Precision measurements on momentum distributions of fragmentation residues for investigating the EOS of nuclear matter

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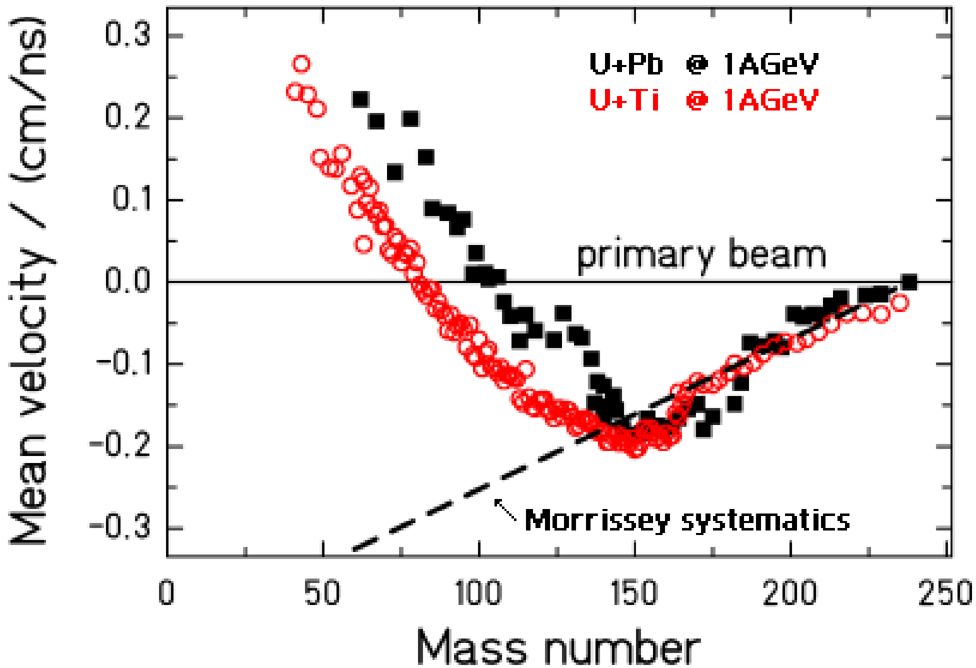
Motivation



<u>Fragment velocities are related to the EOS !!!</u>

„Common“ methods of investigating nuclear EOS

Kaon production

• production yields of kaons in heavy ion collisions
• kaons contain antistrange quark => almost no absorption in the nuclear medium

Collective flow

• pattern of particles escaping from the hot and dense participants zone depends on EOS

Both methods: very complex results, support the idea of a ***soft EOS***

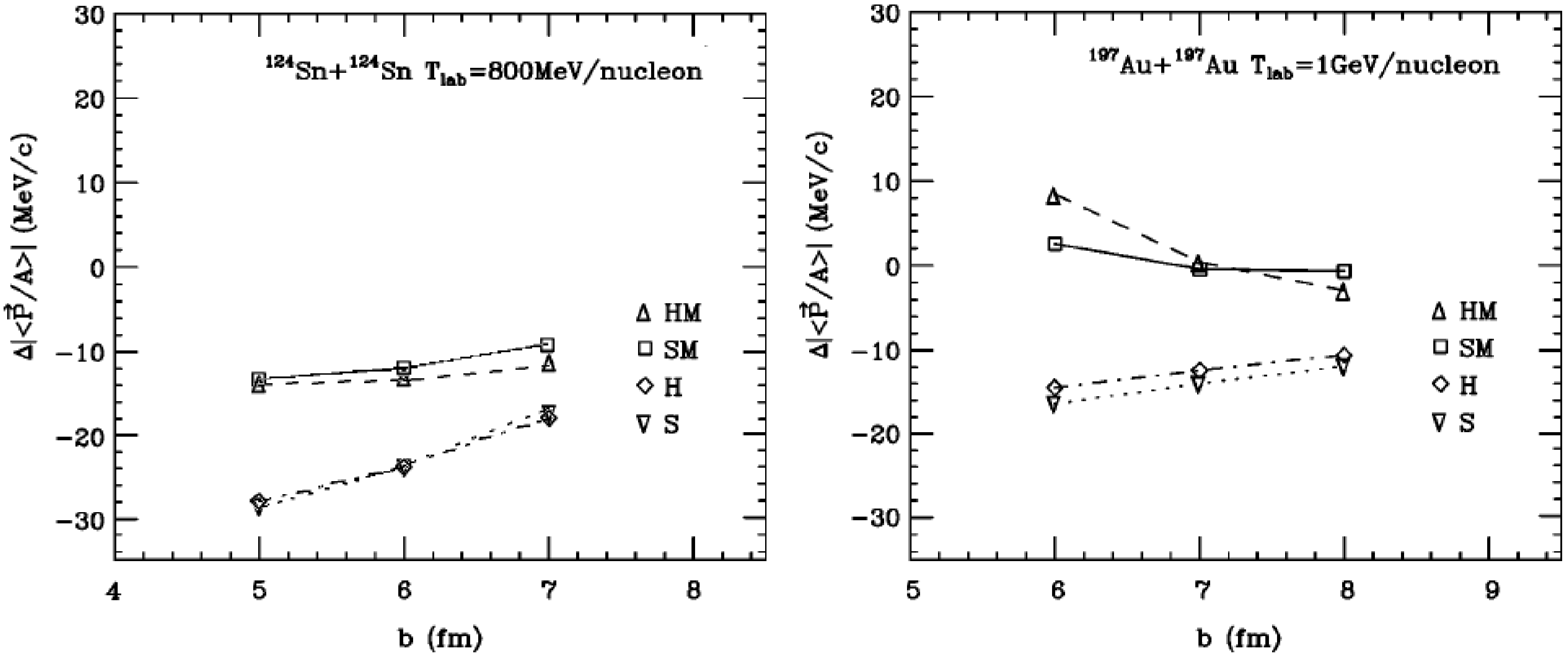
BUT: unfortunately momentum (in)dependence of the nuclear mean field still not disentangled

Spectator response

• surviving spectator „kicked in its back“ by the particles flying from the participants zone at the high-density stage of the collision

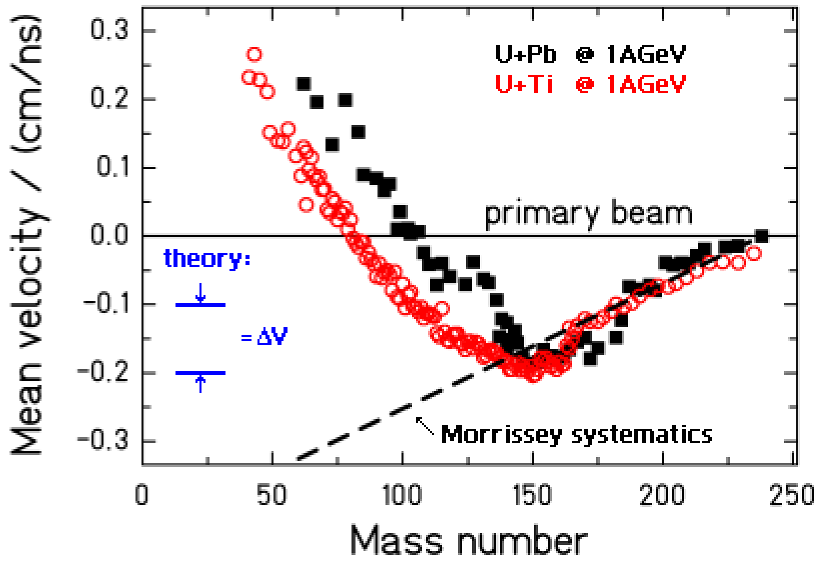
What can we learn from the spectators?

Theoretical calculations: *(Shi, Danielewicz, Lacey)*



1) Change of the net momentum (NM) depends on momentum dependence of the nuclear mean field (MF)
2) Dependence of NM change on stiffness of EOS almost none
3) Different reaction systems => different response

Is the FRS good enough ?



$\Delta\left|<\mathbf{P}/A>\right| = 10$ MeV/c ≈ $\Delta v = 0.1$ cm/ns

<u>According to the theory:</u>

Resolution limit of the FRS is sufficient to distinguish whether the nuclear mean field is momentum dependent or not.

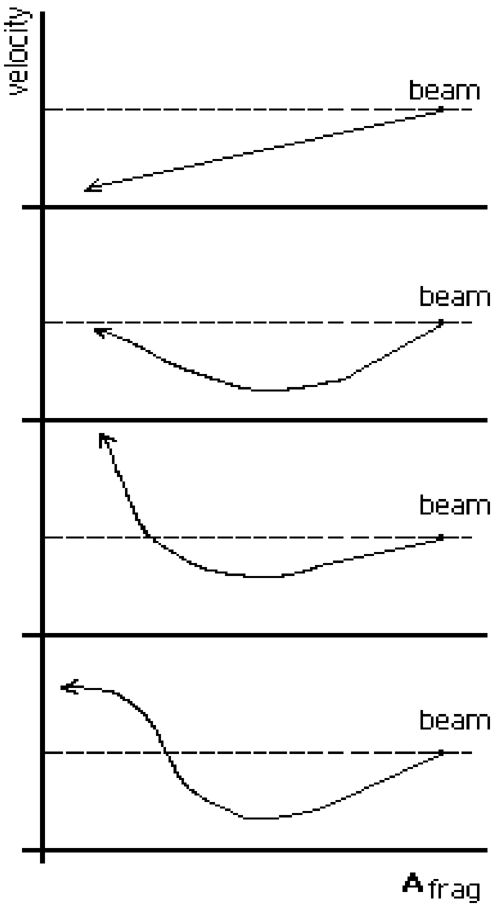
Essential parameters

Beam energy:

- Higher energy of beam particle = more energy in participants zone

➡ stronger re-acceleration effect expected

<u>*Possible dependencies:*</u>



Projectile and target nuclei mass:

- higher mass of beam+target nuclei = more energy in the participants zone

- various beam-target configuration = different participant-spectator mass ratio

➡ shape of the re-acceleration dependence on the survival fragment mass can change

<u>At least a 2-parameter field !!!</u>

Good chance to test even the details of the theory

Preparation of new experimental program
„Search for the momentum (in)dependence of the nuclear mean field“

Experimental idea:

- scan of 3-4 target-projectile systems for 3-4 different beam energies

Experimental requirements:

- beams of U, Pb, Au, Xe ... (???)
  intensities of $10^{7\text{-}8}$ ions per spill
  targets Pb, Au, Ti ... (???)

Planned improvements:

- S2 position resolution

Beam time requirements:

- in the order of weeks (app. 1 week per 1 target-beam system)