si-Si telescope number 38-40. Here, the calibration is made using the punch through energy points from Z=2 to 14 and a N/Z mass factor equal to 1.15 is applied for 9<Z<15, 1.24 for 14<Z<25 and 1.20 for Z>24. This method and these values are working fine for most of the detectors. However, several telescopes don't match with the SRIM calculated lines and we will have to introduce a Si thickness correction in the energy loss calculations. At the end, we will also have to make a correction for the aluminum foil degrader in front of the silicons for rings 2 to 7. For the other detectors, a calibration run will have to be done in order to be able to calibrate the Si-CsI(Tl) and CsI(Tl) detectors properly.

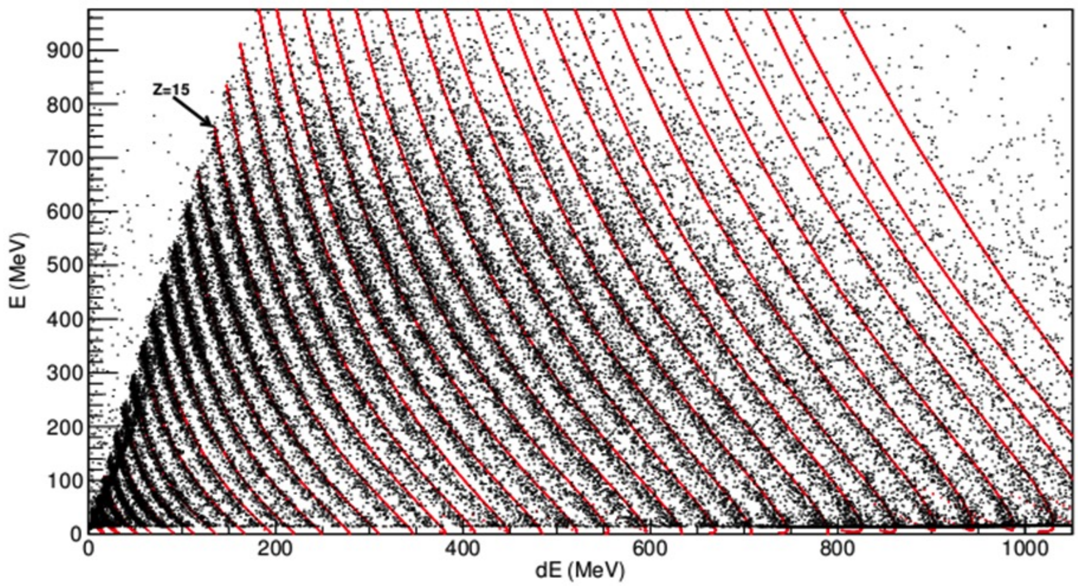

FIG. 3. Calibrated spectra for Si-Si super telescope number 38-40 (ring 4). Red lines are SRIM calculated energy loss data.

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