ABSTRACT

Temperature and Scaling studies from Projectile Fragmentation of \(^{86,78}\text{Kr}+^{64,58}\text{Ni}\) at 35 MeV/A. (August 2009)

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Many observables have been developed to study the effects of the two component nature of nuclei. This thesis has experimentally probed caloric curves as well as scaling observables for their dependence on the asymmetric portion of the nuclear equation of state. Projectile fragmentation sources were identified from the reactions of \(^{86,78}\text{Kr}+^{64,58}\text{Ni}\) at 35 MeV/A taken on the NIMROD-ISiS array. The angular coverage, excellent isotopic resolution, and Neutron Ball allow for quasi-complete event reconstruction in both charge and mass.

A new thermometer for nuclear fragmentation studies has been derived and is presented here. In this thermometer, the temperature is obtained from fluctuations of the transverse momentum. The proton transverse momentum fluctuations are used in this thesis to study the N/Z dependence of the nuclear caloric curve. The caloric curve constructed from proton momentum fluctuations does not show a significant dependence on the source N/Z ratio. Two other thermometers have also been studied in this thesis: the double isotope ratio, and moving source slope thermometers. These thermometers show no statistically significant dependence on the source N/Z.

The source density has been derived from the evolution of fragment Coulomb barriers with increasing \(E^*/A\). This density showed no source N/Z dependence. However, a strong evolution in source density over the \(E^*/A=1.5–7.5\) MeV region was observed.

Fragment scaling was investigated through isoscaling and power law scaling. The
power law scaling showed a strong dependence on the source N/Z. This source N/Z dependence was further investigated through isoscaling. The fragment yields of this data have been shown to exhibit consistent isoscaling for Z=1–17. In addition, isoscaling was observed in data cut on the E*/A of the source yielding decreasing slopes (α) as a function of E*/A. This decrease, normalized to the asymmetries of the sources (α/Δ), has been linked to a decrease in the asymmetry coefficient C_{sym}.

This thesis has shown that the experimentally observed decrease in C_{sym} with E*/A is well correlated to the temperature and density changes experimentally observed in this data.