Reaction Tomography at 47A Mev

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We are investigating the dynamics and thermodynamics in light ion and heavy ion collisions near the Fermi Energy by comparing the yields , spectra and angular distributions of observed products from different reaction systems at same incident energy.A large series of heavy ion reaction systems have been studied with NIMROD. They include

$^{1}H + {}^{112}Sn$	$^{1}H + {}^{124}Sn$
$^{2}H + {}^{112}Sn$	$^{2}H + {}^{124}Sn$
$^{3}He + {}^{112}Sn$	$^{3}He + {}^{124}Sn$
$^{4}He + {}^{112}Sn$	$^{4}He + {}^{124}Sn$
$^{10}B + {}^{112}Sn$	$^{10}B + {}^{124}Sn$
$^{20}Ne + {}^{112}Sn$	$^{20}Ne + {}^{124}Sn$
$^{40}Ar + {}^{112}Sn$	$^{40}Ar + {}^{124}Sn$
$^{64}Zn + {}^{112}Sn$	$^{64}Zn + {}^{124}Sn$

all with the same incident energy, 47 Mev/A .

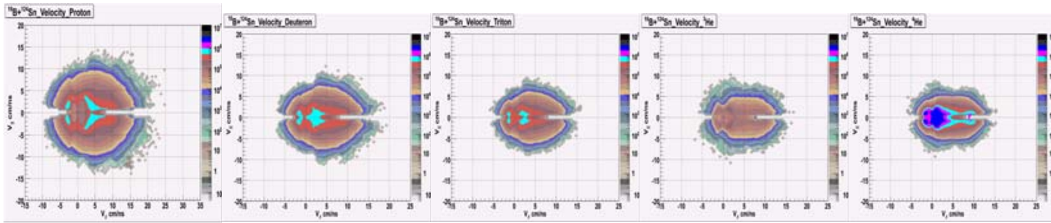
In our data analysis, we expect to be able to separate emission resulting from nucleon-nucleon collisions from that resulting from the thermalized system and obtain a much cleaner picture of the dynamic evolution of the hotter systems. This series of experiments provides us an opportunity to probe temperature evolution , in-medium nucleon-nucleon cross sections ,isospin effects ,and symmetry energy by creating similar systems with different densities and different N/Z ratios in the interaction region [1-3, 5, 6].

A common technique i.e Three Source Fitting has been used to to fit the observed spectra assuming contributions from three sources, a projectile like fragment (PLF) source, an intermediate velocity (*NN*) source, and a target like fragment (TLF) source . This allows us to characterize light particle emission and provides us a schematic picture of the emission process and estimation of the multiplicities and energy emission at each stage of the reaction [4].

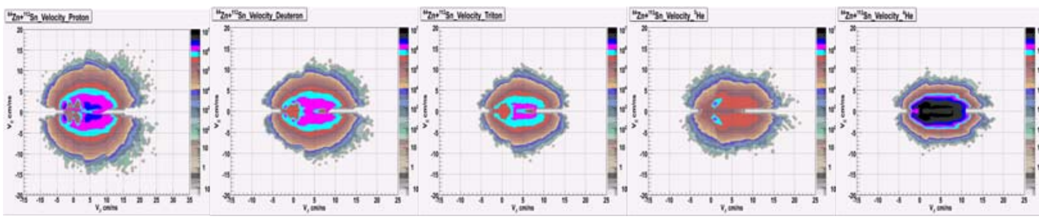
In our approach, we select the most violent events by taking into account only the events with the 30% largest light particle multiplicity. In Figure 1 below are the velocity plots of p ,d ,t, ^{3}He , ^{4}He from $^{10}B+{}^{124}Sn$, $^{64}Zn+{}^{112}Sn$, $^{64}Zn+{}^{124}Sn$ respectively .

From these velocity plots, we can see that emission in the different systems looks qualitatively similar but the intensities are quite different

$^{10}B+^{124}Sn$



$^{64}Zn+^{112}Sn$



$^{64}Zn+^{124}Sn$

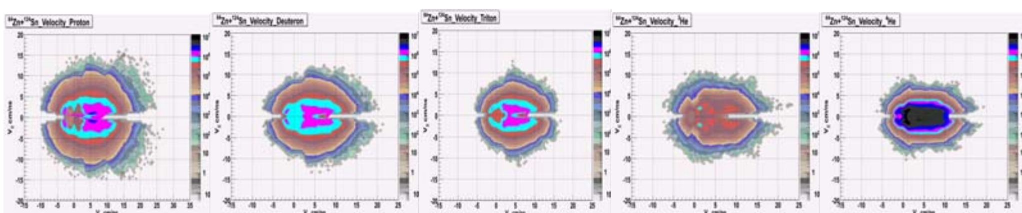


Figure 1. Velocity plots of p ,d ,t, ^{3}He , ^{4}He emission from $^{10}B+^{124}Sn$, $^{64}Zn+^{112}Sn$ and ^{64}Zn $+^{124}Sn$

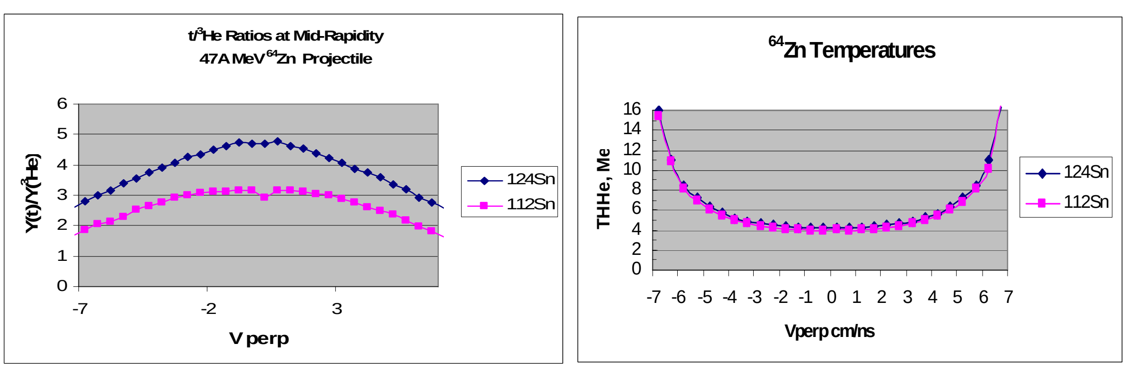


Figure 2. (Left) t/^{3}He ratios at mid-rapidity. (Right)^{64}Zn temperatures.

We also generated plots of t/ ^{3}He ratios and ^{64}Zn temperatures from source fitting parameters at mid-rapidity Vp 5-6 cm/ns. These are in Figure 2 and show that the t/ ^{3}He ratios are different, reflecting the different N/Z in the system. Double isotope ratio temperatures, T_{HHe}, are very similar. Further analyses are under way.

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