ABSTRACT

N/Z Equilibration in Deep Inelastic Collisions and the Fragmentation of the Resulting Quasiprojectiles. (May 2007)

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When target and projectile nuclei have a difference in neutron to proton ratio (N/Z), the quasiprojectiles formed in a deep inelastic collision (DIC) should have a mean N/Z between the N/Z of the target and the N/Z of the projectile, depending on the amount of N/Z equilibration that occurred. Data from six reaction systems at two beam energies (32 and 45 MeV/nucleon) were collected. The systems in order of increasing difference between target and projectile N/Z (shown in parentheses) are $^{40}\text{Ar} + ^{112}\text{Sn}$ ($\Delta N/Z = 0.018$), $^{48}\text{Ca} + ^{124}\text{Sn}$ ($\Delta N/Z = 0.080$), $^{48}\text{Ca} + ^{112}\text{Sn}$ ($\Delta N/Z = 0.160$), $^{40}\text{Ca} + ^{112}\text{Sn}$ ($\Delta N/Z = 0.240$), $^{40}\text{Ar} + ^{124}\text{Sn}$ ($\Delta N/Z = 0.258$) and $^{40}\text{Ca} + ^{124}\text{Sn}$ ($\Delta N/Z = 0.480$).

The quasiprojectile N/Z was determined by two techniques. The first technique used the isotopically resolved fragments to reconstruct the quasiprojectile N/Z. The second technique, developed in this thesis, used fragment yield ratios and a simple equation to simultaneously fit all six systems to determine the quasiprojectile N/Z. Simulations and a filter of the FAUST (Forward Array Using Silicon Technology) acceptance were used to calculate neutron loss; this accounted for the difference between the two techniques.

To study the fragmentation of quasiprojectiles the fragment yields were used to calculate the isobaric, isotopic, fractional and mean N/Z yields. The results showed that as neutron richness increased, more neutron-rich fragments were produced. In
addition observation showed evidence for an inhomogeneous distribution of N/Z between the light charged particles (LCPs Z less than 3) and intermediate mass fragments (IMFs Z greater than 2).

The theoretical results, which used different values of the symmetry energy, were compared to experimental data to determine which symmetry energy best represents the experimental data. The comparison showed the experimental data was the overall best fit with a lower value of the symmetry energy. These results were not conclusive and further investigation is required.