Analysis of ^{86,78}Kr + ^{64,58}Ni data taken on the upgraded NIMROD-ISiS

S. Wuenschel, S. Galanopoulos, K. Hagel, Z. Kohley, L. W. May, J. B. Natowitz, D. V. Shetty, S. N. Soisson, G. Souliotis, B. C. Stein, R. Wada, and S. J. Yennello

Projectile fragmentation data from the reaction of ^{86,78}Kr with ^{64,58}Ni at 35MeV/u was taken on the upgraded NIMROD-ISiS detector [1]. The data was taken with high multiplicity and downscaled minimum bias triggers as well as a pulser trigger for Neutron Ball background. A total of 209 hours of data were taken.

Data analysis started with particle identification of the delta E- E and CsI Fast-Slow plots. Linearization was chosen rather than gating as a result of its improved isotope separation and error analysis capabilities. The linearization method was based on an established method of R. Wada. Lines are chosen for each element with two chosen for Hydrogen. A graphical user interface was developed for the line picking/adjusting. The linearization method intrinsically depends on the user's ability to create a smooth line and then calculate an accurate distance between the data points and the line. A new method of distance calculation was developed and is described in [2].

Once a distance can be calculated between the data points and the chosen lines, the data can then be re-plotted as a function of element (defined from the line) and channel number (which roughly correlates to energy). This plot is then projected onto the X-axis yielding a visual and quantitative quality of the line fit (Figure 1). This plot can then be analyzed for charge and mass particle identification.

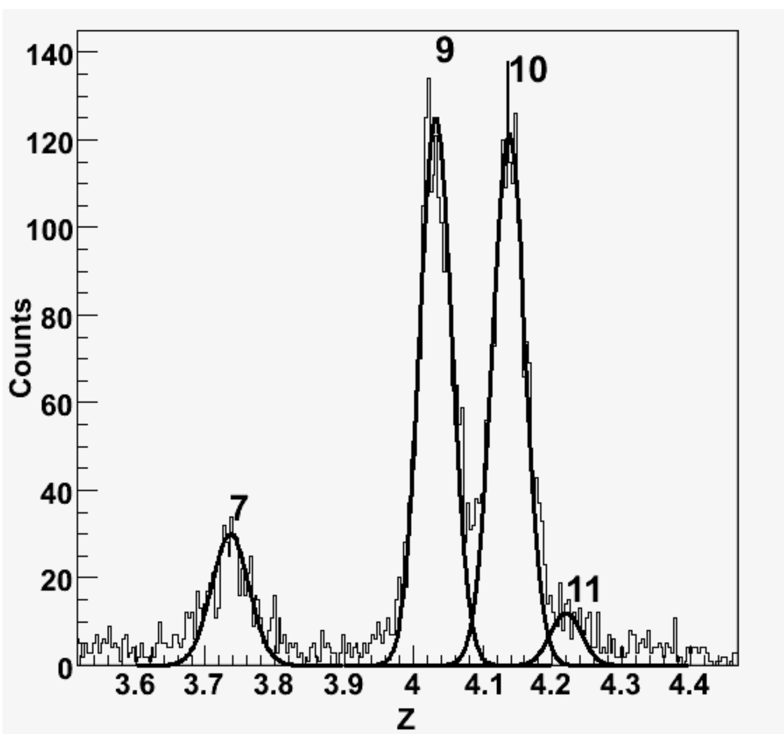

Figure 1. A 1D projection of linearized data with fitted Gaussian functions.

To establish a reliable estimate of mass for peaks that are not completely separated, Gaussians were fitted to the isotopes of each element in each detector. An idea of the error in mass identification can then be made from the probability of the particle belonging to the peak of a particular isotope.

Resolution can be improved by the addition of upper and lower limits on the data. Upper limits are used to cut saturated data points while low thresholds cut out low level noise inherent in the detectors.

Energy calibration of the data is underway. The silicon detectors are calibrated using a combination of punch-through points and punch-in points. These methods have been compared and shown to agree within a few percent. The energy loss characteristic of heavy particles is dominated by the silicon signals, so they can be calibrated using an extrapolation of the silicon energy to total energy based on the Orsay energy loss tables. Intermediate mass fragments are also calibrated by this method though considerably more sensitive to minor changes in the silicon calibration. The light charged particles (Z=1,2,3) are calibrated using the cesium iodide slow signal through the Tassan-Got [3] formula. The calibrations for the light charged particles are compared to earlier NIMROD data for which the calibration is very well established. This will ensure consistency of the current data set.

[1] S. Wuenschel *et al.*, *Progress in Research*, Cyclotron Institute, Texas A&M University (2006-2007), p. II-34.

[2] L. W. May *et al.*, *Progress in Research*, Cyclotron Institute, Texas A&M University (2007-2008), p. II-26.

[3] L. Tassan-Got, Nucl. Instrum. Methods Phys. Res. **B194**, 503 (2000).