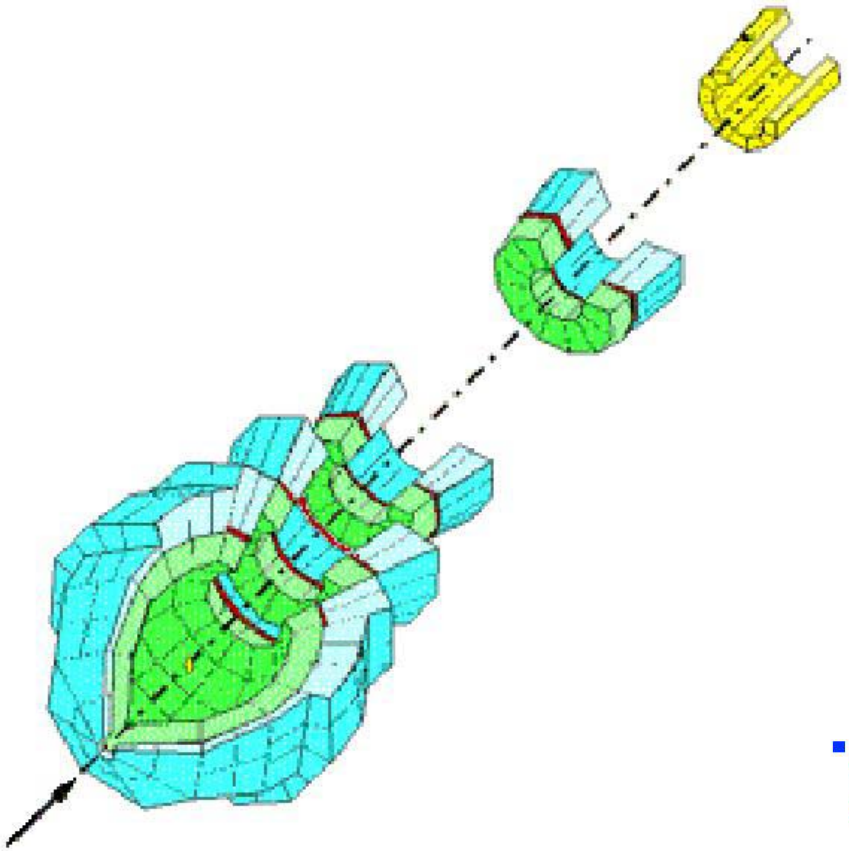
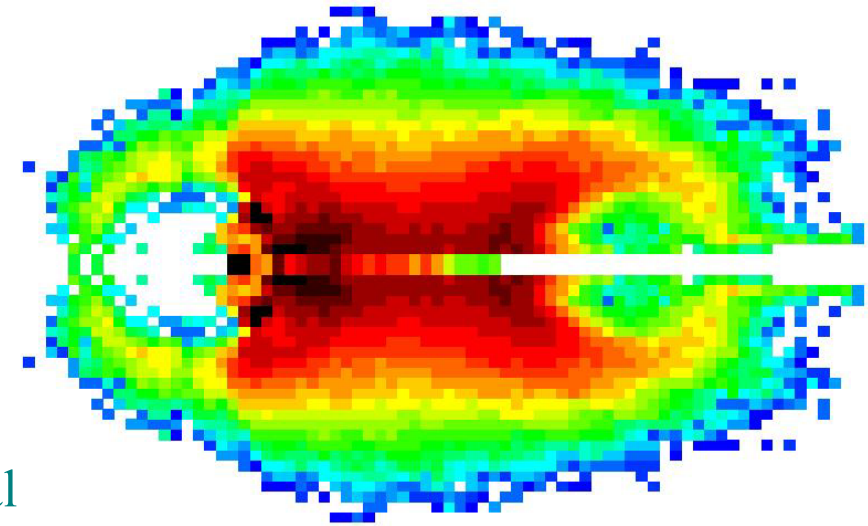
INDRA at GSI

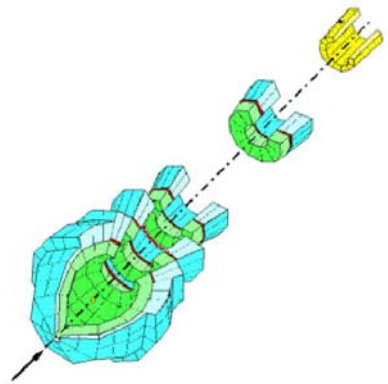
November 1997 – April 1999



Z=3
Au + Au
80 AMeV
Very peripheral

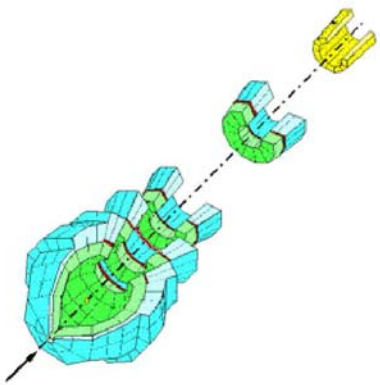


INDRA at GSI



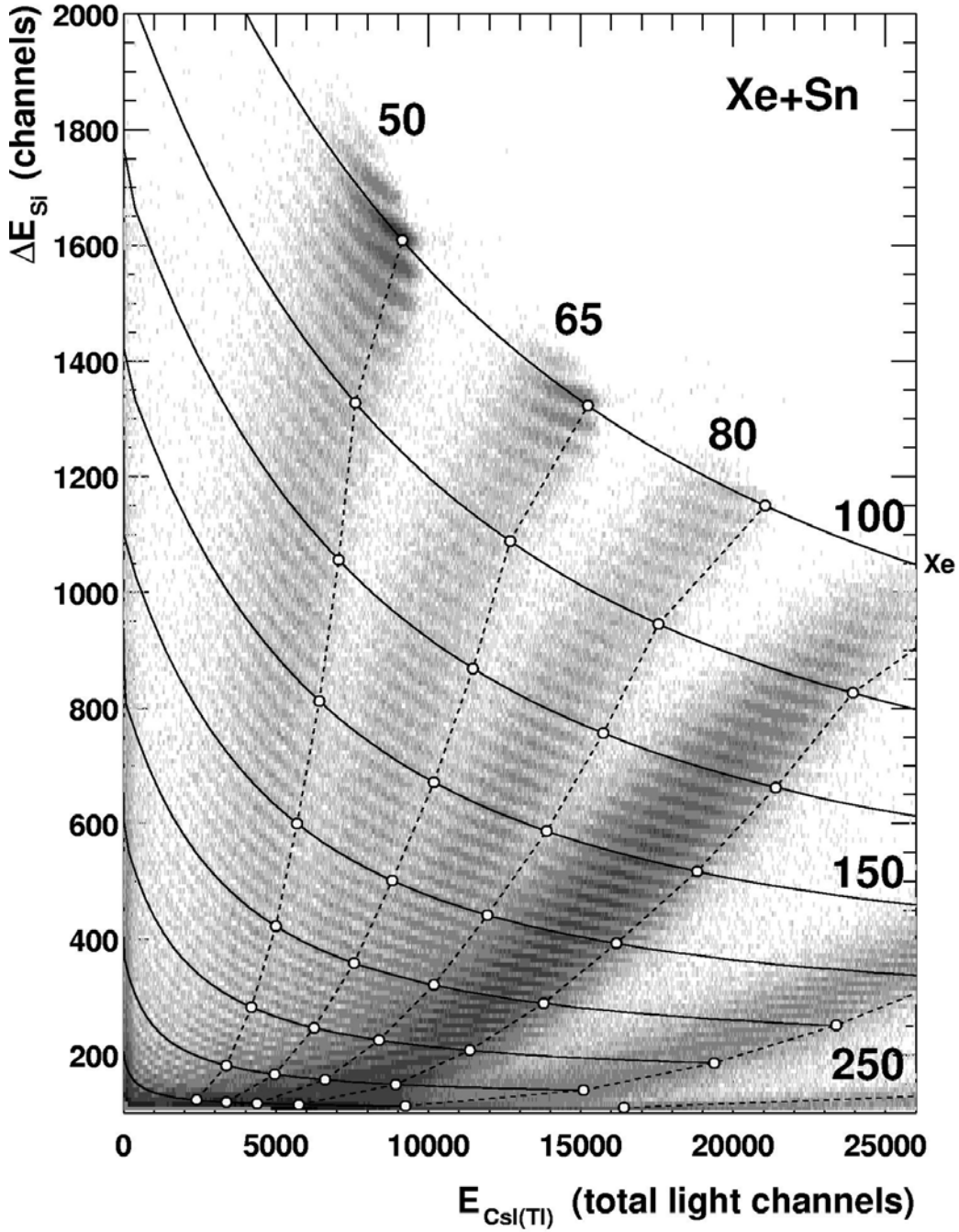
Systems:	Au + Au	40 to	150 AMeV
	Xe + Sn	50 to	250 AMeV
	C + Au	95 to	1800 AMeV

Identification



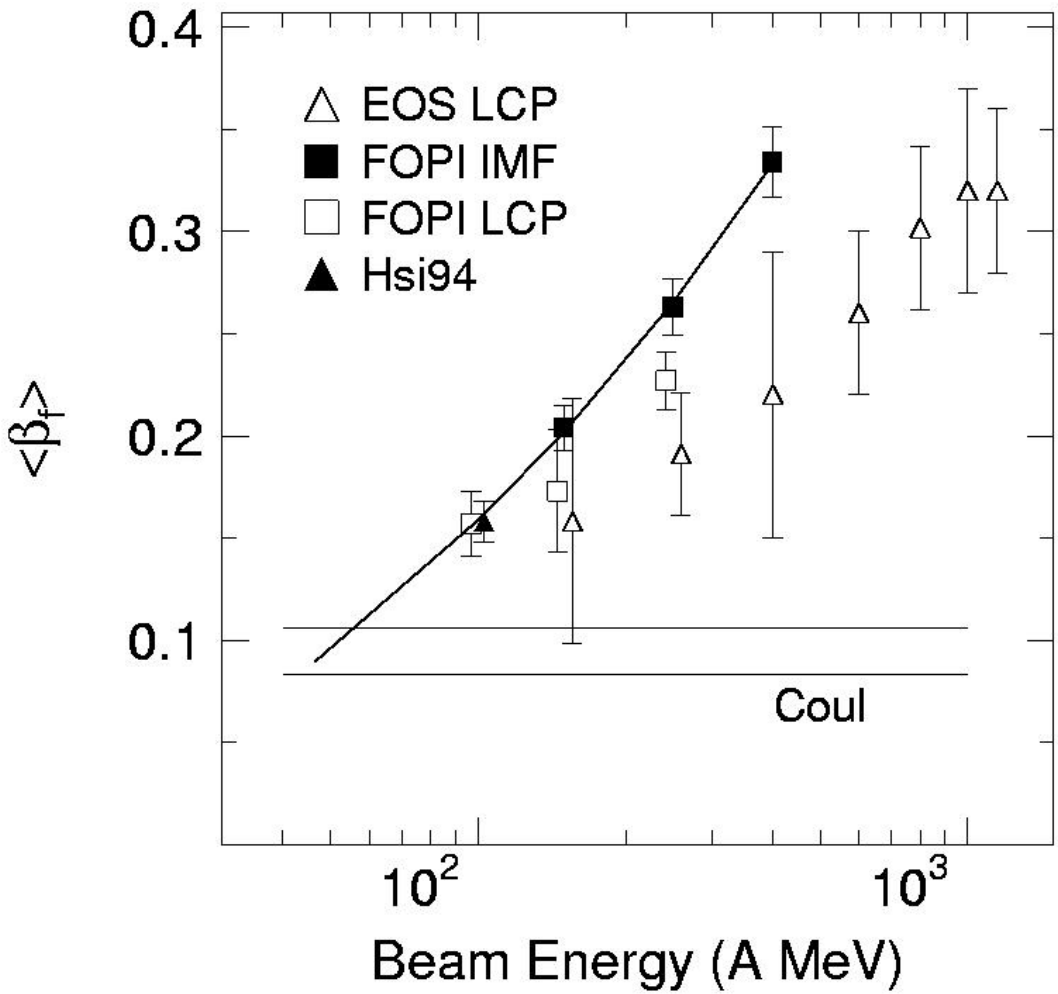
Ring 1

Pârlog parameterization



Motivation

Flow and fragmentation

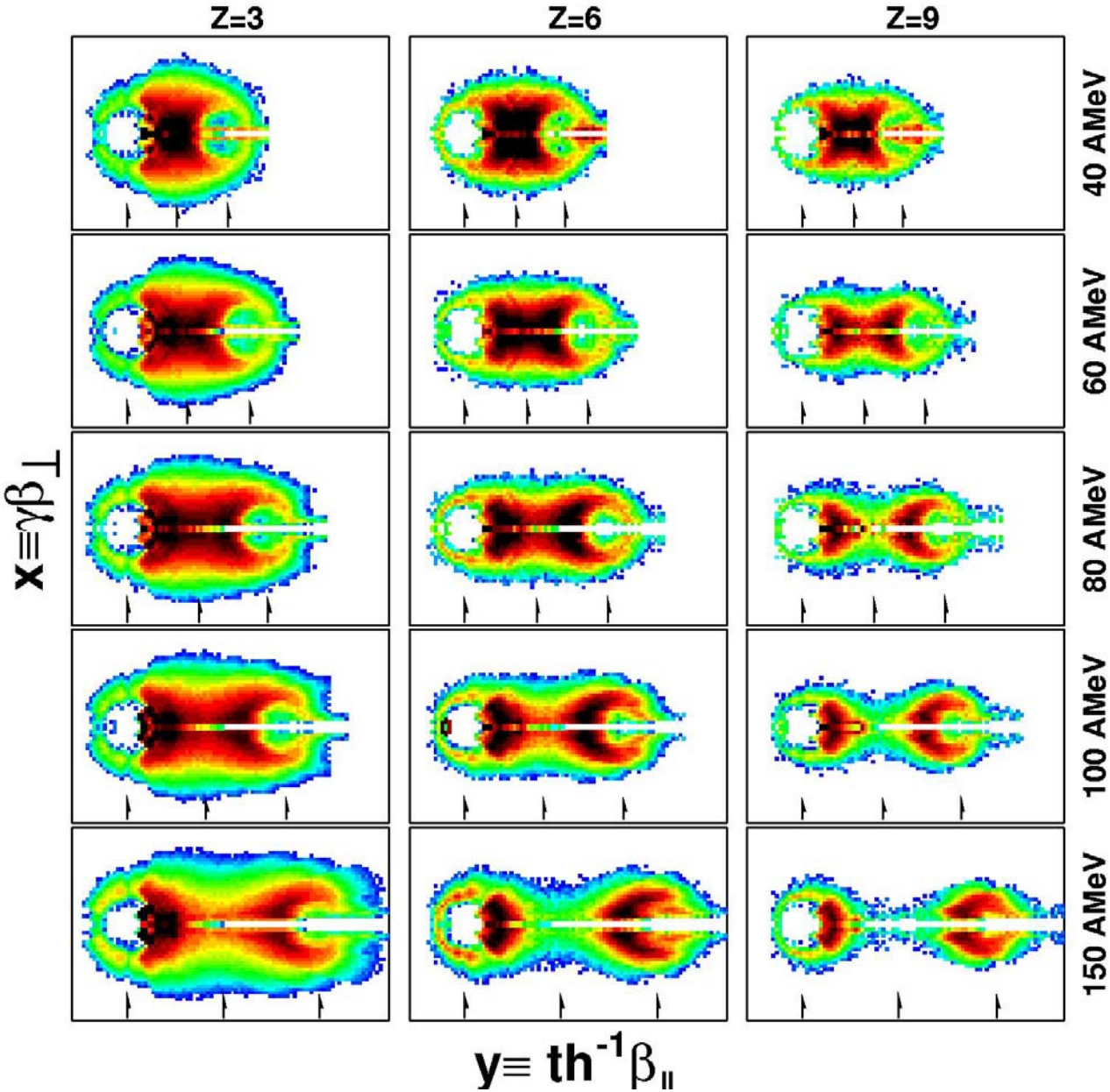


Reisdorf & Ritter,
Ann. Rev. Nucl. Part. Sci. (1997)

Motivation

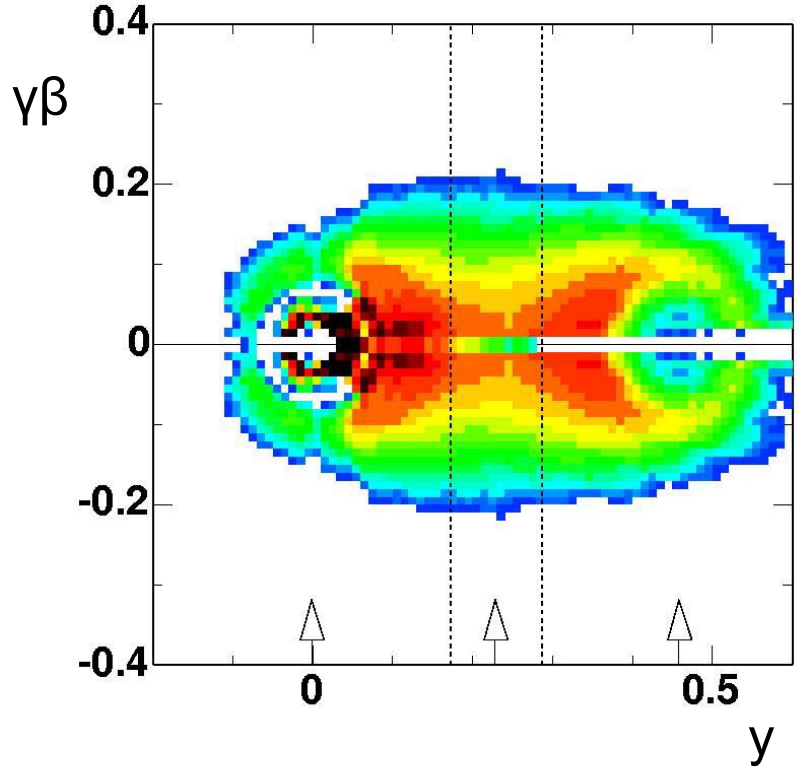
From the Fermi
to the relativistic
domain

Invariant
cross sections
for Au + Au
at peripheral
impact parameters



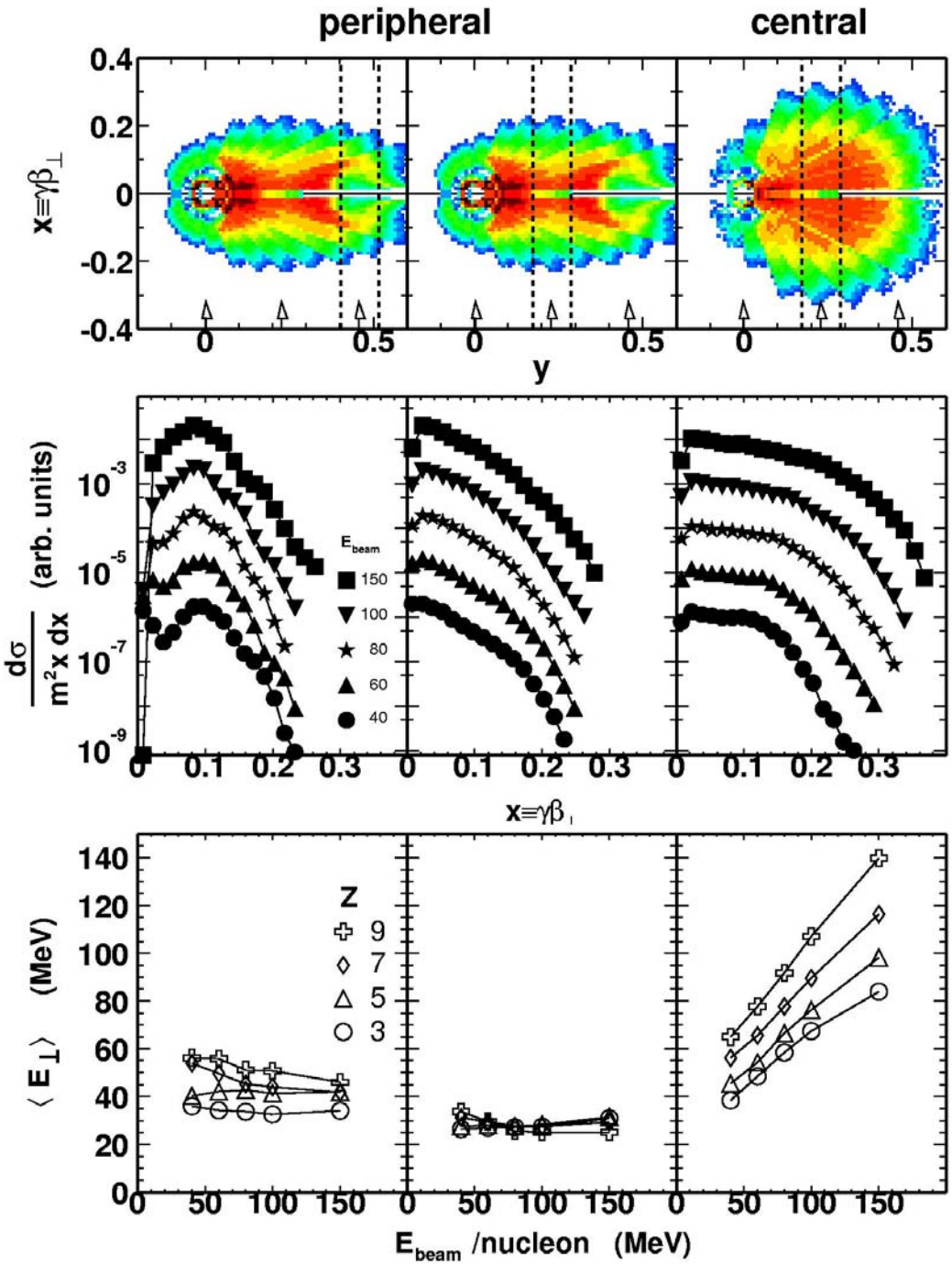
Part I:

Peripheral Au + Au



Z = 3 at 100 A MeV

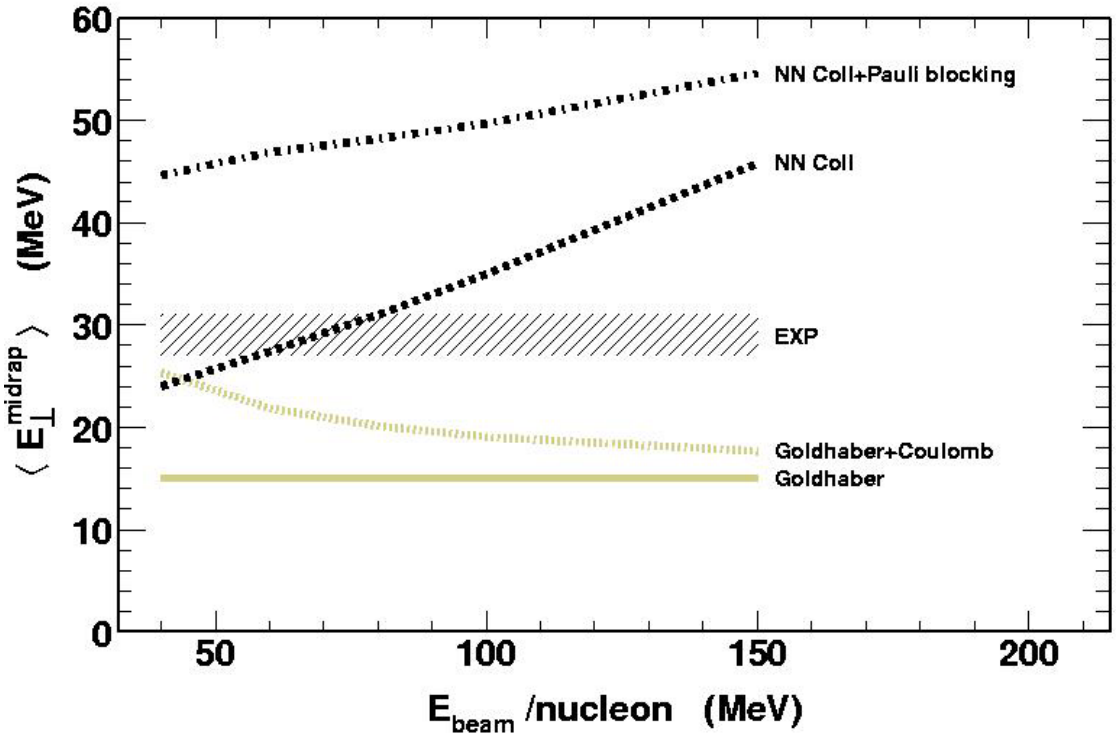
Transverse velocity spectra



J. Łukasik et al., Phys. Rev. C 66, 064606 (2002)

Contributions to transverse energies

at midrapidity



N-N scattering is too much

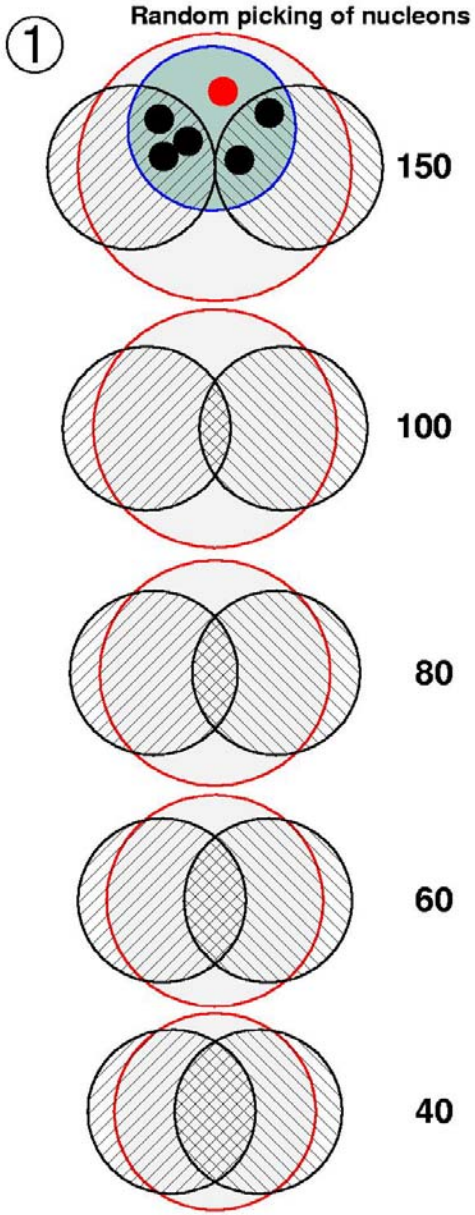
Fermi motion is not enough

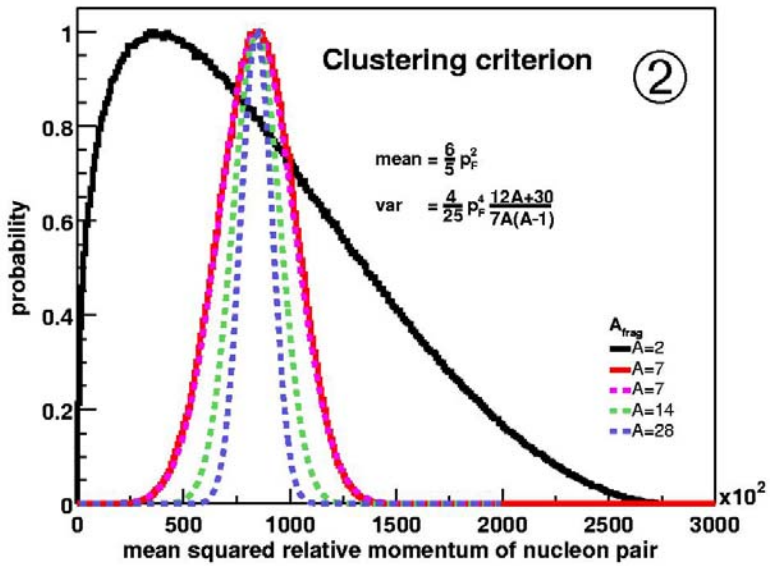
Compensation due to Coulomb

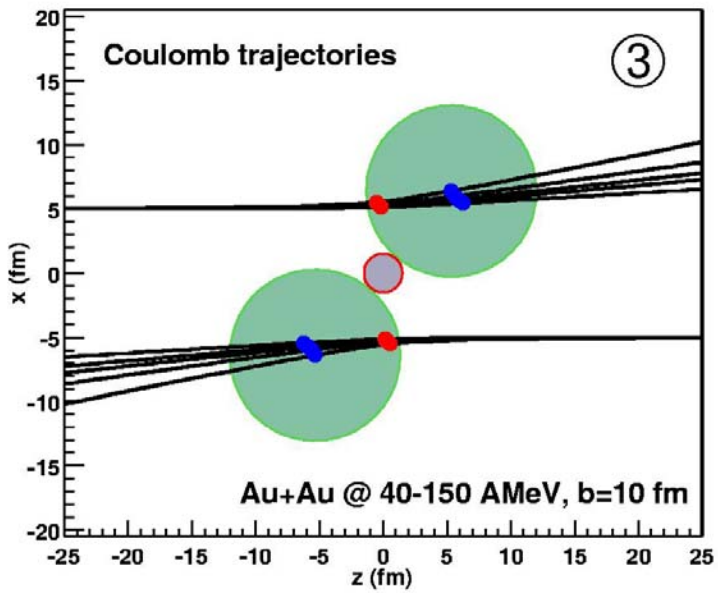
Extended Goldhaber model

in 3 steps

J. Łukasik et al., Phys. Lett. B 566 (2003) 76

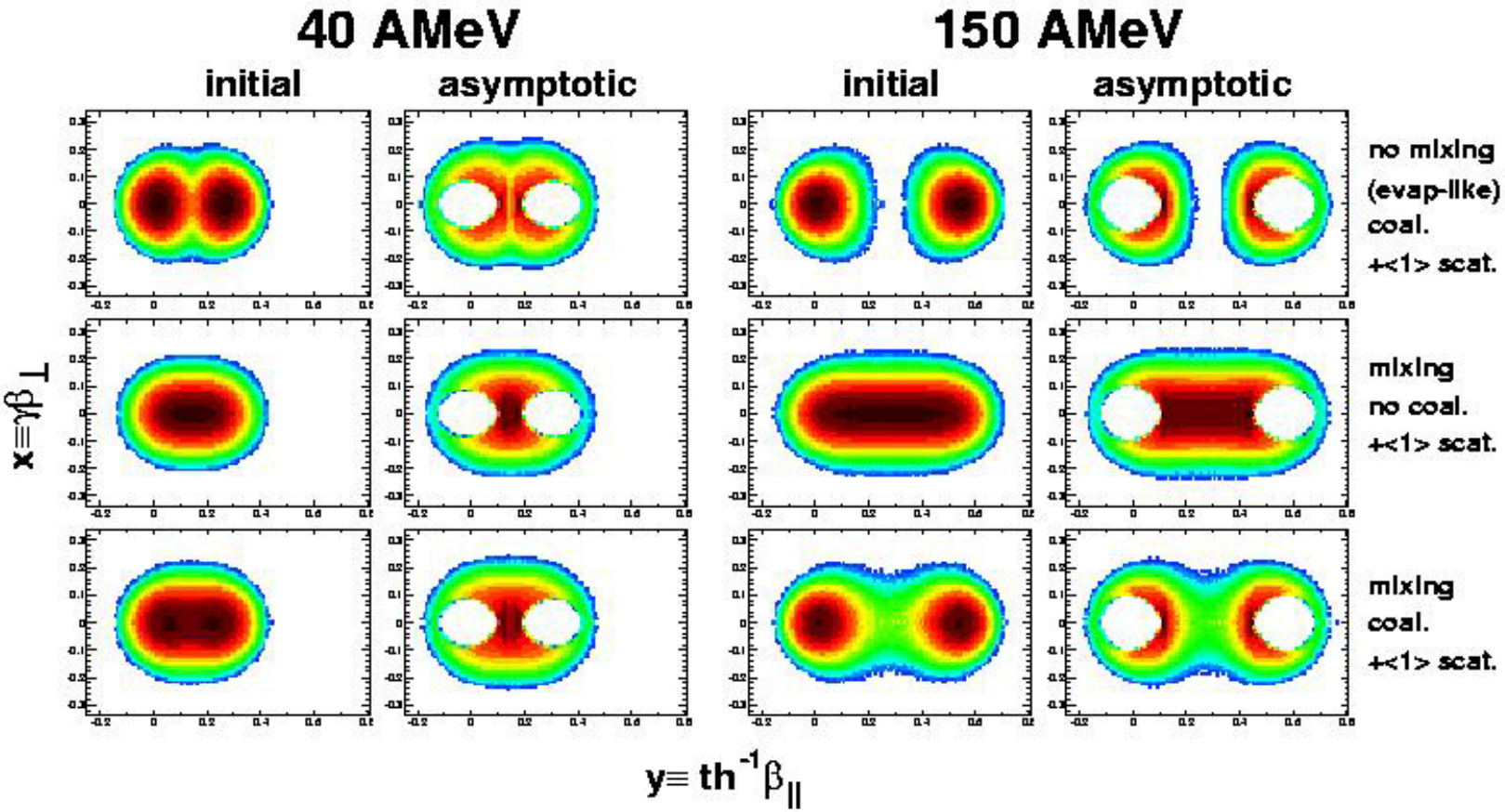




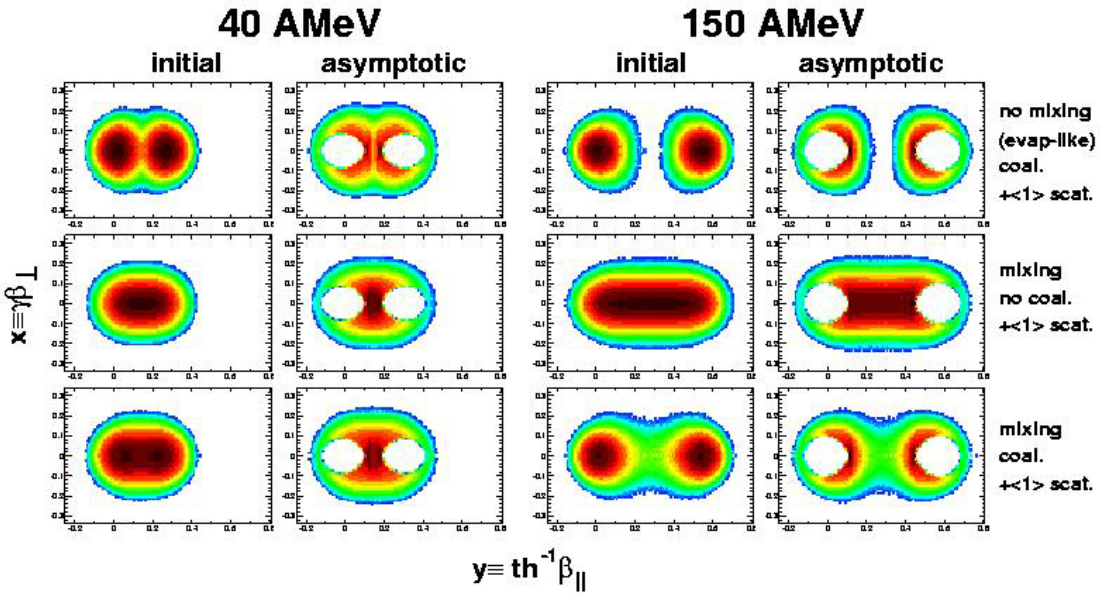


Model results

^{7}Li

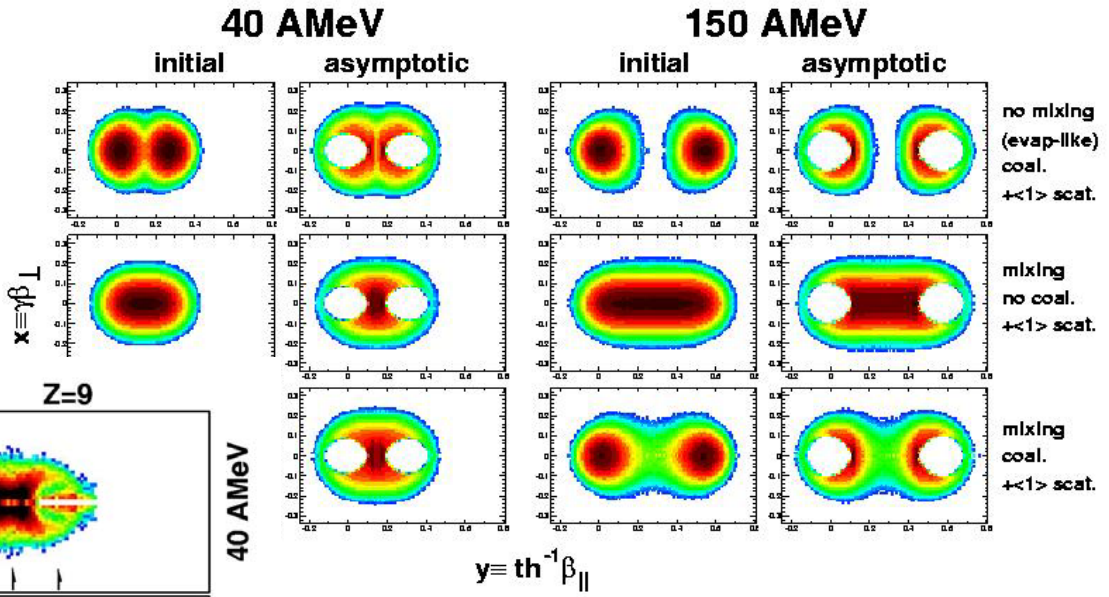


Comparison

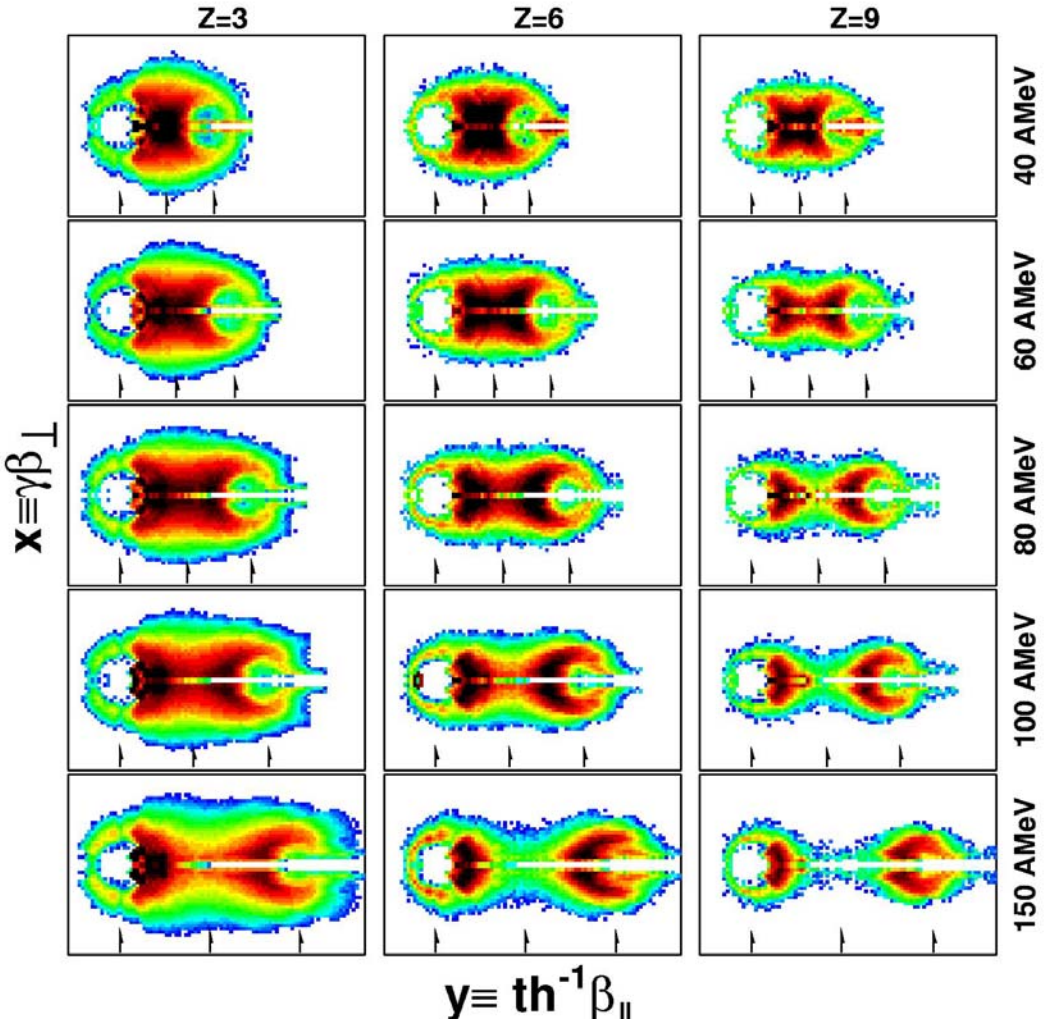


model

Comparison



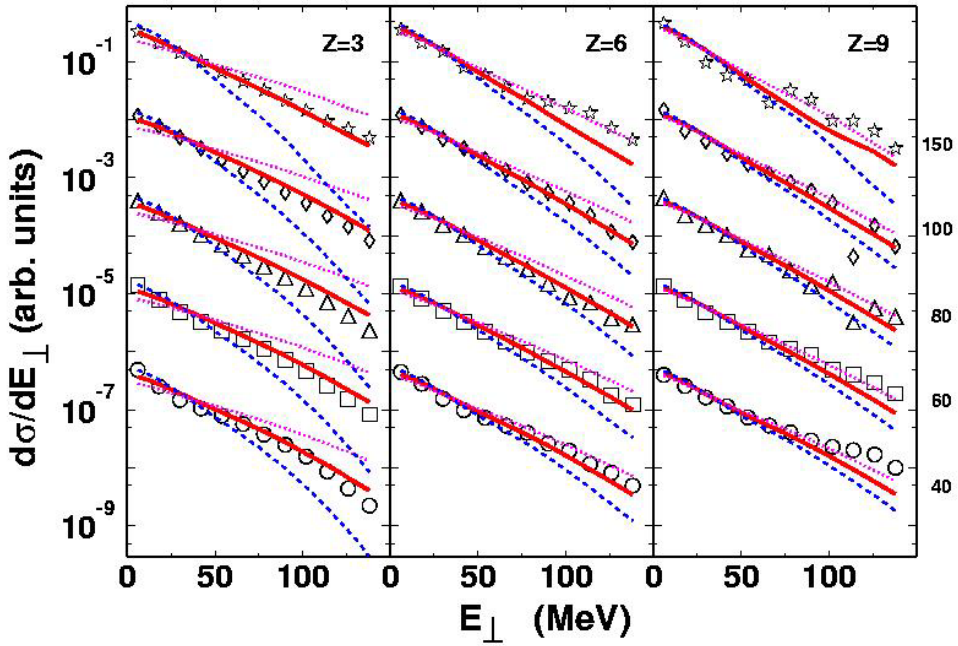
model



data

Quantitative description of data

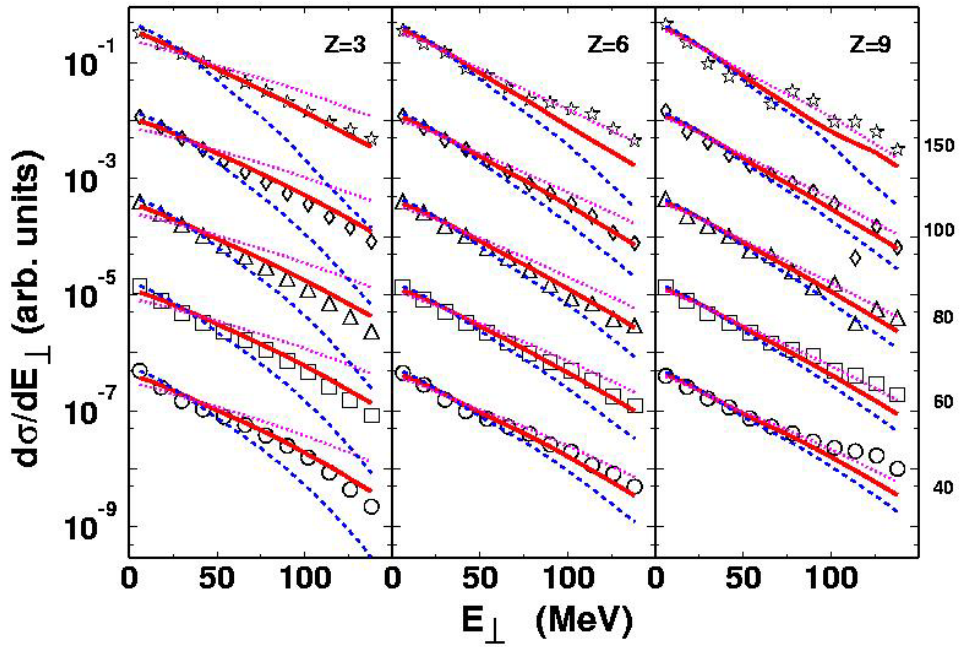
Transverse energy spectra



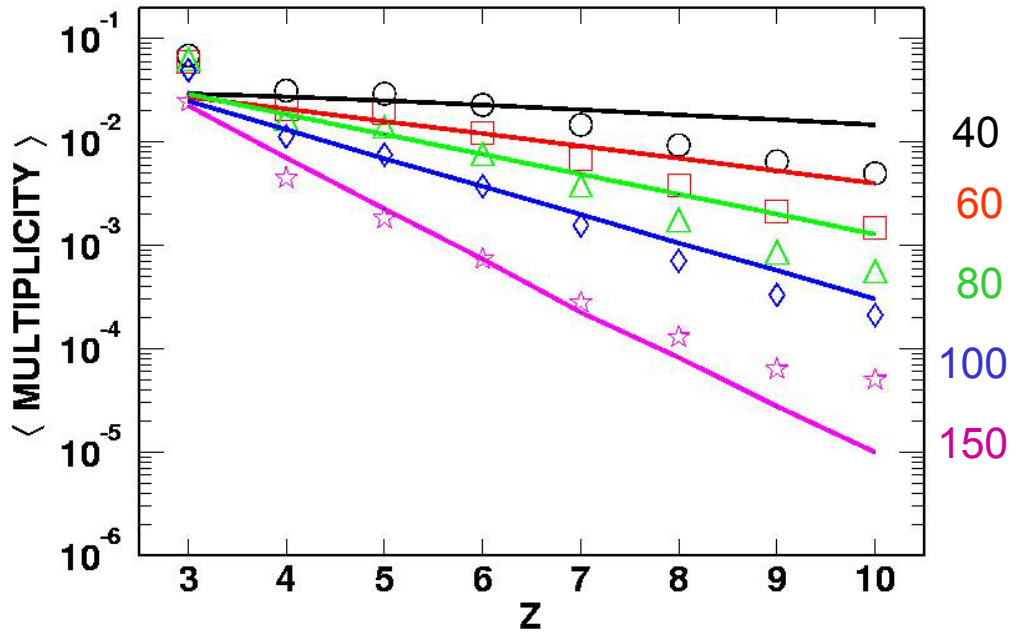
2 hard scattered
1 nucleons
0

Quantitative description of data

Transverse energy spectra



Atomic number Z spectra



Conclusions/Questions Part I

1) Dynamical processes at mid-rapidity !

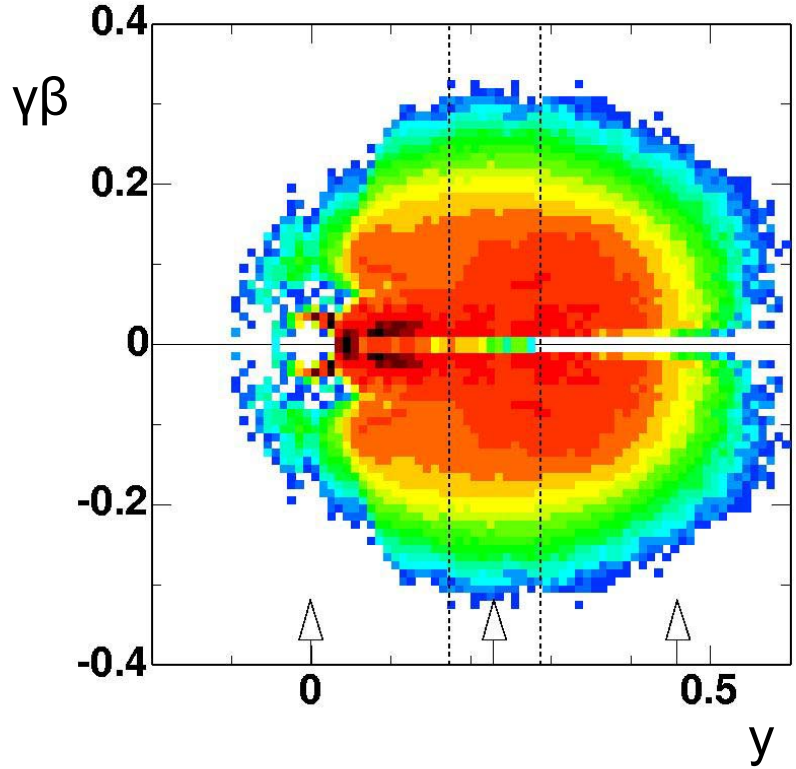
2) Clustering/coalescence seems to be a very general principle !

3) Successful modeling with advanced transport codes !

4) Identification of equilibrated target/projectile residues ?

Part II:

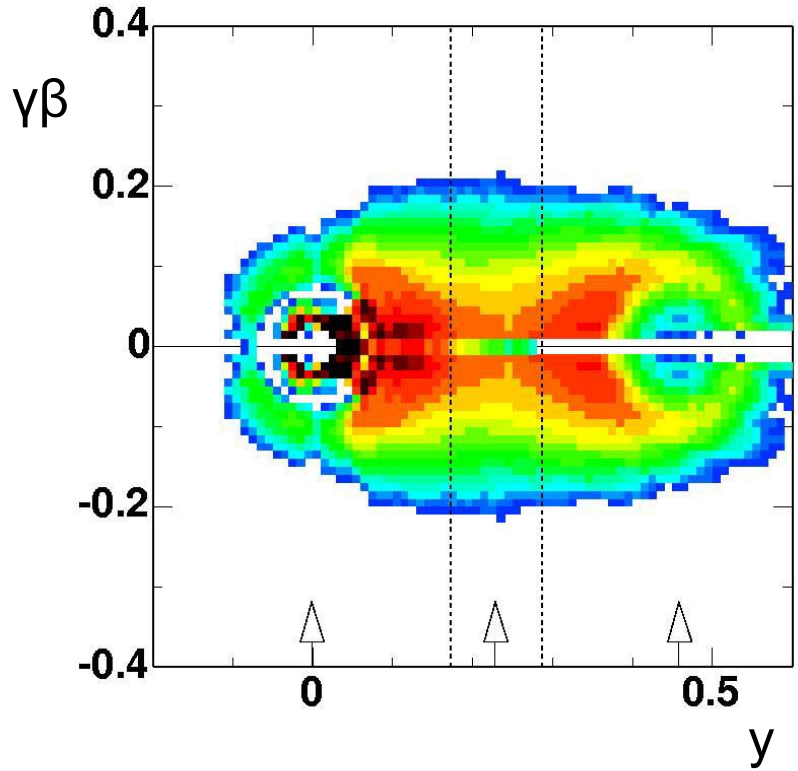
Central Au + Au



Z = 3 at 100 A MeV

Part II:

Central Au + Au

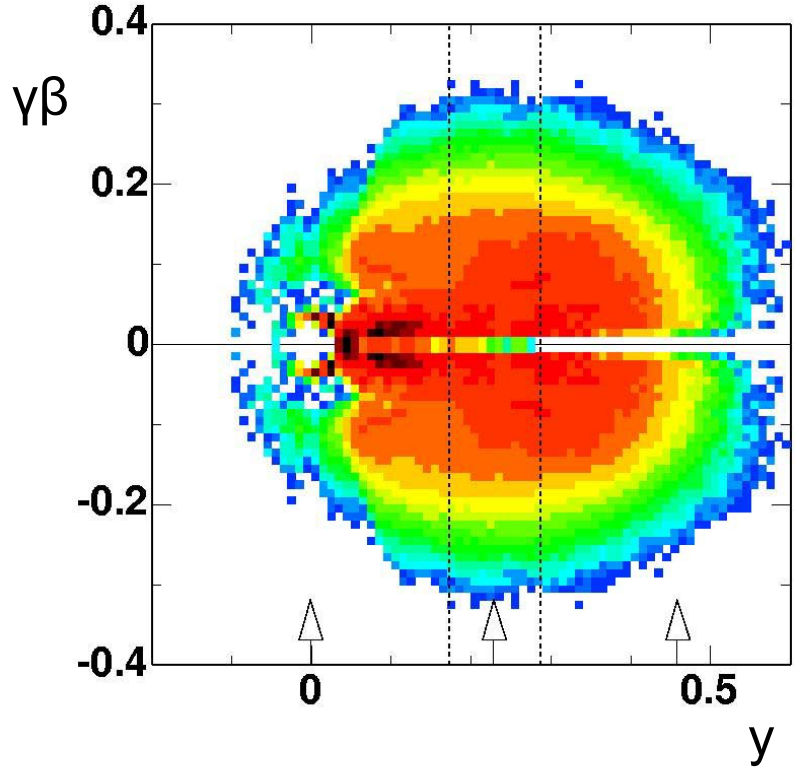


Z = 3 at 100 A MeV

peripheral

Part II:

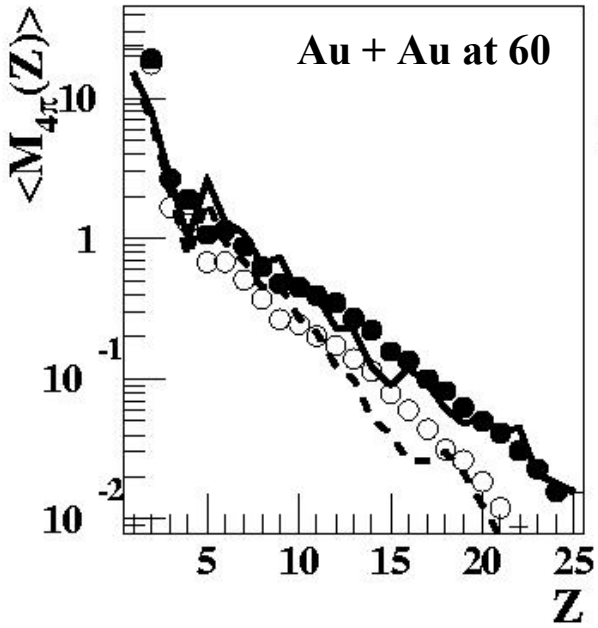
Central Au + Au

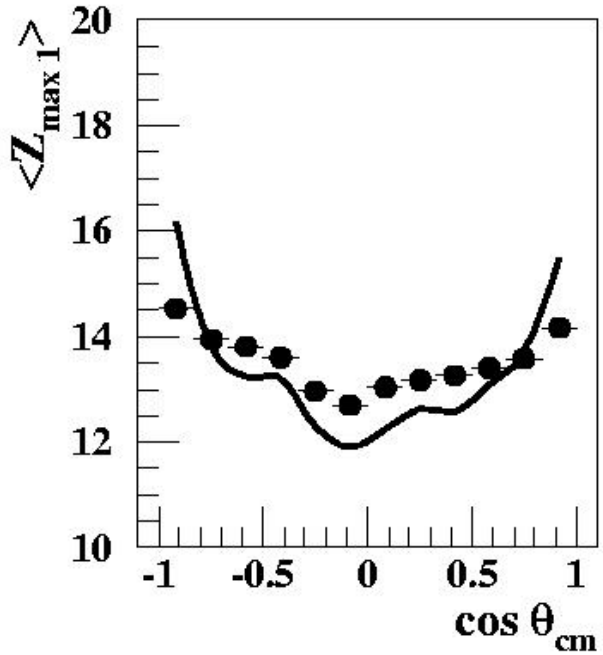


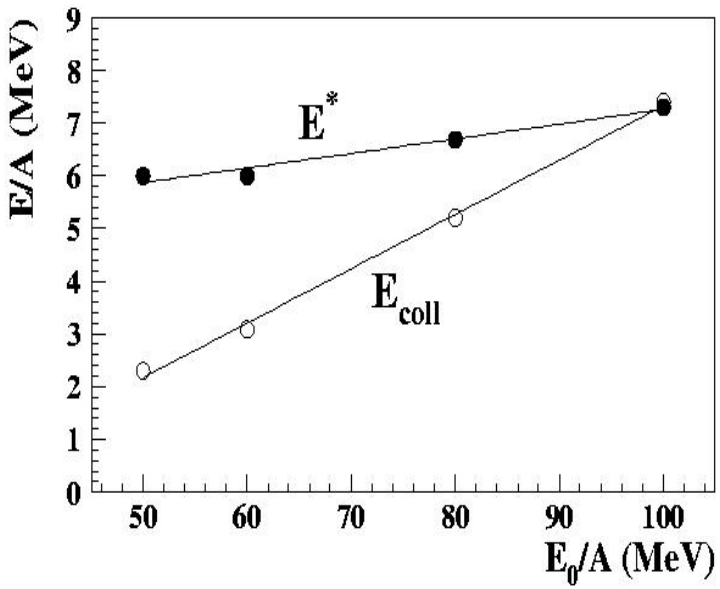
Z = 3 at 100 A MeV

central

Flow and fragmentation







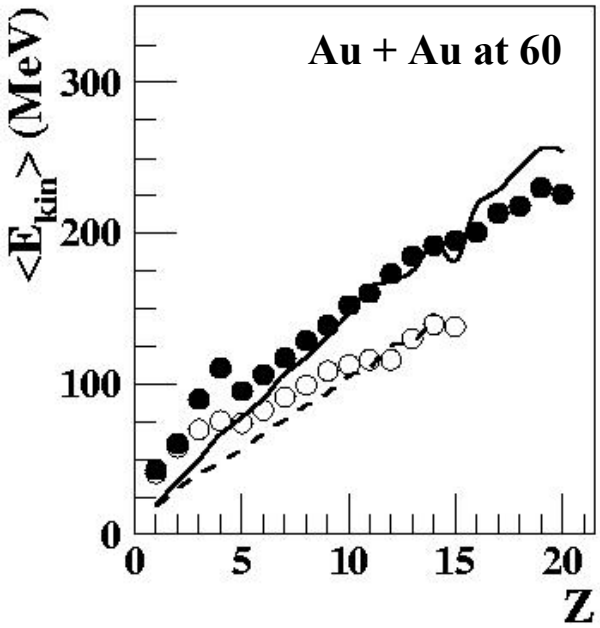
● longitudinal

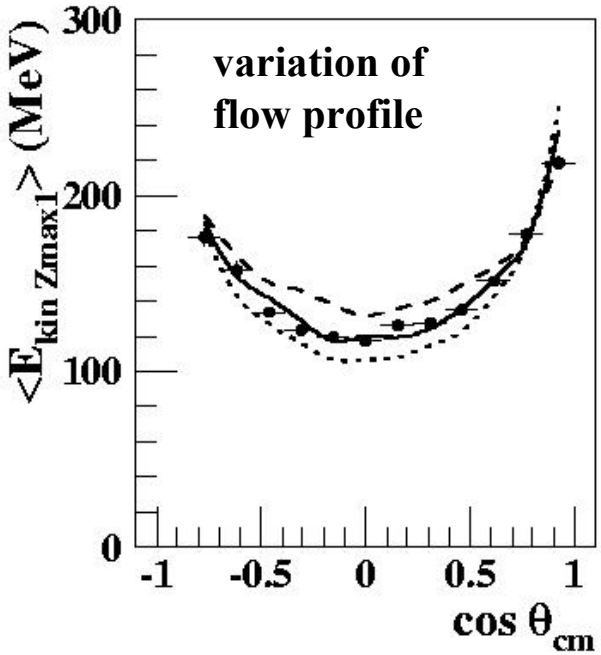
○ transverse

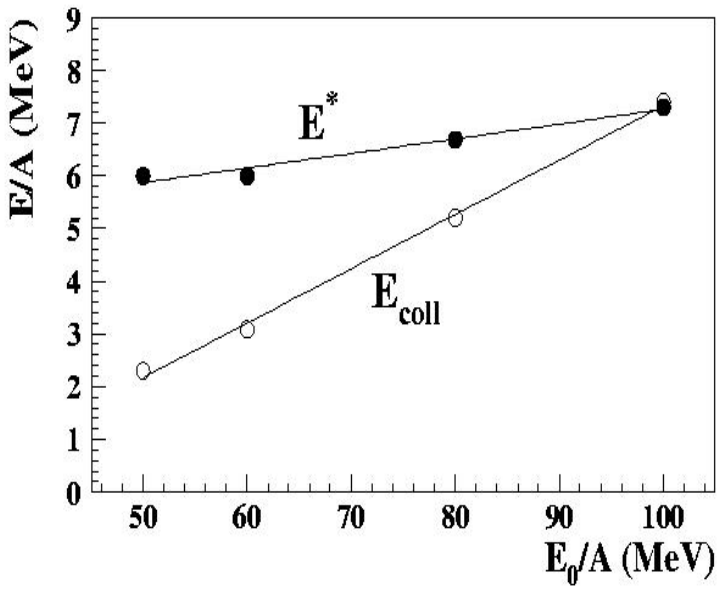
from MMMC model description with deformed source (0.7:1) and with decoupled radial flow

A. Le Fèvre et al., nucl-ex/0309016

Flow and fragmentation







● longitudinal

○ transverse

from MMMC model description
with deformed source (0.7:1)
and with decoupled radial flow

A. Le Fèvre et al., nucl-ex/0309016

Questions

1) Why does the SMM or MMMC work so well in a dynamical situation ?

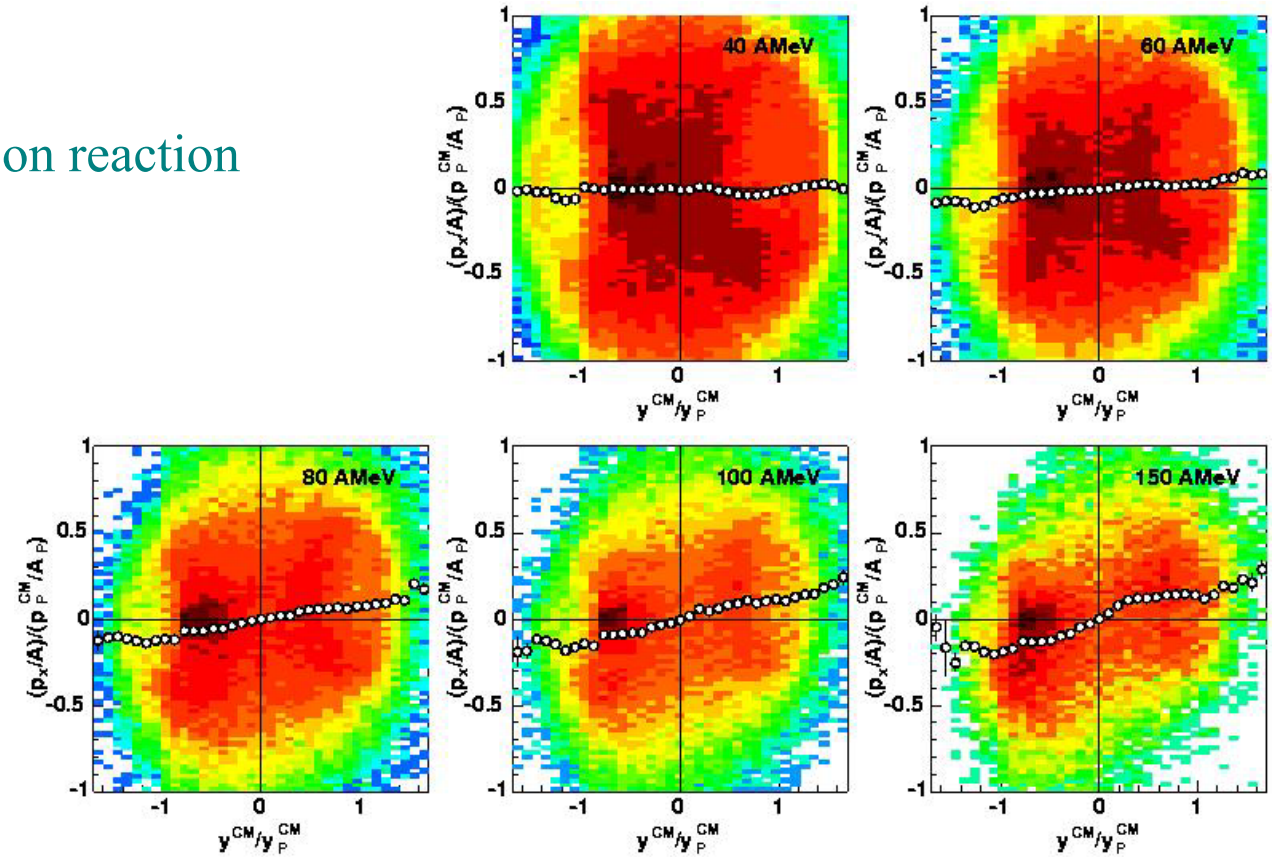
2) Deformation as a dynamical constraint ?

3) Nature of the collective motion ?

work in progress
J. Łukasik et al.

Directed flow

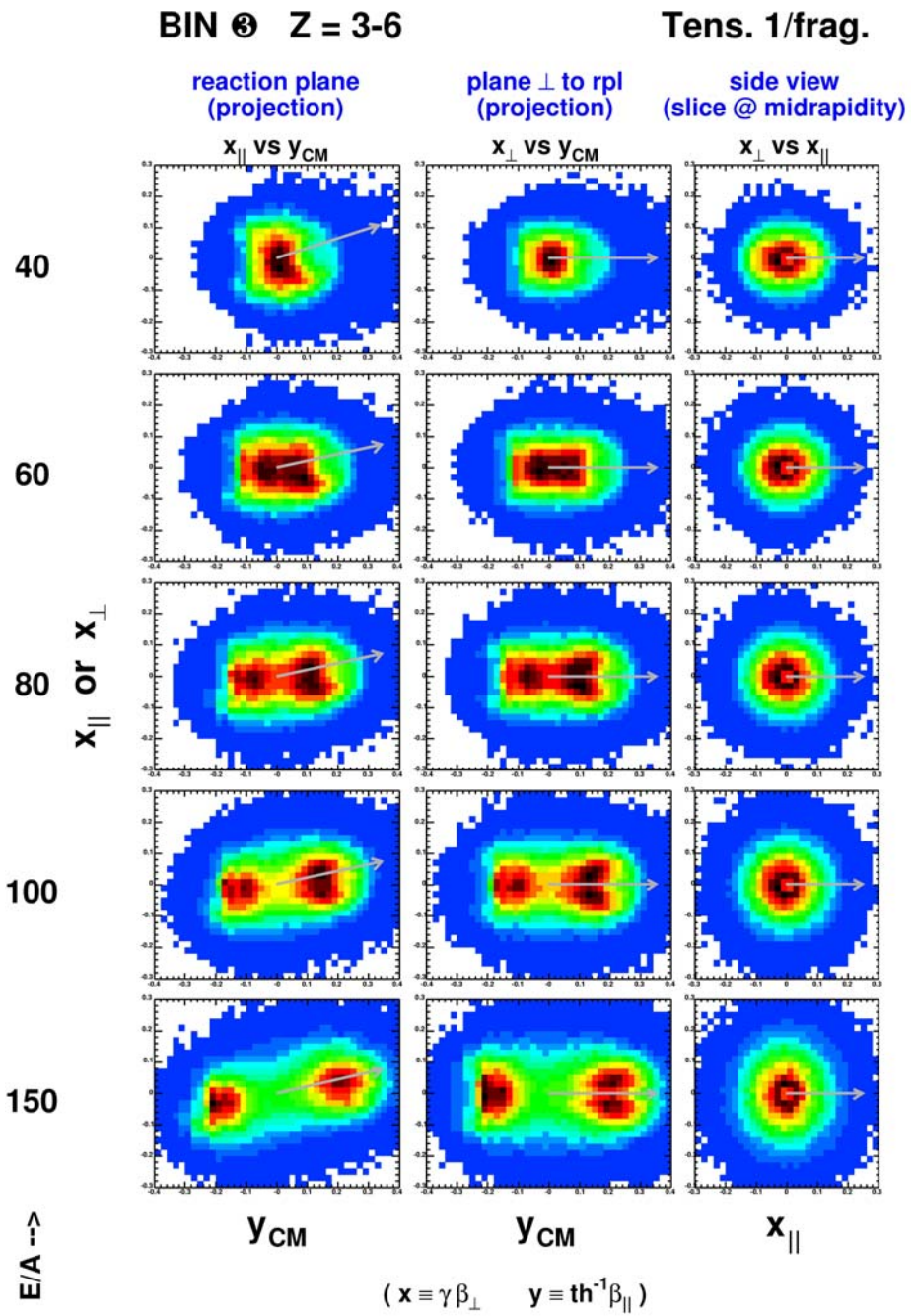
projections on reaction plane



Au + Au, Z = 2, midcentral, scaled variables

Various slices

elliptic flow



Squeeze-out

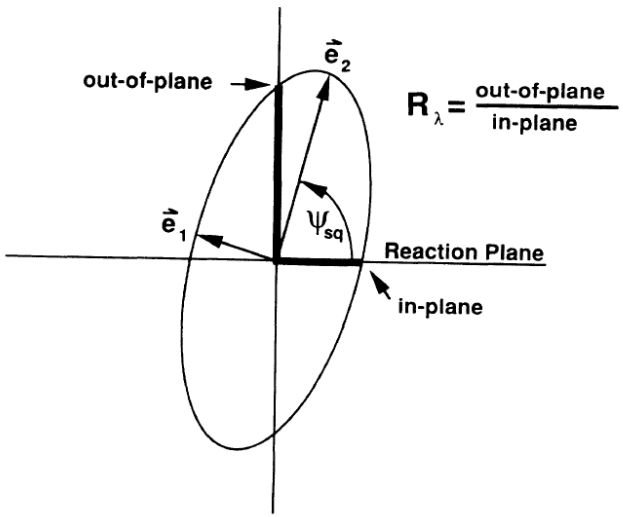
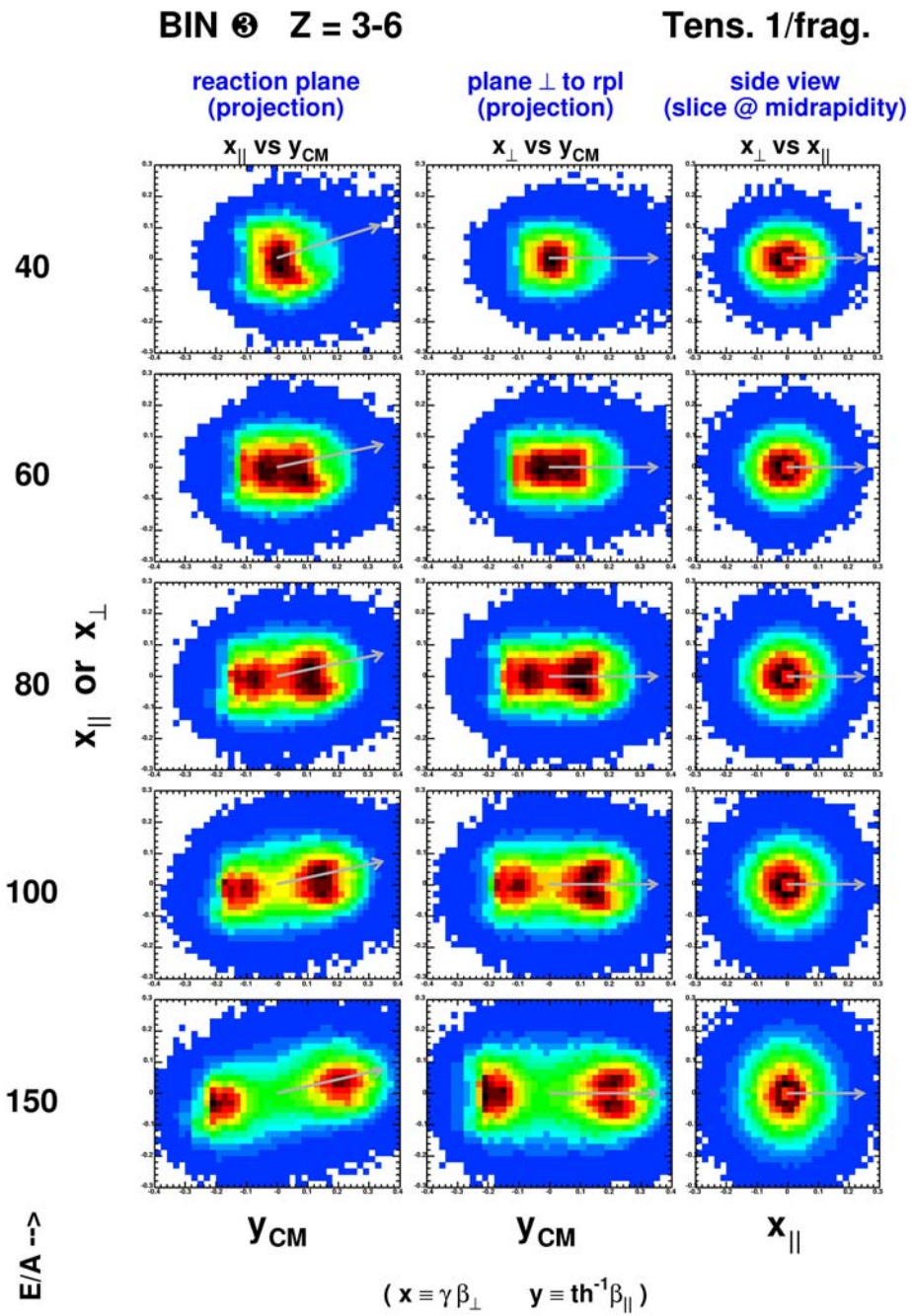


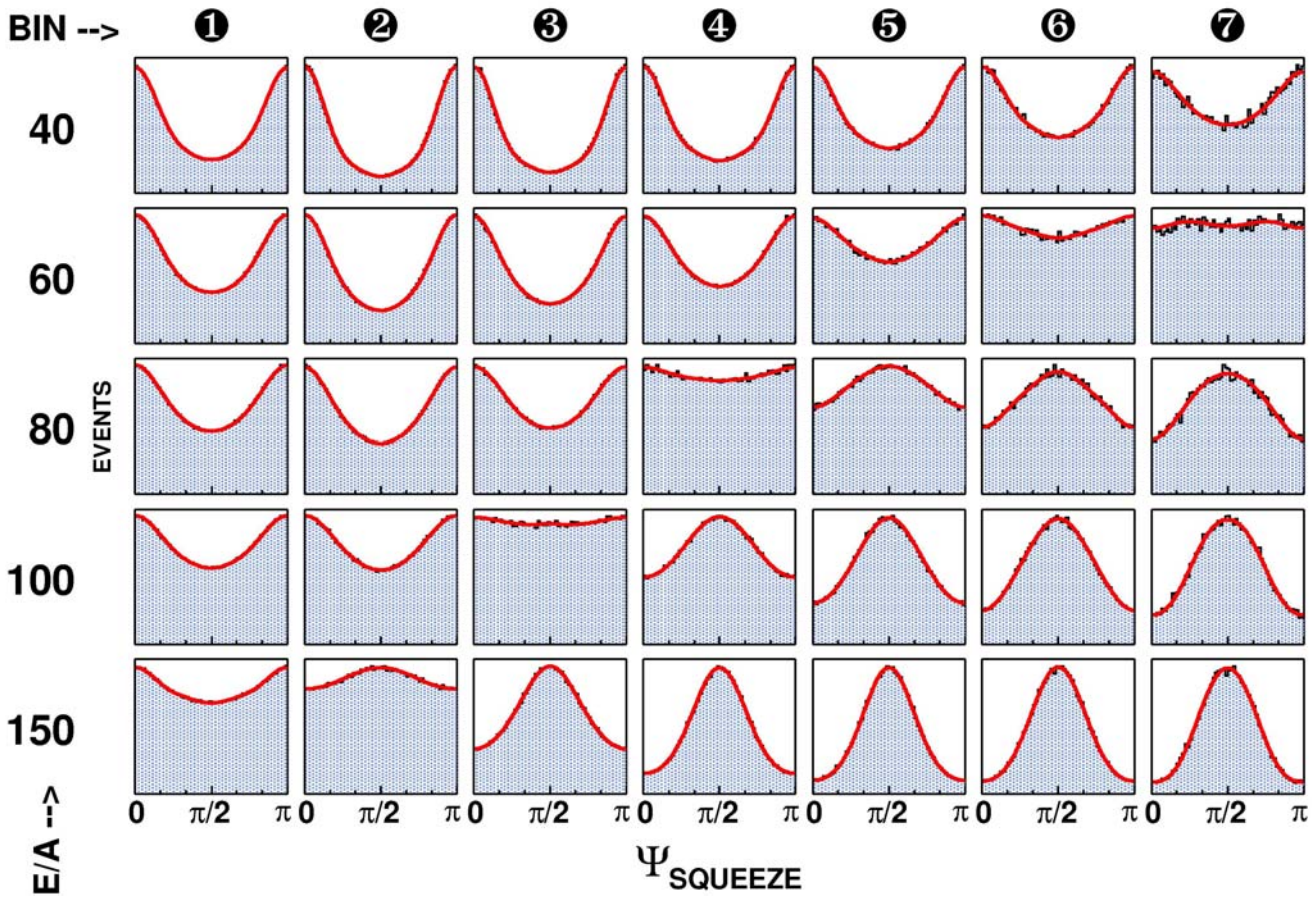
FIG. 5. The plane perpendicular to the flow axis through the origin, showing how R_λ is calculated from the two smaller eigenvalues and the reaction plane.

H.H. Gutbrod et al. PRC 42(1990)



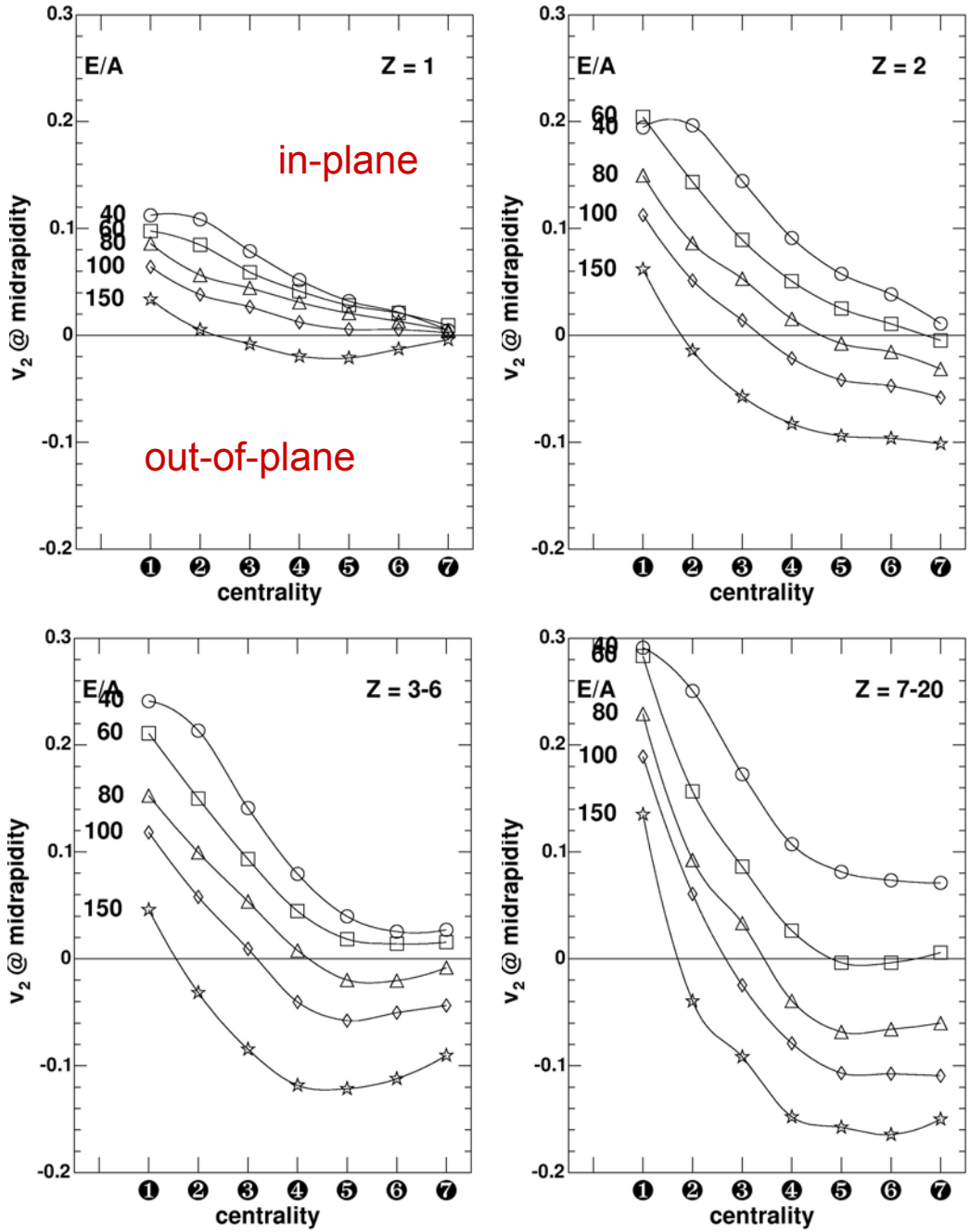
Squeeze-out: Ψ distributions

$Z = 2$



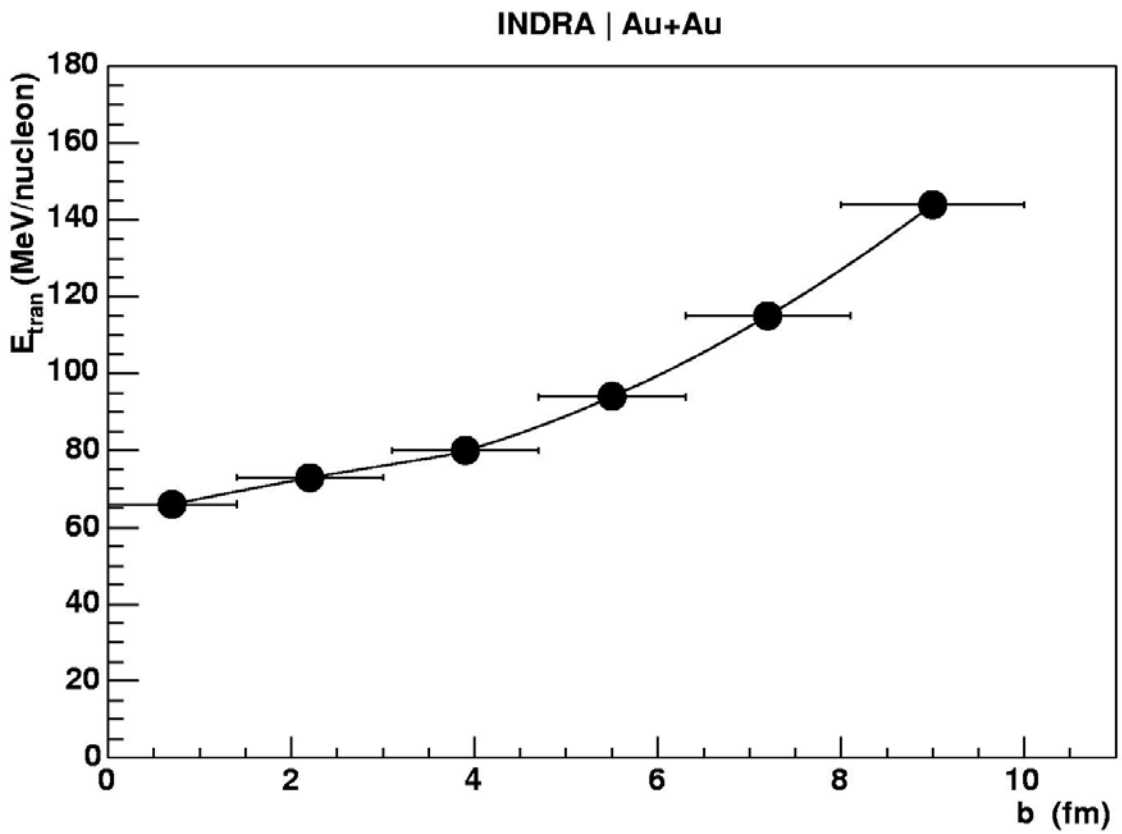
Squeeze-out

$v_2 = \langle \cos 2\Psi \rangle$



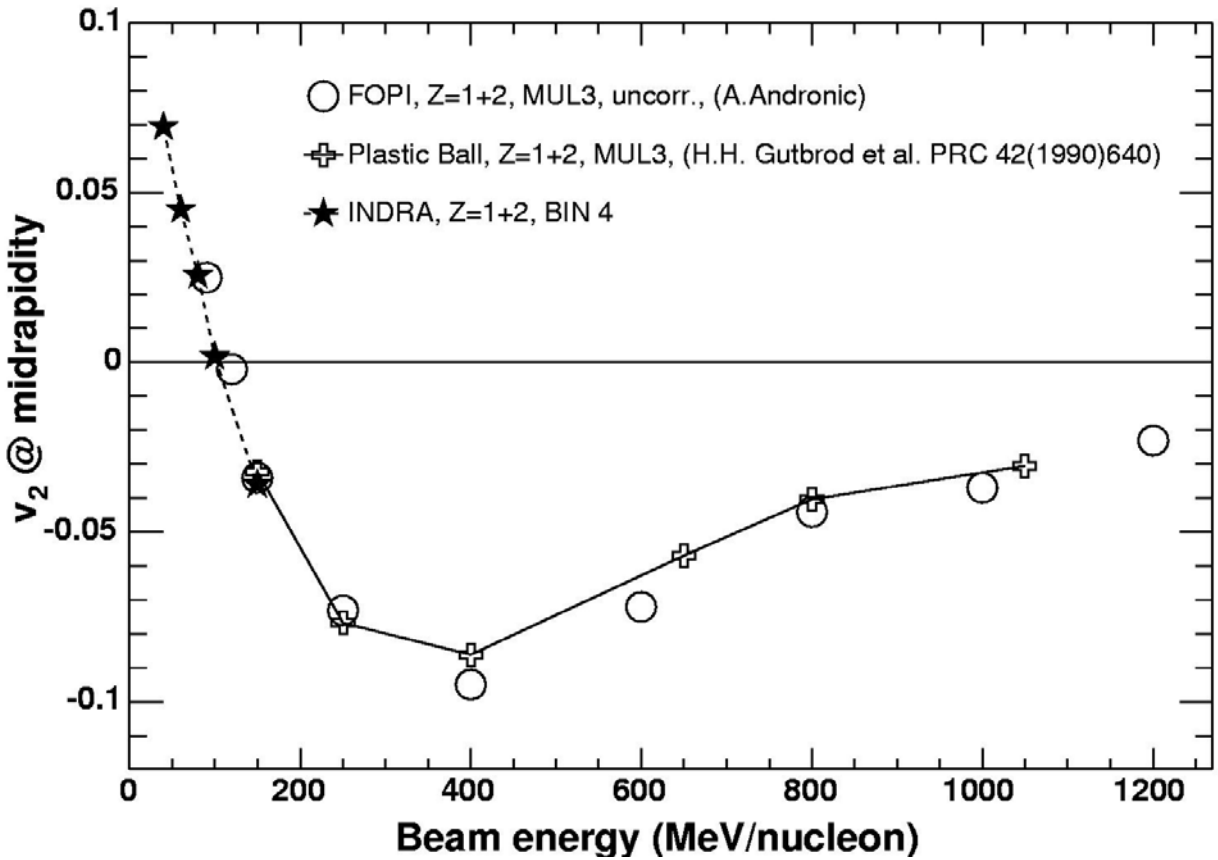
Squeeze-out balance

Z = 2



Squeeze-out: excitation function

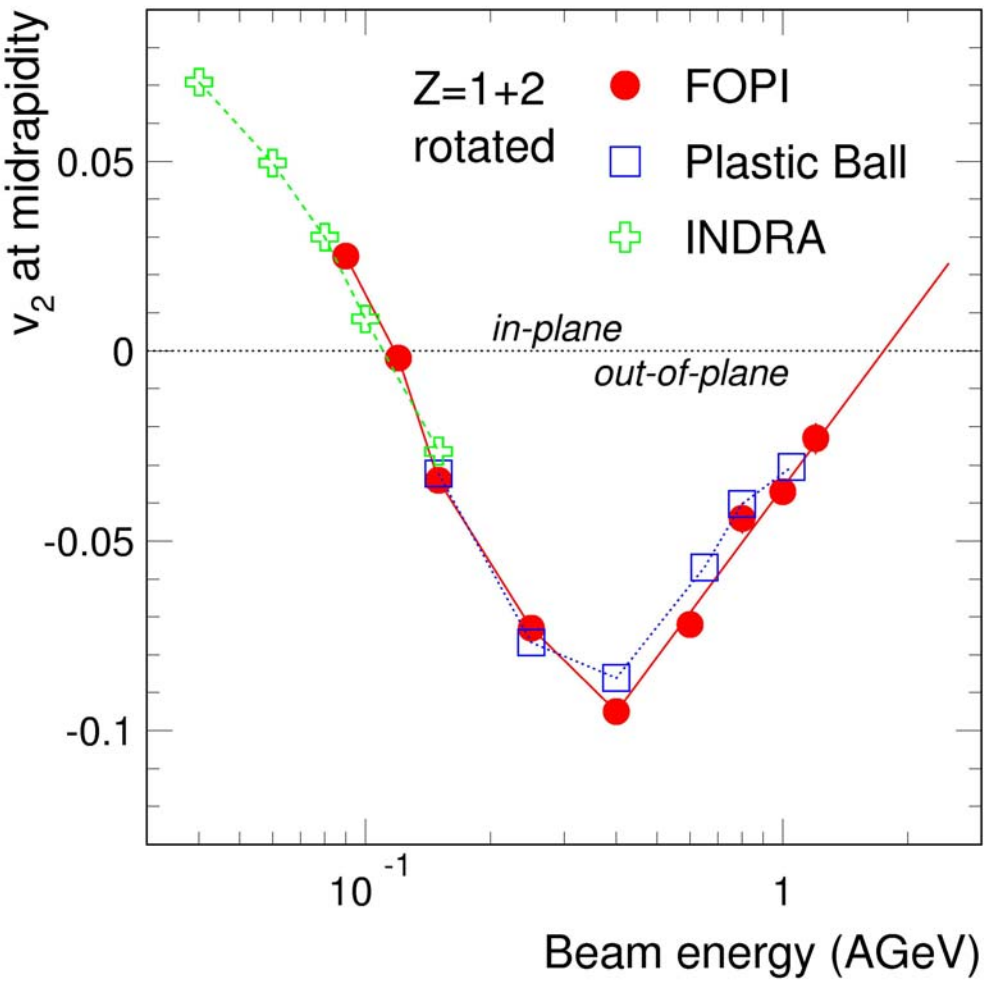
Z = 1,2
mid-central



A. Andronic

Squeeze-out

from
intermediate
to
relativistic energies



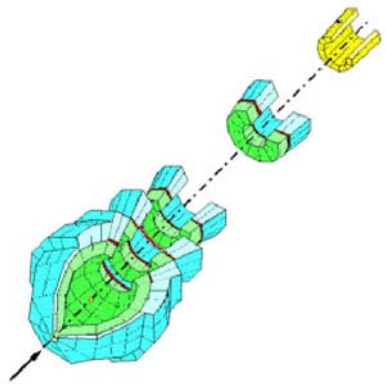
Summary

1) Peripheral:
Good description with extended Goldhaber model (clustering criterion!).

2) Central:
Good description with deformed statistical source and decoupled radial flow; directed and elliptic flow in progress.

3) New results also for Xe + Sn and C + Au.

the end



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