## Phoswich Alray for Sub-Fermi Energy Heavy Ion Reaction Dynamics

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$E_{B}=a_{v} A-a_{s} A^{2 / 3}-a_{c} \frac{Z^{2}}{A^{1 / 3}}-a_{a} \frac{(N-Z)^{2}}{A}+\delta(A, Z)$
$E(\rho, I)=E(\rho)+\underbrace{E_{\text {sym }}(\rho) I^{2}}_{\begin{array}{c}\text { Symmetry energy not well constrained } \\ \text { at low and high densities }\end{array}}$
EoS is used to further understand astrophysical objects.


Refining the EoS Using Geant4 Simulation


## Goal

Record the time it takes for a photon to be emitted and use it to get Time-of-Flight Mass Measurements

ToF Mass Calculations:
Start with the kinetic energy equation:

$$
E=\frac{1}{2} m v^{2}
$$

With a set distance and a measured time, velocity ( v ) may be found.

$$
m=\frac{2 E}{v^{2}}
$$

Using a known energy ( E ) and a measured velocity, the mass of the particle can be calculated.

Simulation Results

Alpha Particles Timing:
Alpha 10 MeV


Zr-90 I ons Timing:


Zr-90 300 MeV


Zr-90 400 MeV


Zr-90 500 MeV


Mass Measurement Calculations


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