A new approach to the properties of hot and dense nuclear matter

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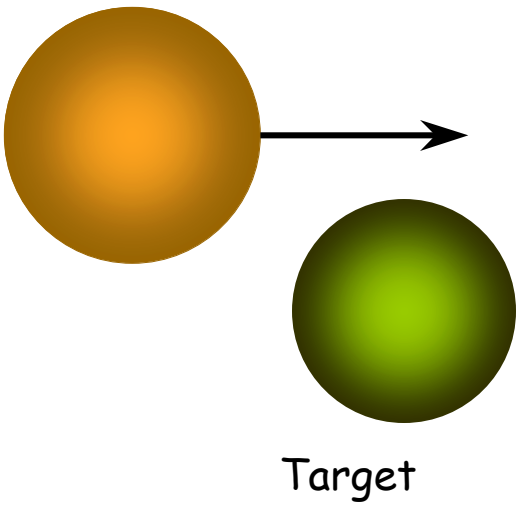
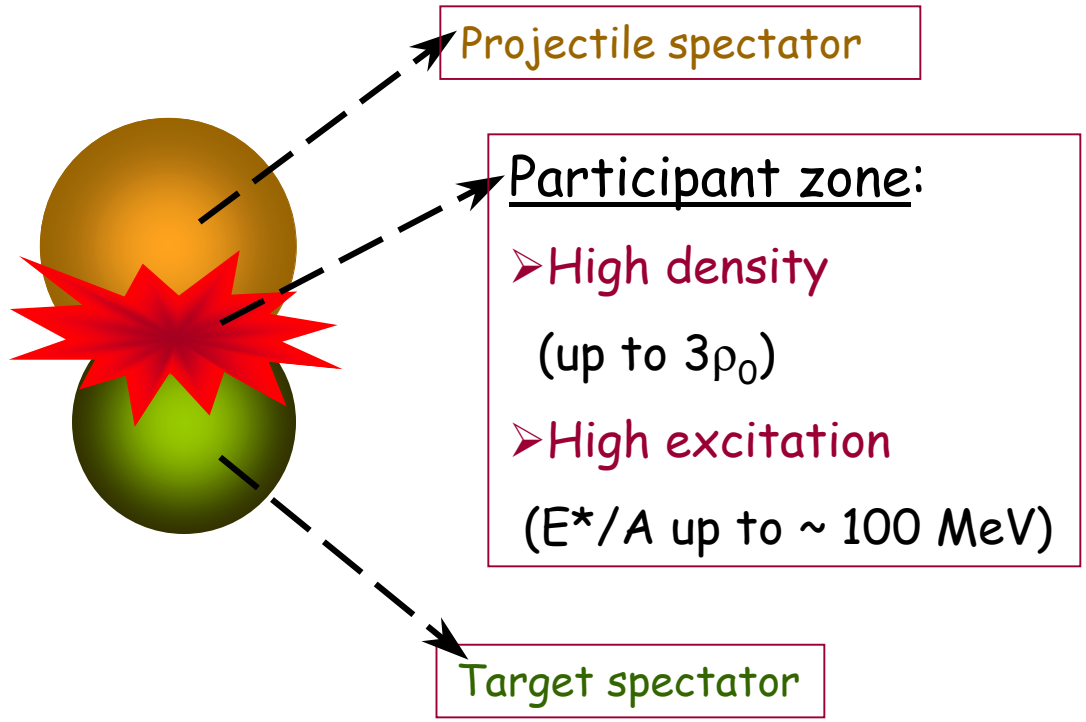
Astrophysical interest:

- Evolution of the early universe
- Supernovae explosions
- Formation and stability of neutron stars

Governed by properties of the nuclear matter at extreme conditions (high T, P, ρ).

Heavy-ion collisions at relativistic energies





➢"Standard" experiments: Detection of nucleons, produced particles, very light fragments in large-acceptance experiments.

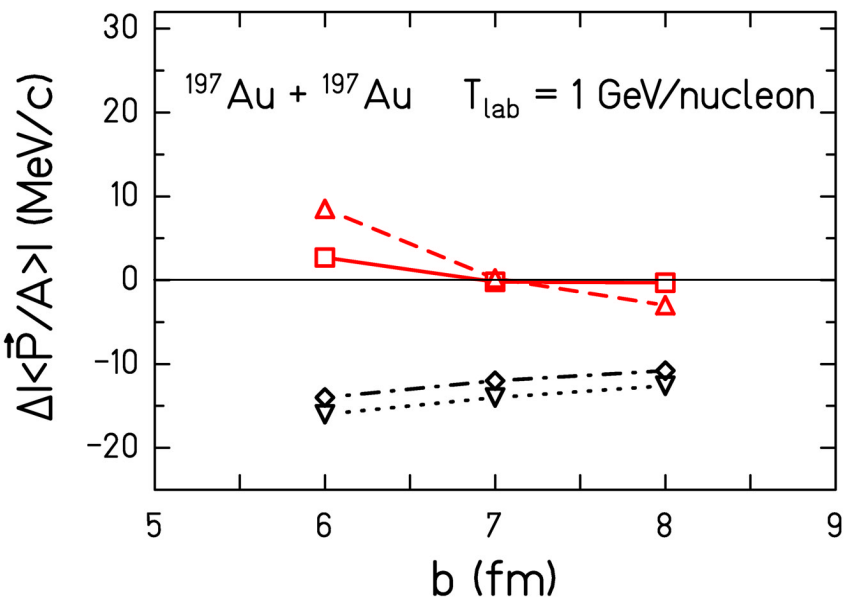
➢Shi, Danielewicz, Lacey, Phys. Rev. C 64 (2001) 034601:

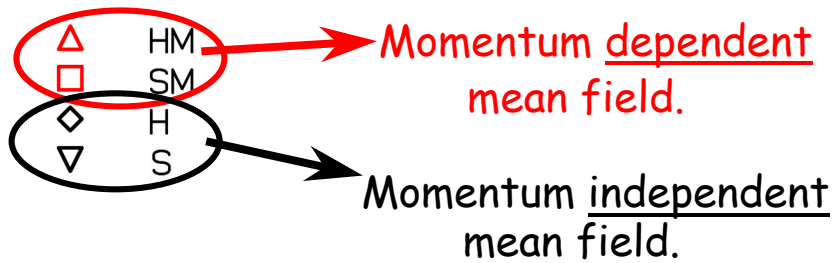
Explosion of the participant zone influences the spectator matter.

Spectator response to the participant blast

Theory

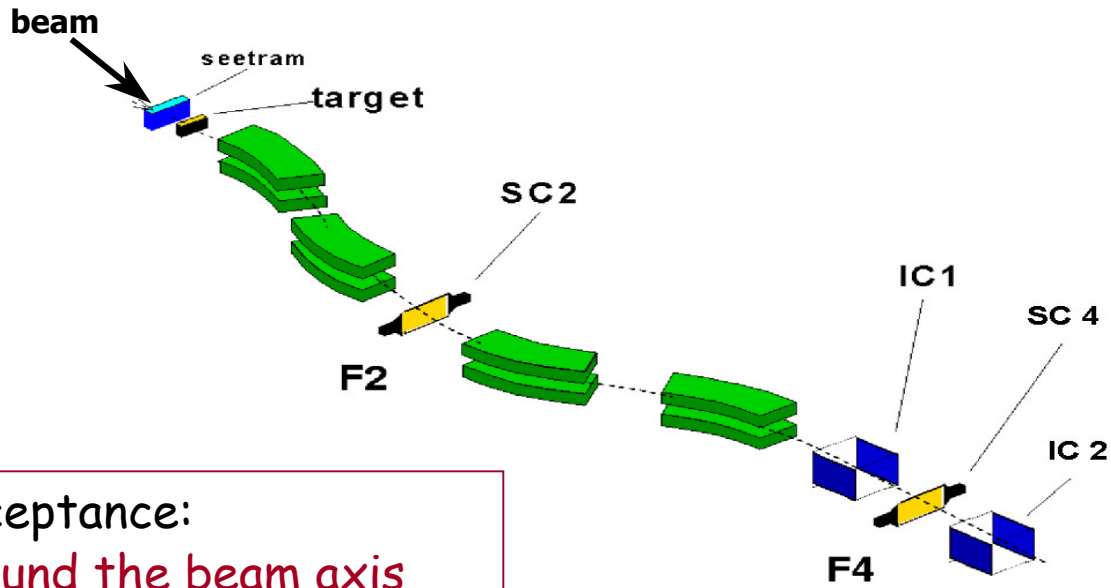
BUU calculations of Shi, Danielewicz, Lacey, Phys. Rev. C 64 (2001) 034601





- A measure of the momentum dependence of the nuclear mean field.

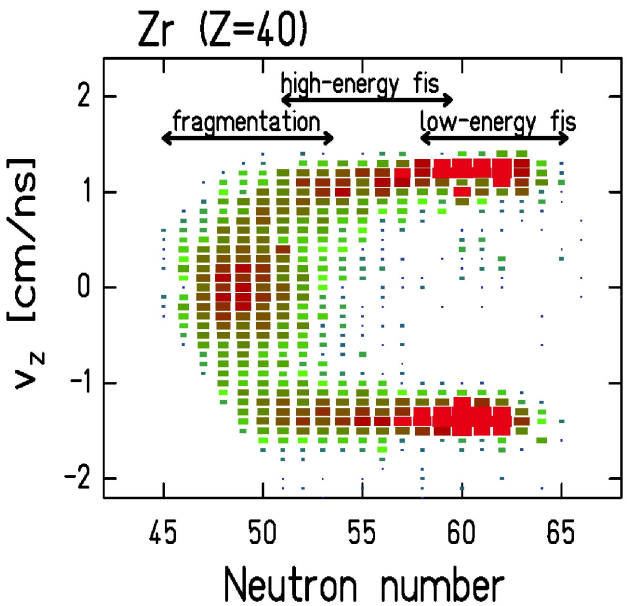
Experiment at the FRS - GSI

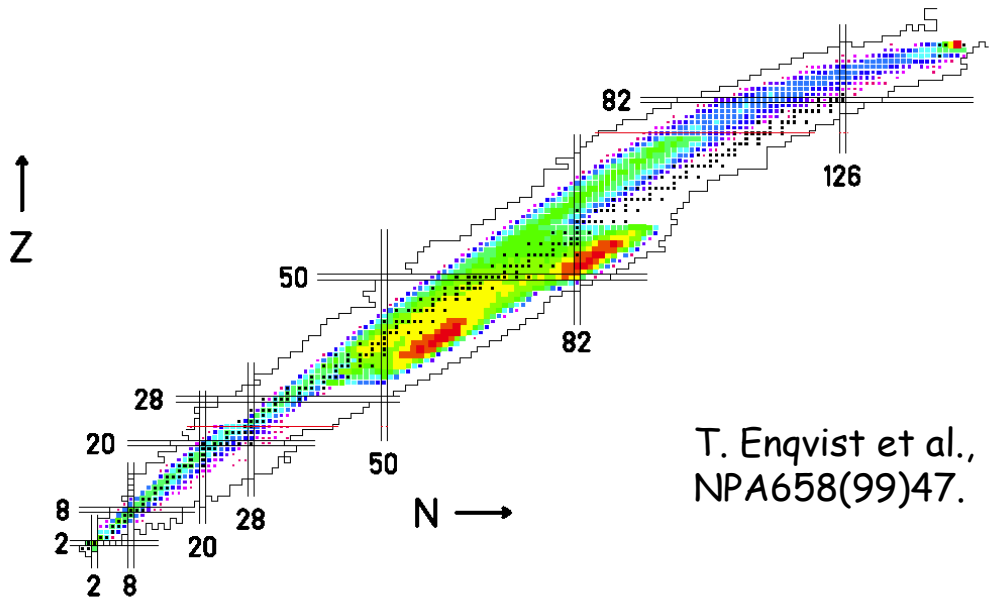


- Angular acceptance:
  15 mrad around the beam axis
- Momentum acceptance:
  ±1.5 % in $\Delta p/p$
- Resolution:
  $\Delta A/A \sim 2.5 \cdot 10^{-3}$
  $\Delta p/p \sim 5 \cdot 10^{-4}$

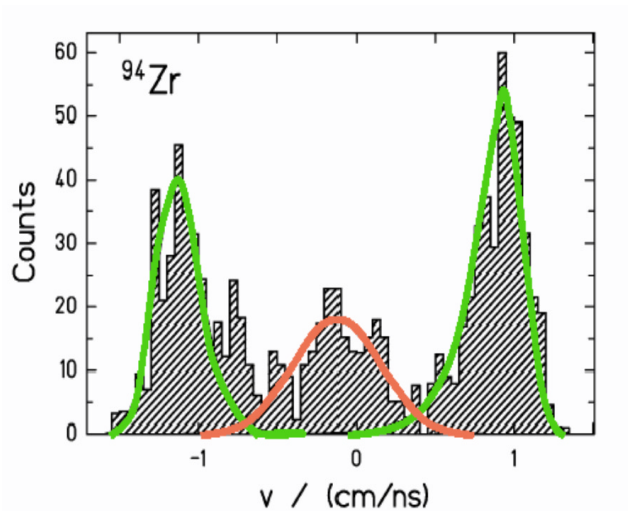
- Z from: ΔE in IC
- A/Z from: $\frac{A}{Z} = \frac{e}{m_0 c} \cdot \frac{B\rho}{\beta \cdot \gamma}$

Experimental results – e.g. ^{238}U + Pb 1 A GeV





T. Enqvist et al., NPA658(99)47.

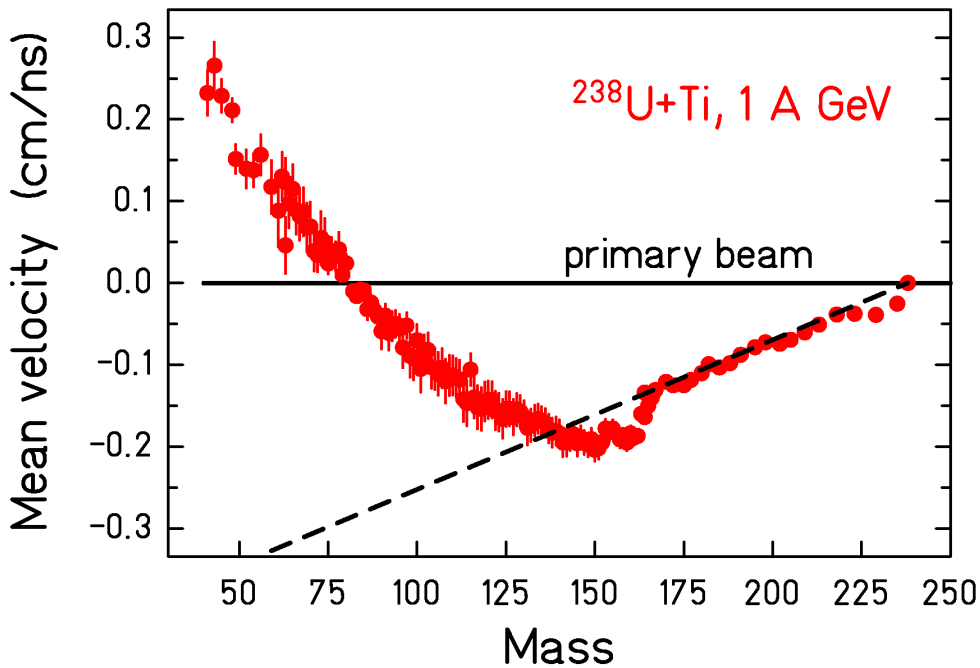


Systematic information on nuclide distributions and velocities!

Spectator response to the participant blast

Experiment

M.V. Ricciardi et al., PRL 90 (2003) 212302



- The postulated response of the spectators to the participant blast has been established experimentally.
- Valuable basis for general verification of transport calculations.

Outlook

- Ongoing studies on the influence of a beam energy (energy deposited in the participant zone) and of a neutron-to-proton ratio on the strength of the spectator response to the participant blast.

- Dedicated calculations.