Experiment1: stopping/flow

Main goals:

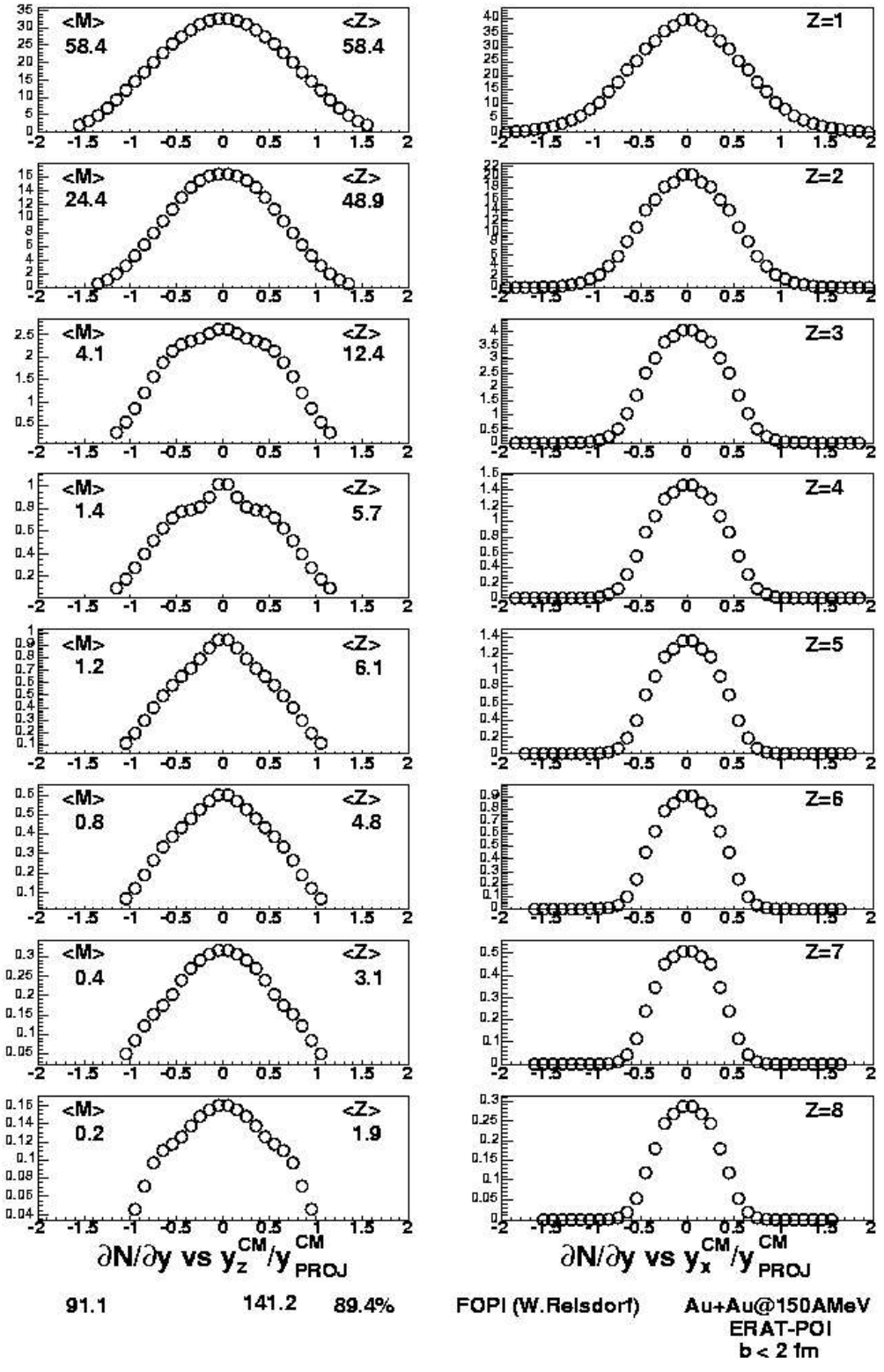
- bridge different experiments and get some “hard” numbers (is it at all possible..?)
- construct various “universal” systematics (excitation functions)

Au+Au

- Multics-Miniball Au+Au 35 AMeV
- MSU Au+Au 25-60 AMeV
- INDRA-ALADIN Au+Au 40-150 AMeV
- FOPI Au+Au 90-1500 AMeV
- MSU-ALADIN Au+Au 100-400 AMeV
- Plastic-Ball Au+Au 150-1050 AMeV

- vartl (stopping)
- v_2 (elliptic flow)
- v_1 (directed flow)

Rapidity distributions and vartl $\equiv \langle y_x^2 \rangle / \langle y_z^2 \rangle$ (stopping)

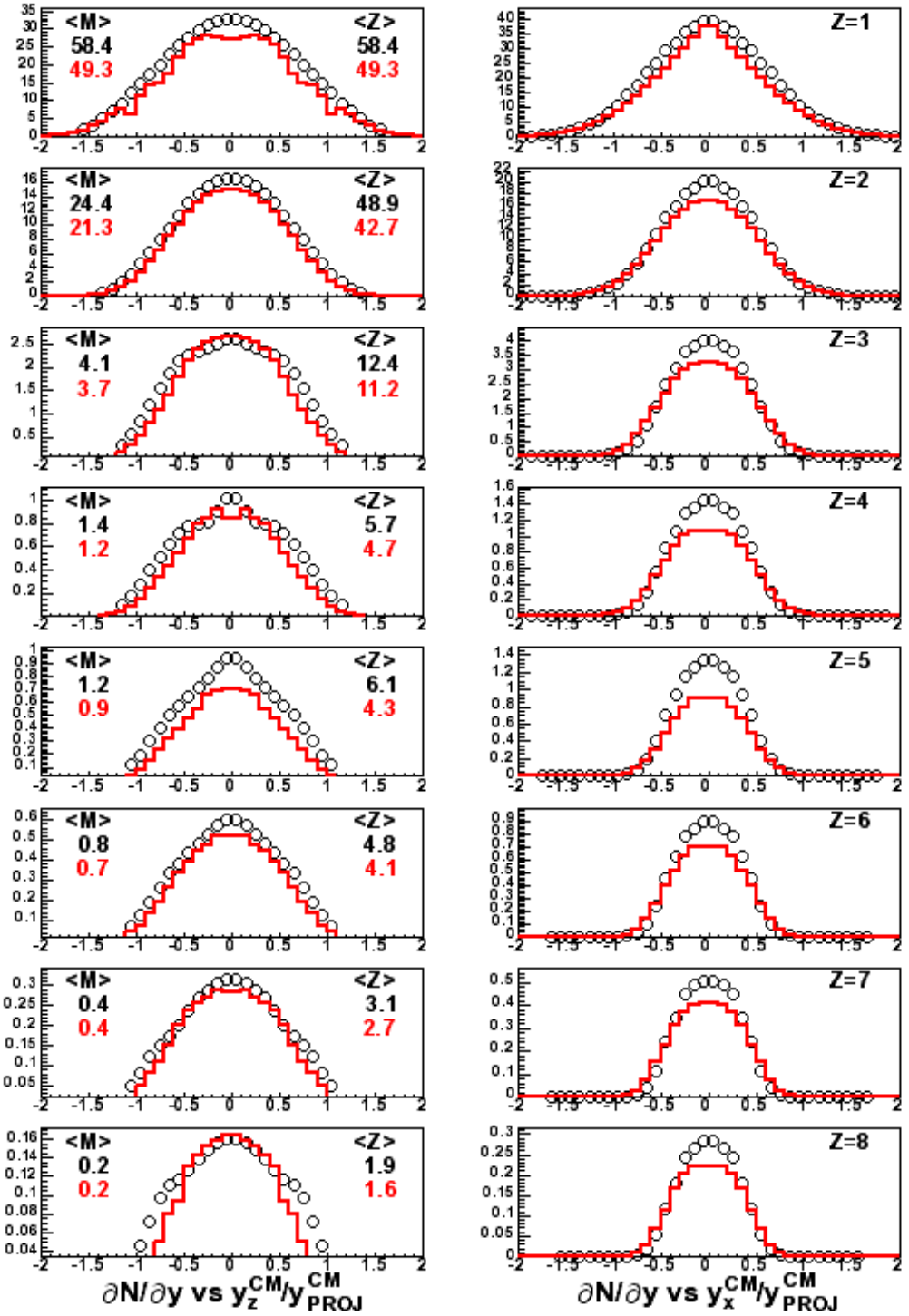


Scaled rapidity density

FOPI
150 AMeV
b<2fm

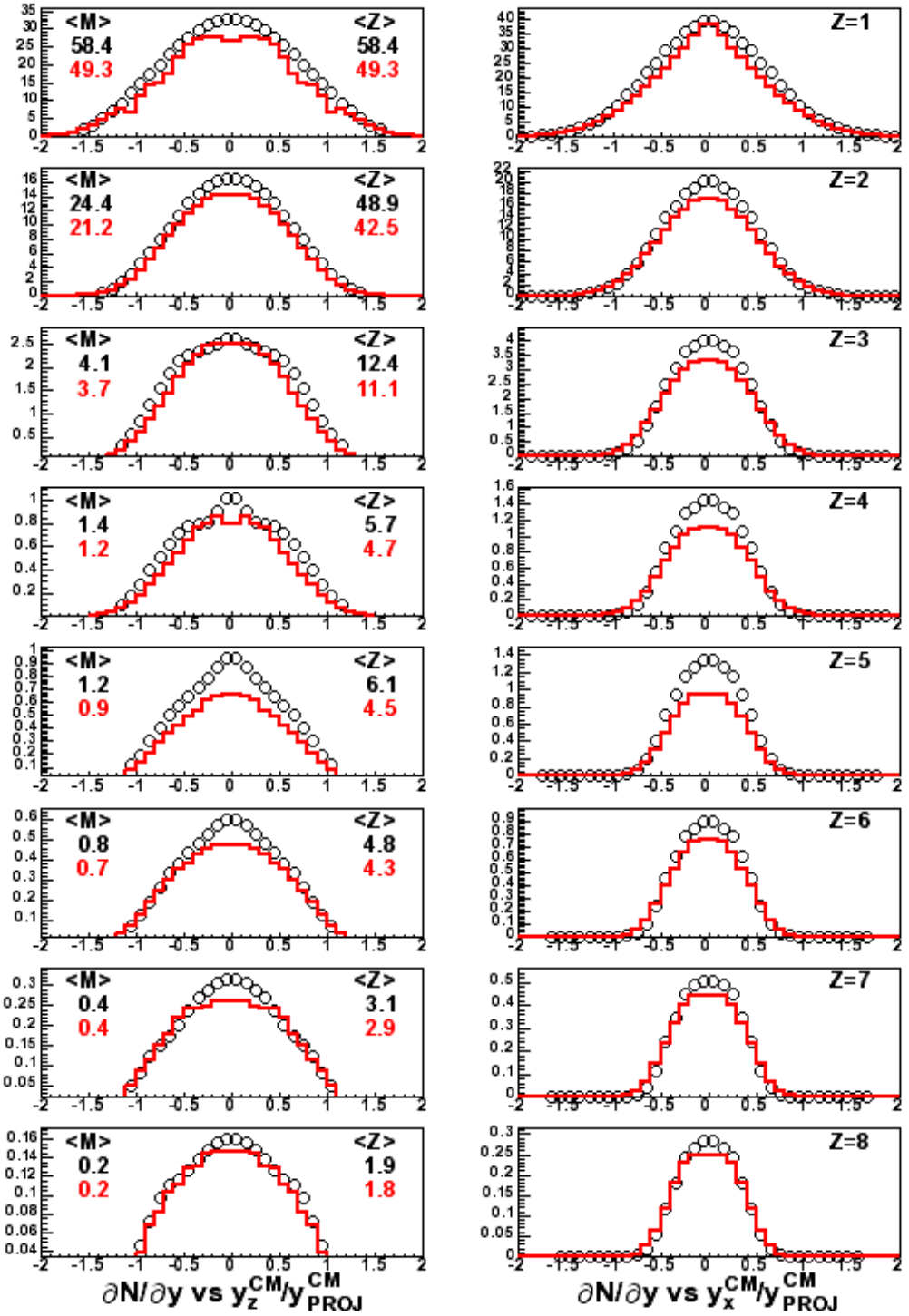
rapidity →

← transverse rapidity



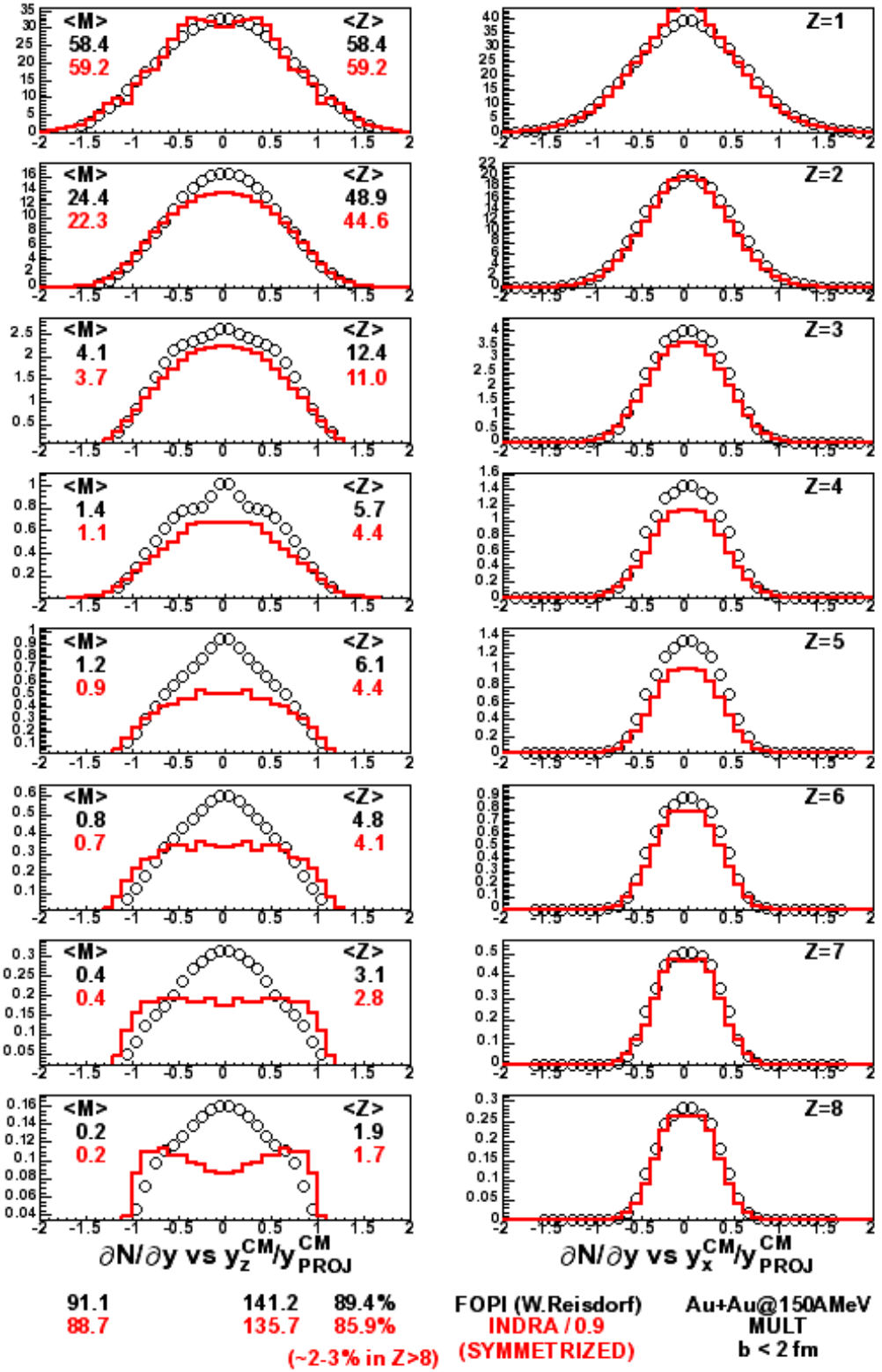
INDRA
symmetrized
b<2 fm
Erat-POI

FOPI
b<2 fm
Erat-POI



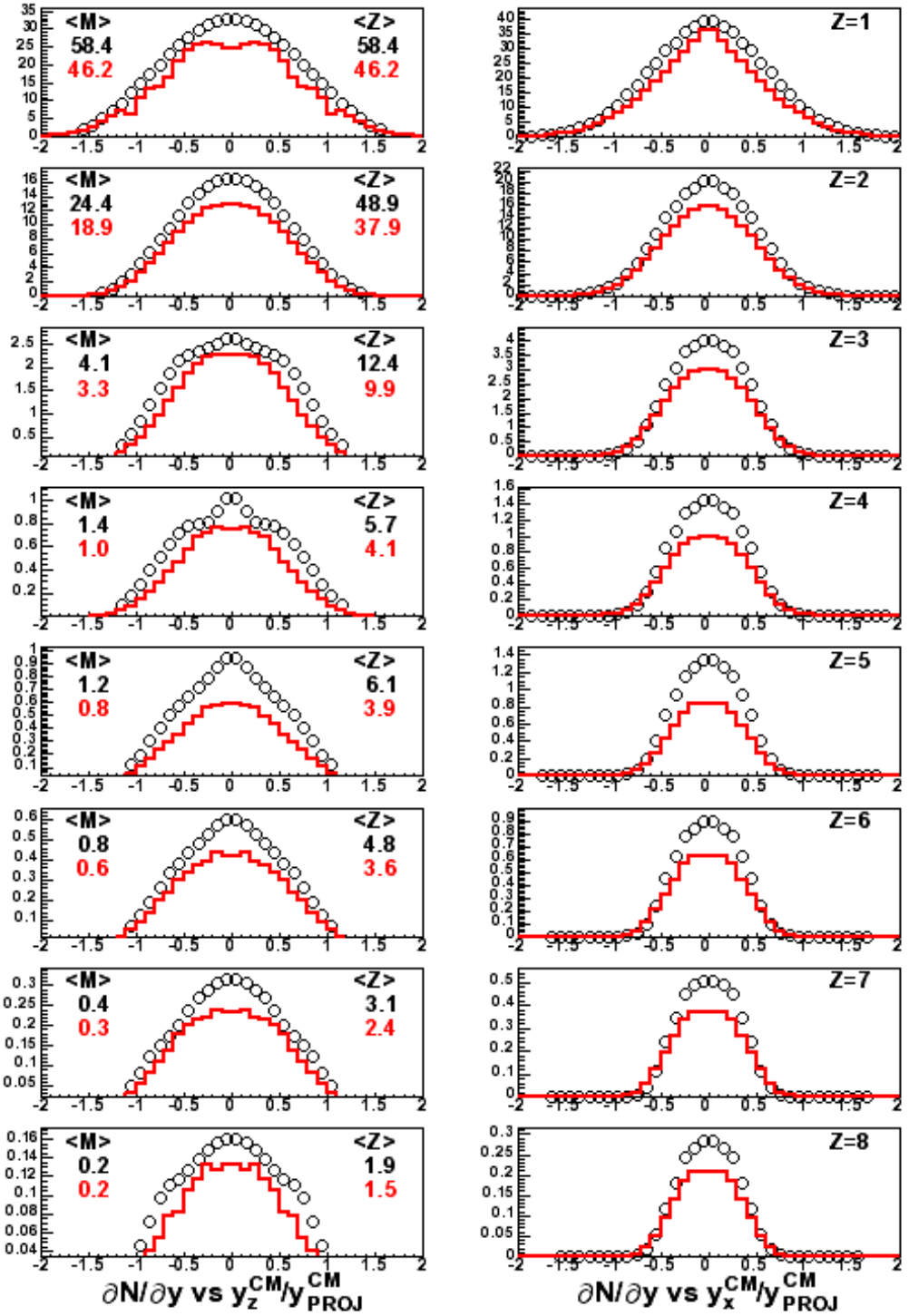
INDRA
symmetrized
b<3 fm
Erat-POI

FOPI
b<2 fm
Erat-POI



INDRA symmetrized b<2 fm MULT sel.

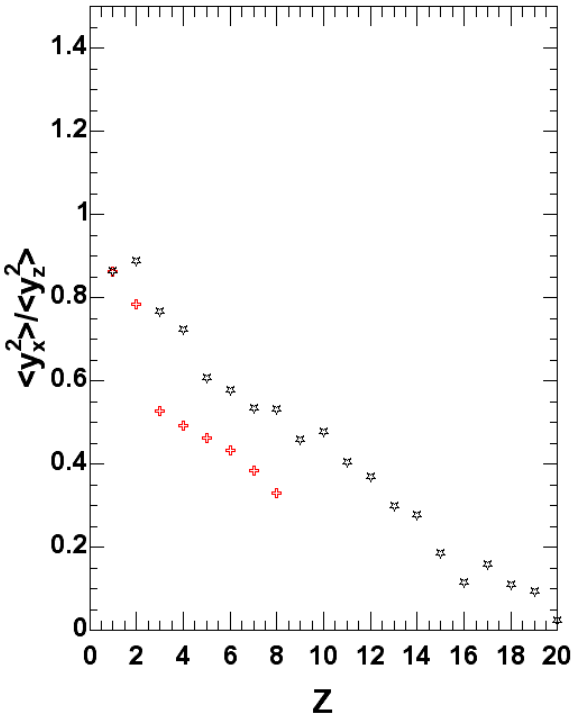
INDRA selects different class of events with MULT sel.

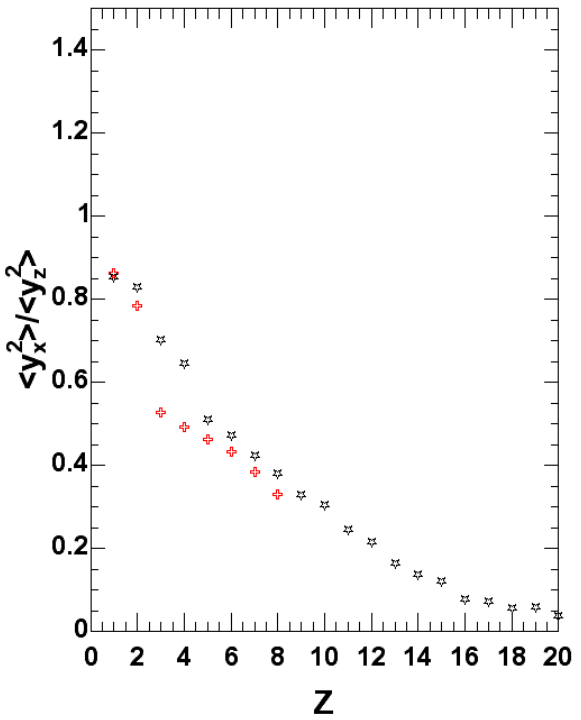


INDRA
symmetrized
b<2 fm
$E_{\perp}^{12}$-POI

FOPI
b<2 fm
Erat-POI

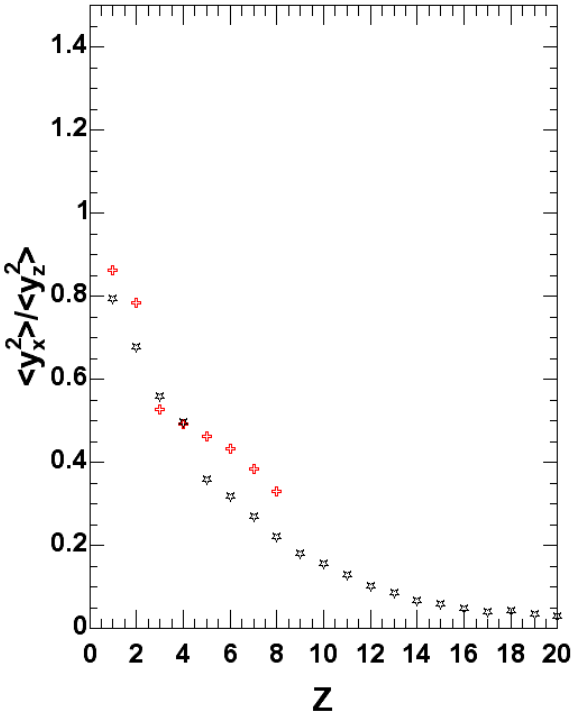
Erat, 2 fm

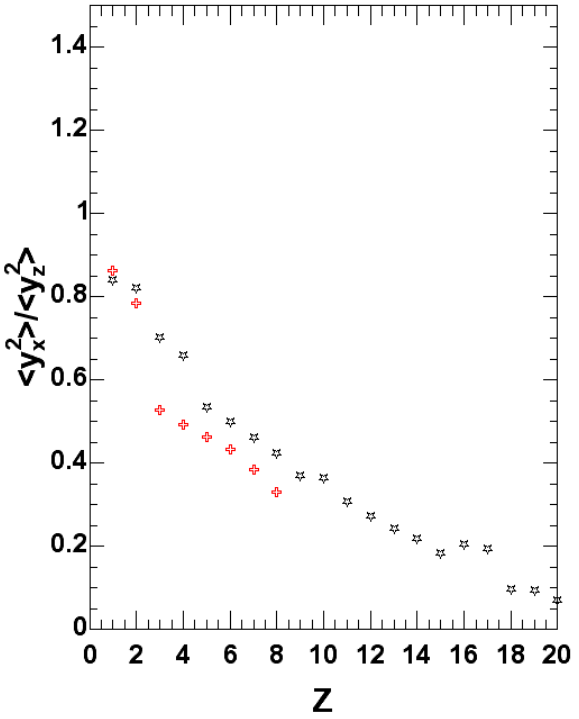




Erat, 3 fm

Mc, 2 fm

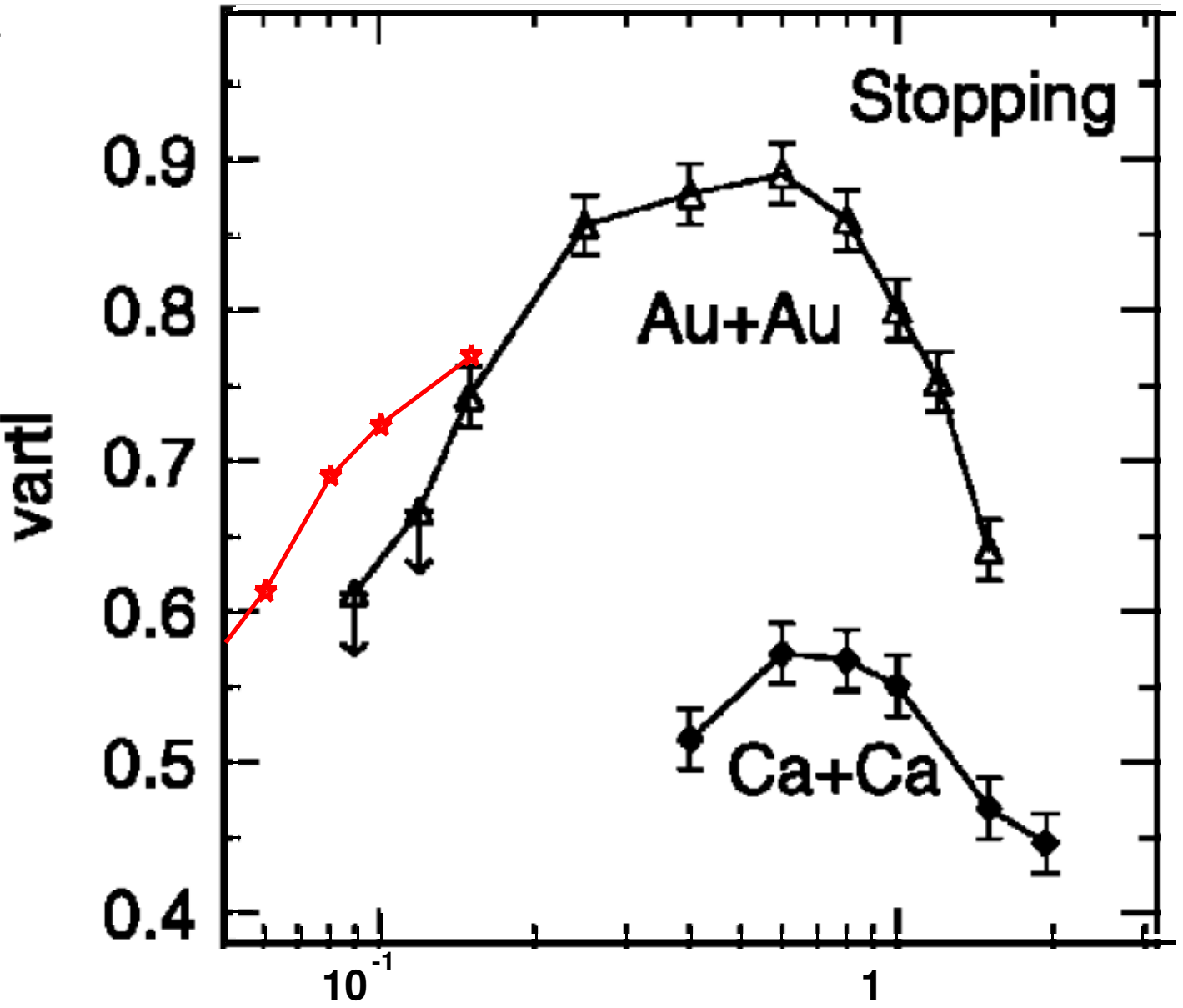


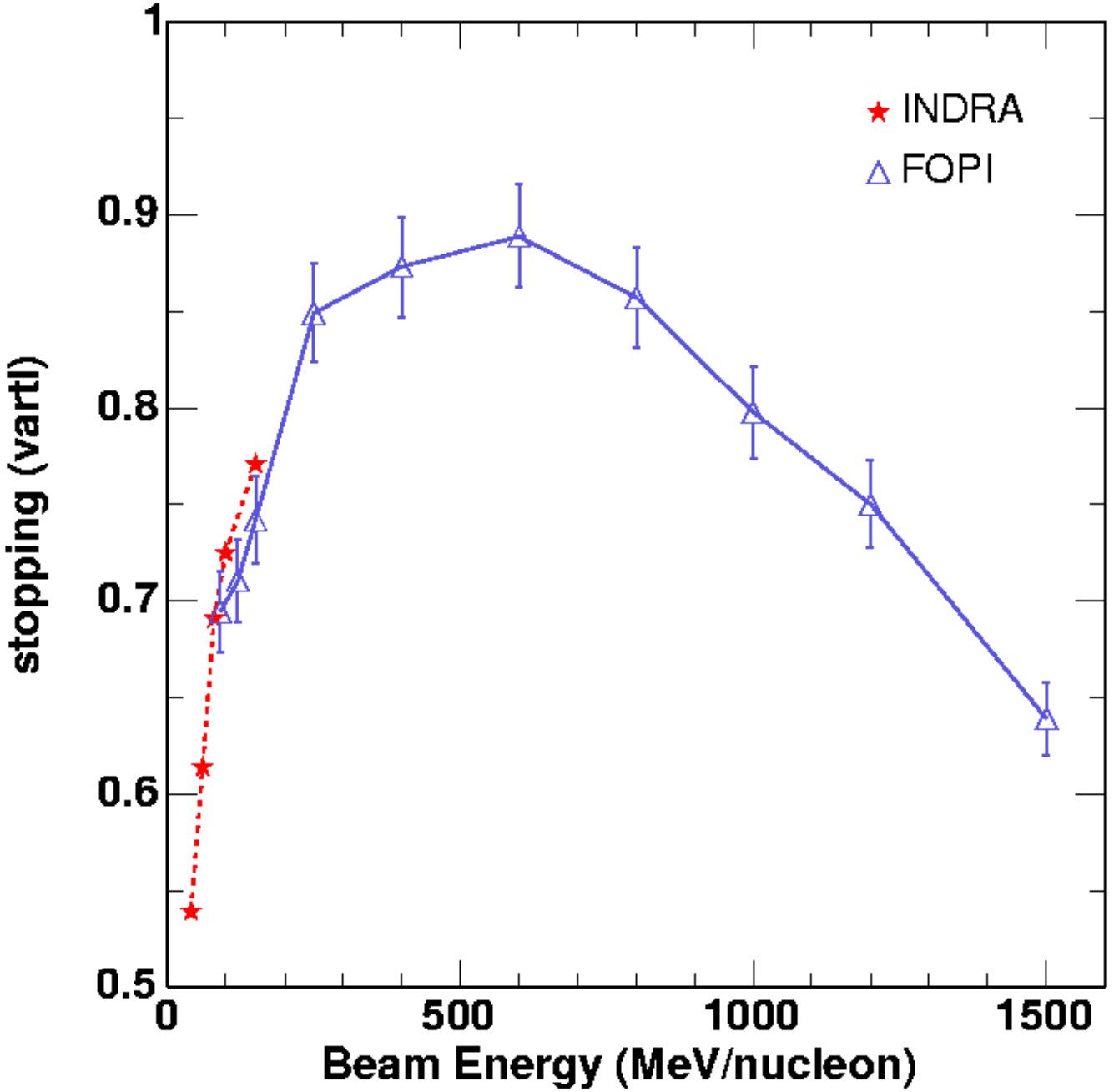


$E_{\perp}^{12}$, 2 fm

W. Reisdorf et al. PRL 92(04)232301

Z-weighted vartl





Centrality selector which one?

- ERAT (-POI)
- MULT
- $E_{\perp}^{12}$ (-POI)
- ...

Z-distr

E/A

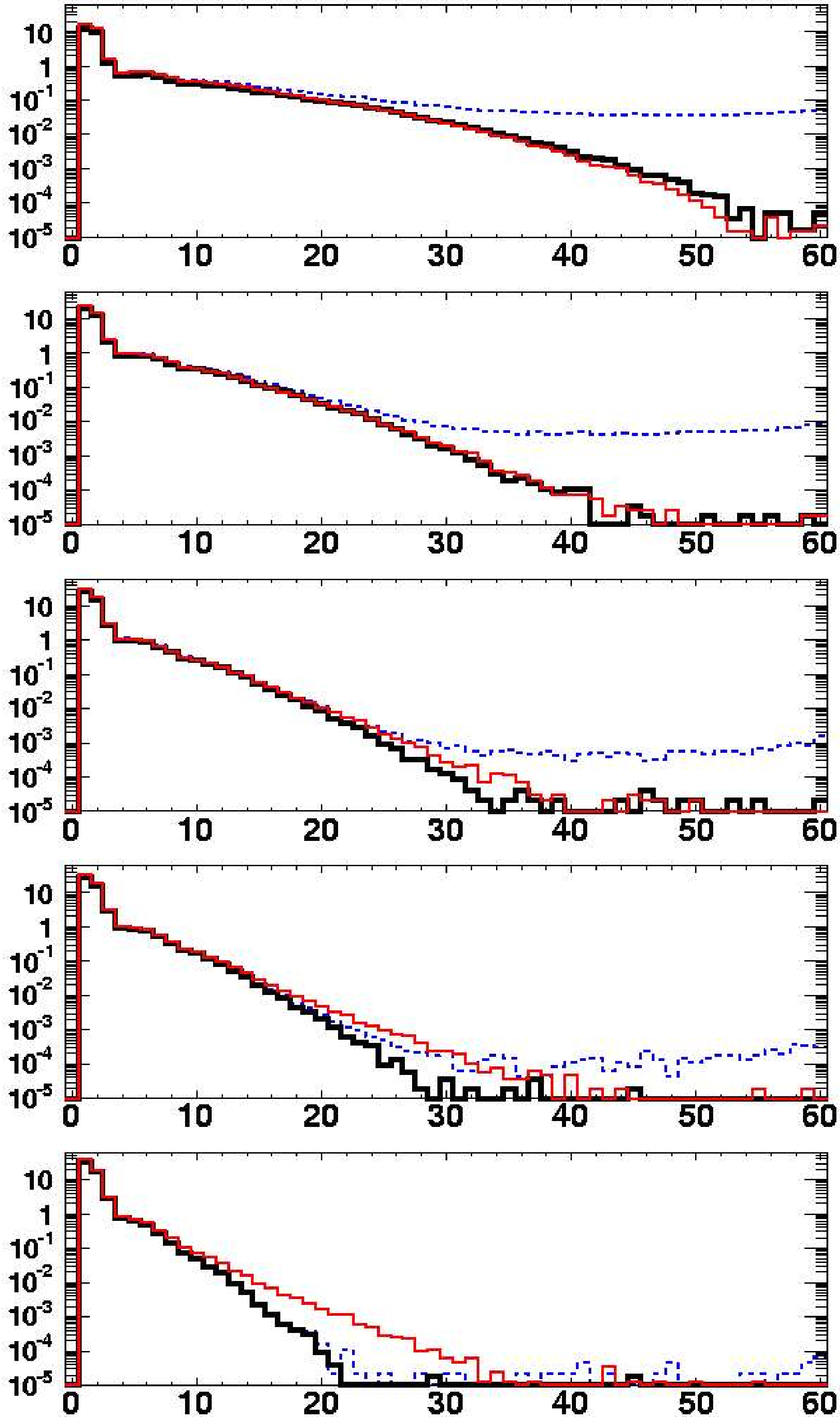
40

60

80

100

150



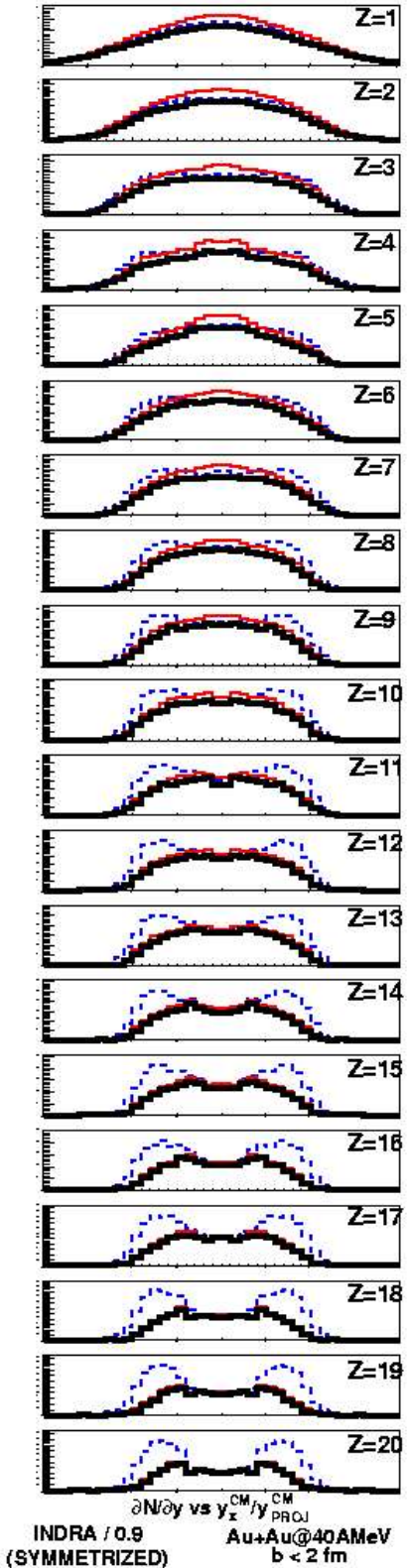
INDRA,
b<2fm selected
using:

ERAT-POI

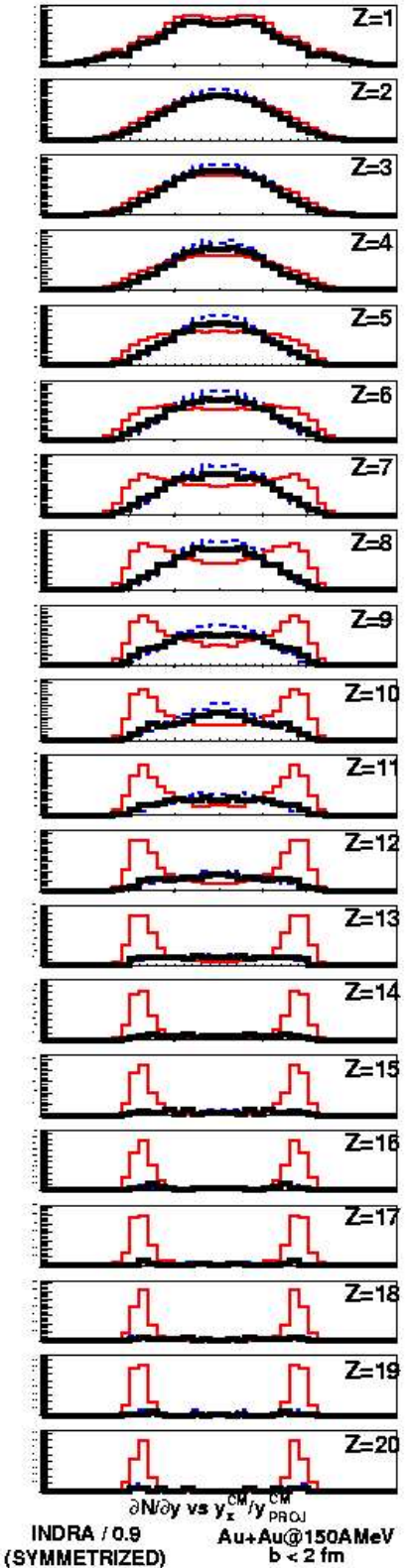
MULT

$E_{\perp}^{12}$-POI

40



150



Scaled rapidity density distr.

INDRA, b<2fm selected using:

ERAT-POI

MULT

$E_{\perp}^{12}$-POI

$\mathbf{V}_2$

Fourier expansion of the azimuthal distributions measured with respect to the reaction plane

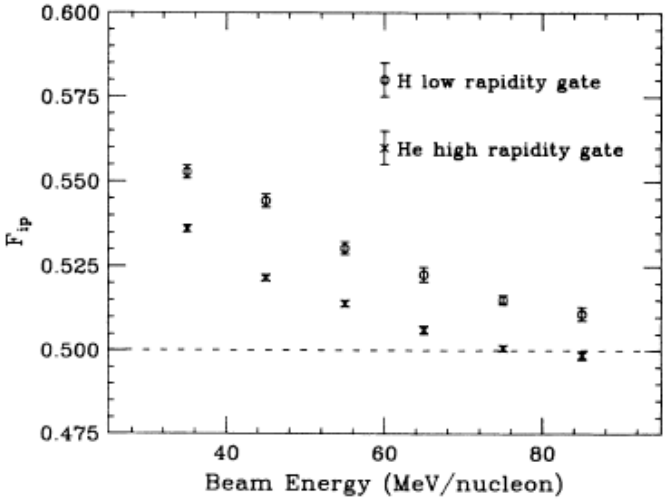
$$dN/d\varphi \propto 1+2v_1\cos\varphi + 2v_2\cos 2\varphi + \ldots$$

$$v_1 = \langle \cos\varphi \rangle$$

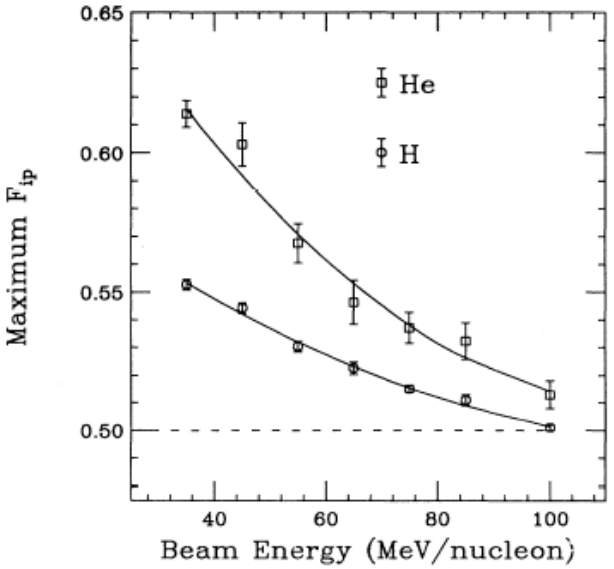
$$v_2 = \langle \cos 2\varphi \rangle$$

$$v_i = v_i(Z, y, p_\perp)$$

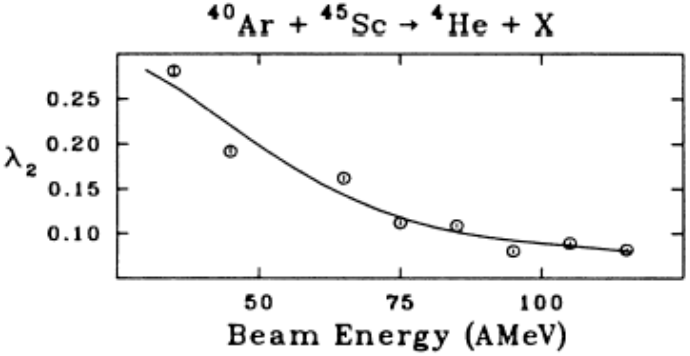
^{40}Ar+^{51}V, MSU 4π
W.K. Wilson et al. PRC 41(90)R1881



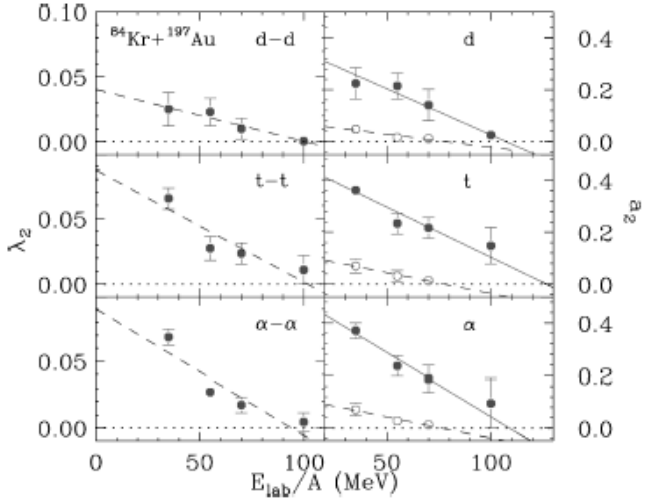
^{40}Ar+^{51}V, MSU 4π
W.K. Wilson et al. PRC 51(95)3136



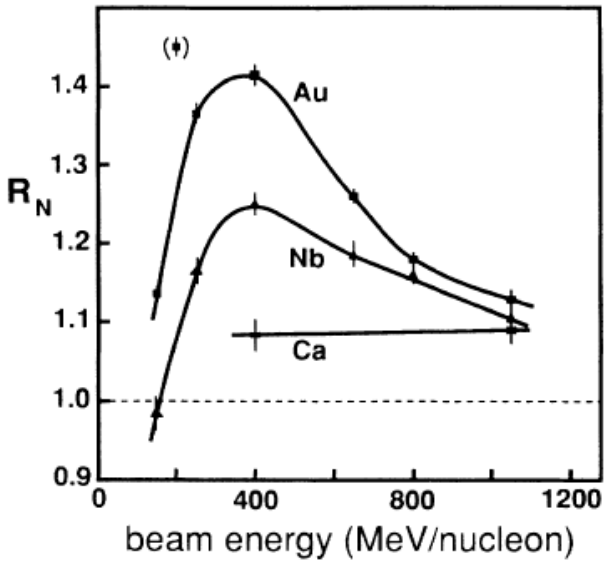
^{40}Ar+^{45}Sc, MSU 4π
R.A. Lacey et al. PRL 70(93)1224



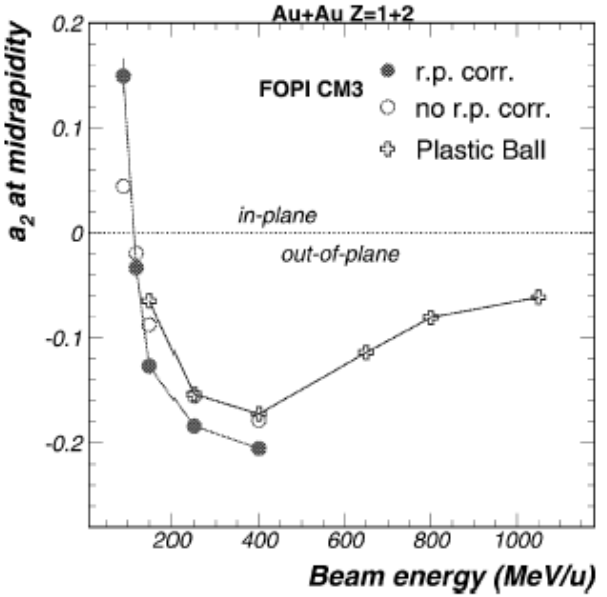
^{84}Kr+^{197}Au, MSU Miniball/Miniwall
W.Q. Shen et al. PRC 57(98)1508



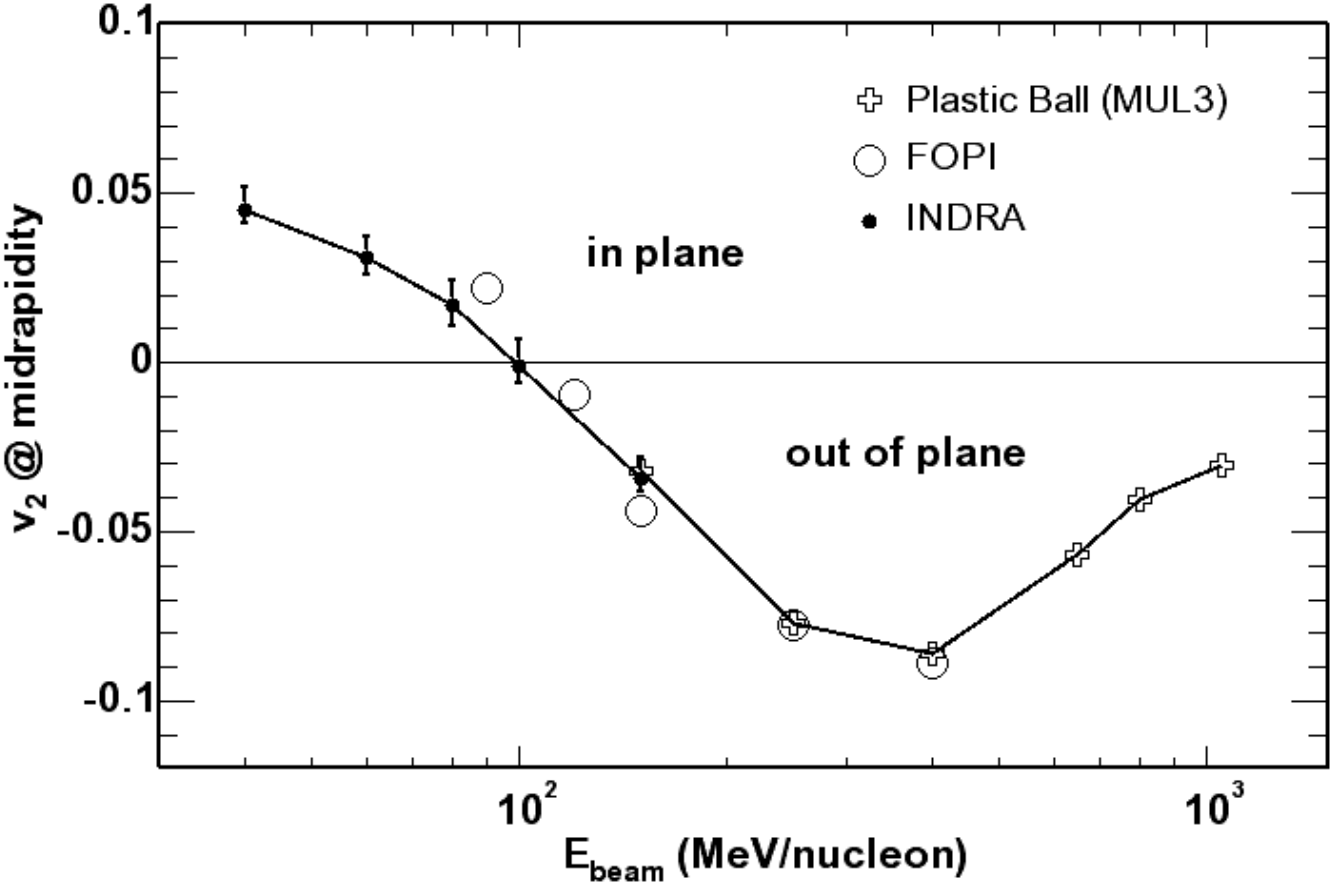
^{197}Au+^{197}Au, Berkeley, Plastic Ball
H.H. Gutbrod et al. PRC 42(90)640



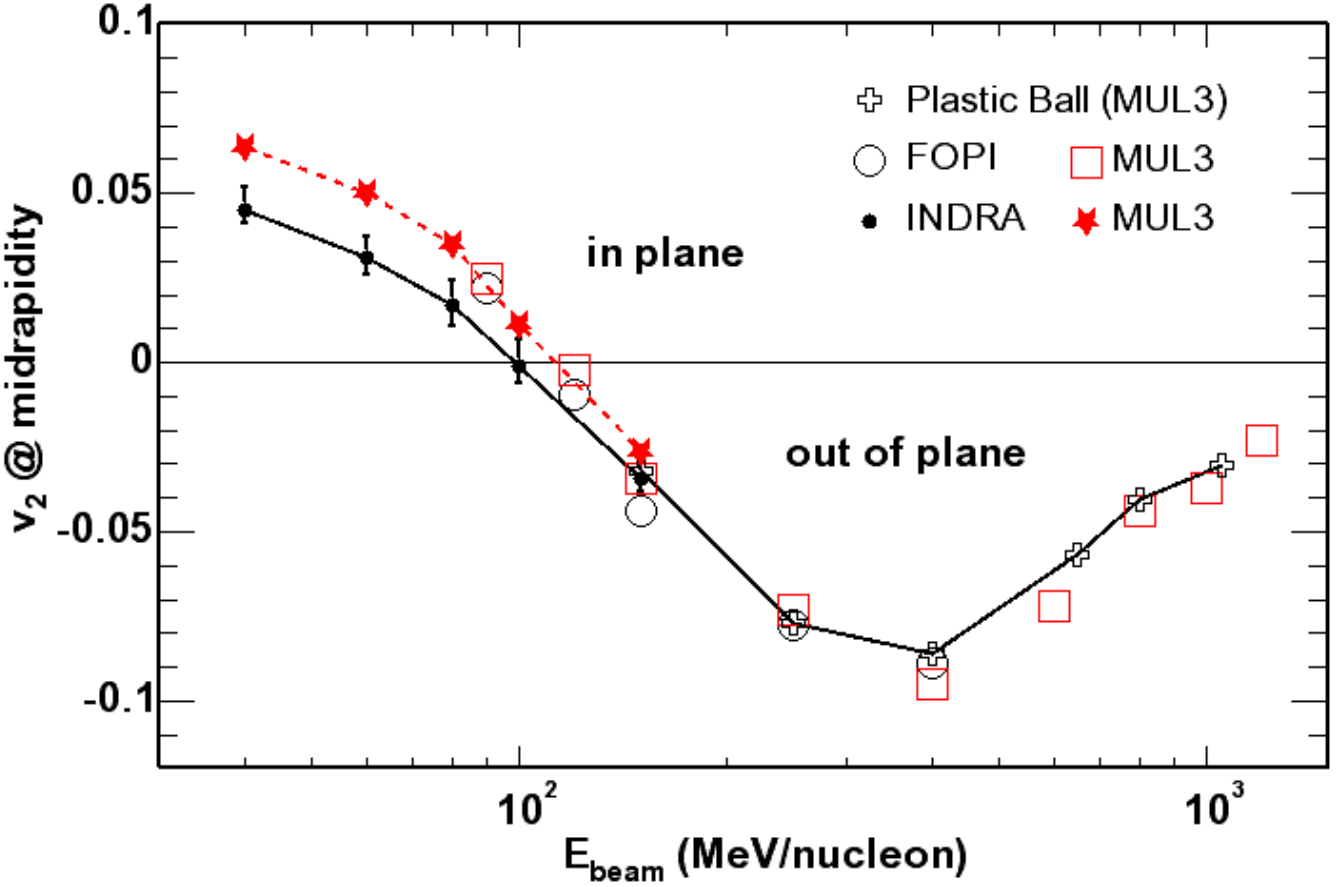
^{197}Au+^{197}Au, GSI, FOPI
A. Andronic et al. NPA 679(01)765



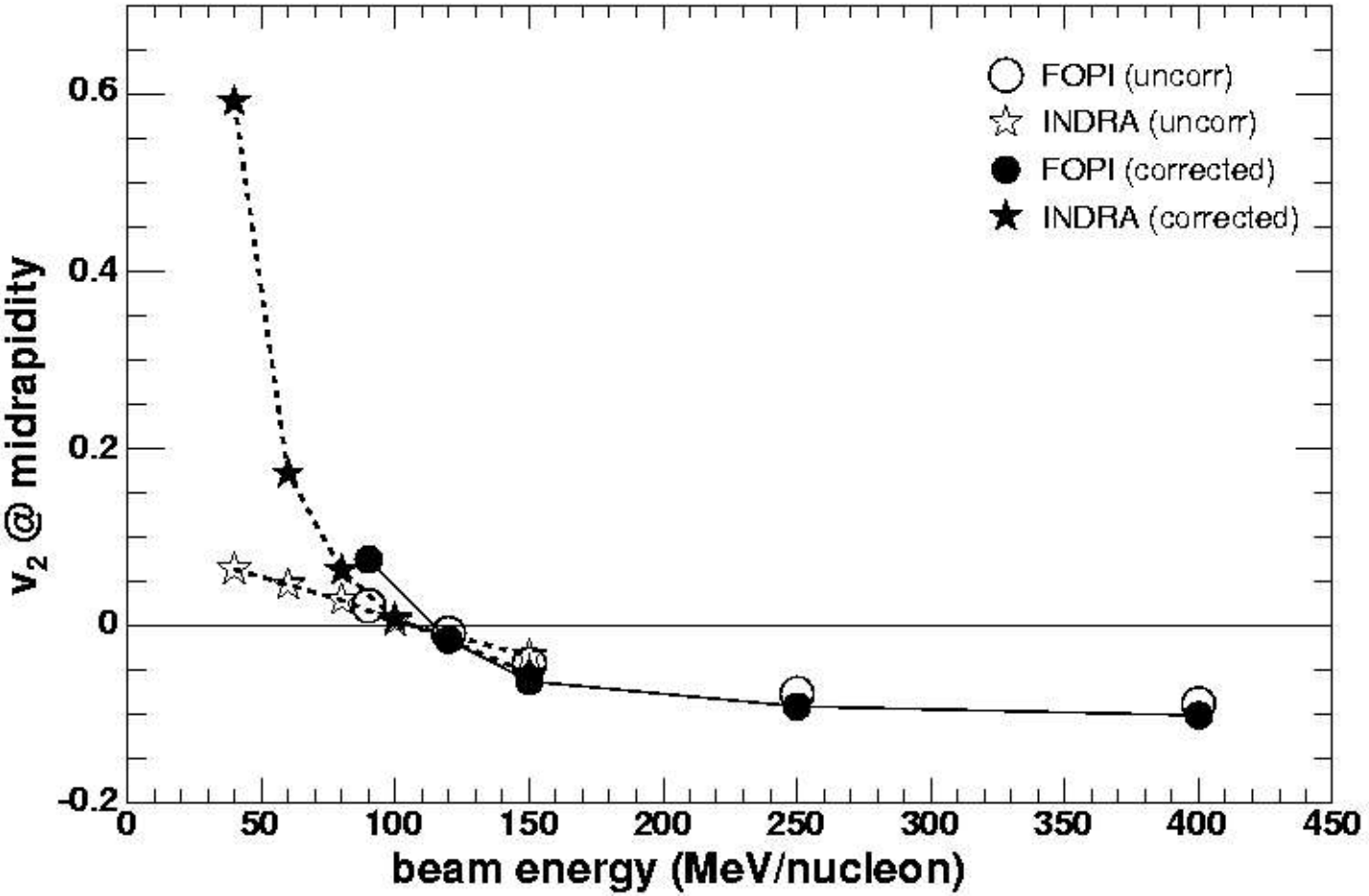
Elliptic flow for Z≤2, b=4-6 fm, rotated frame



Elliptic flow for Z≤2, b=4-6 fm, rotated frame



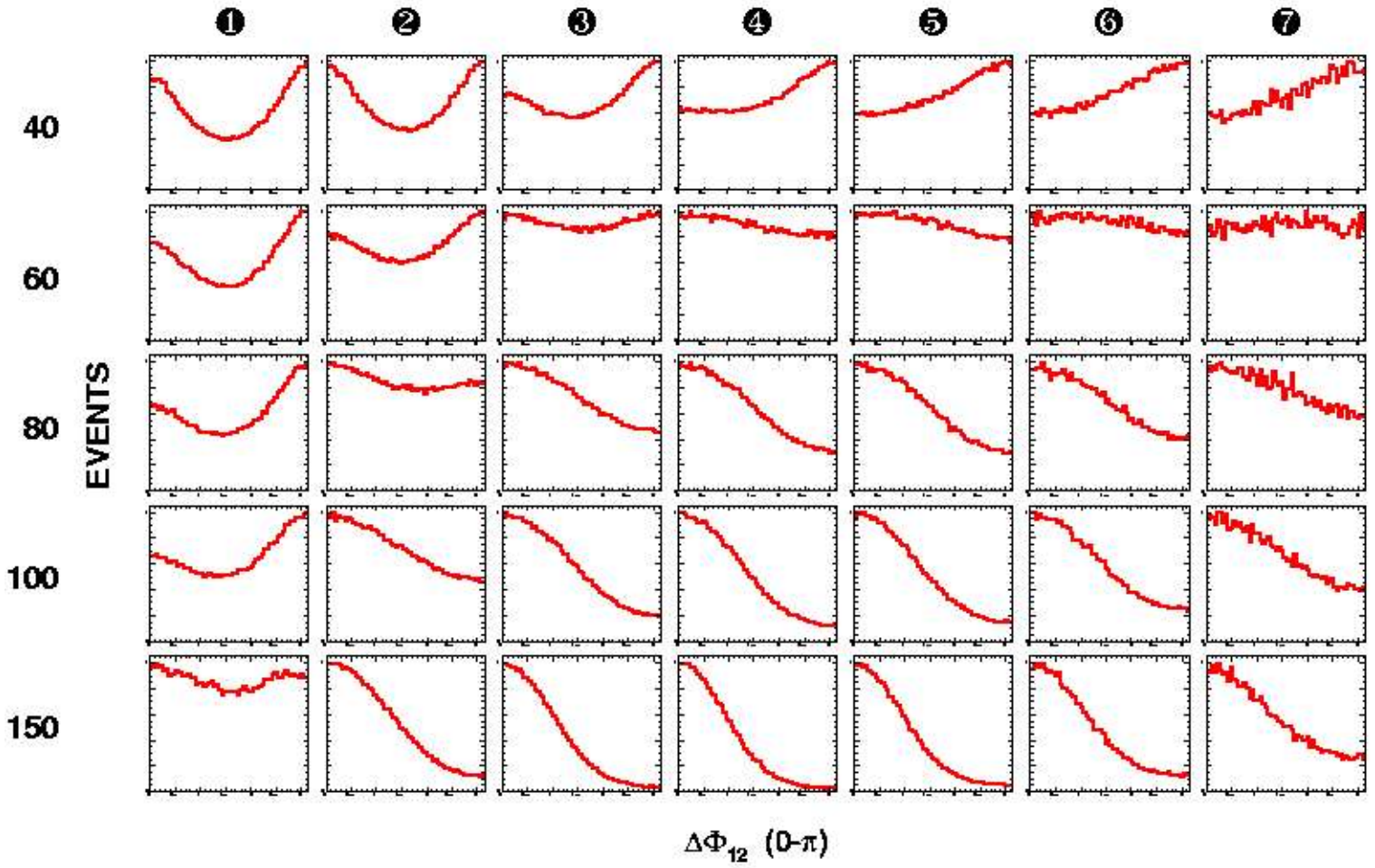
v_2 uncorrected vs corrected



Reaction plane: how to correct?

INDRA: reaction plane resolution

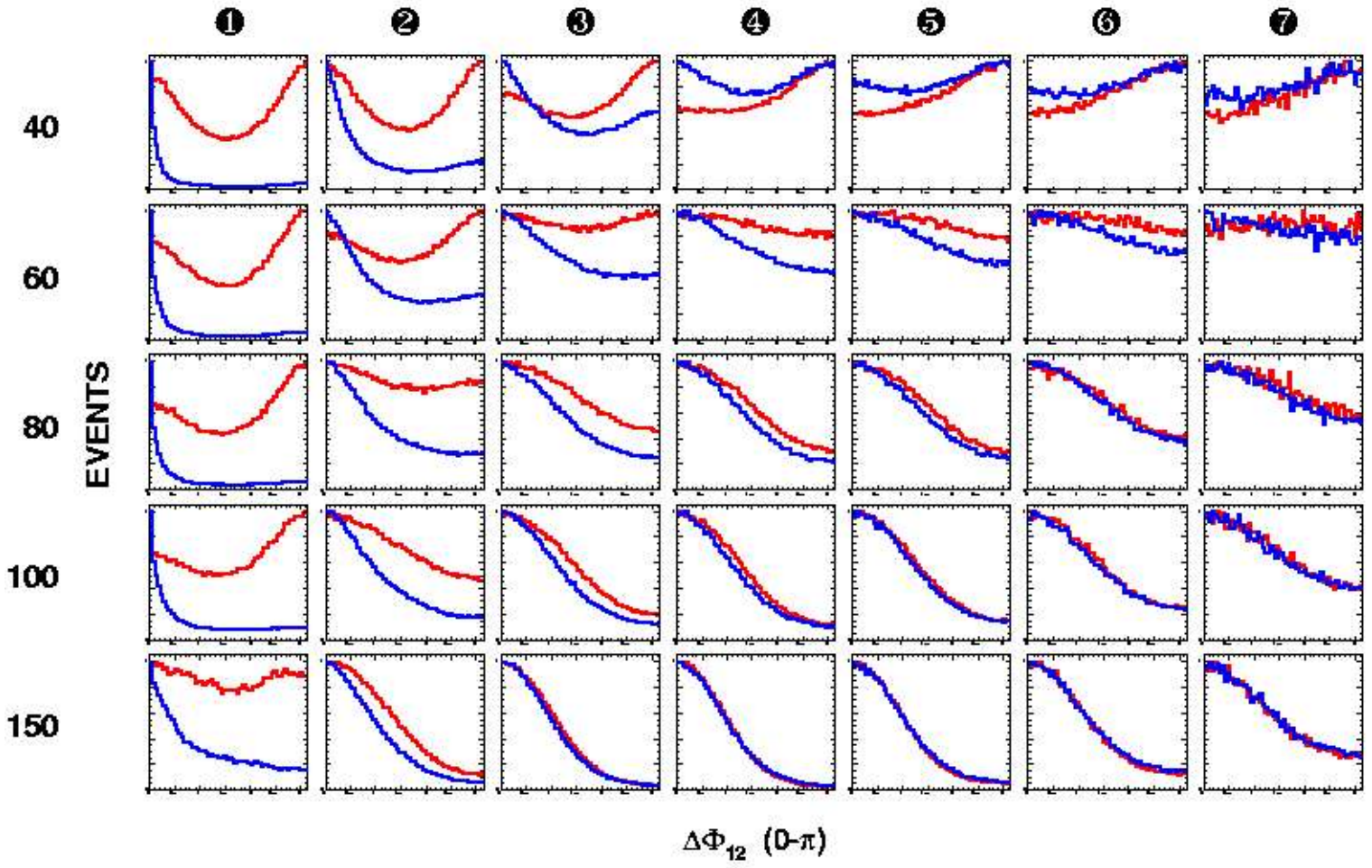
random subdivision



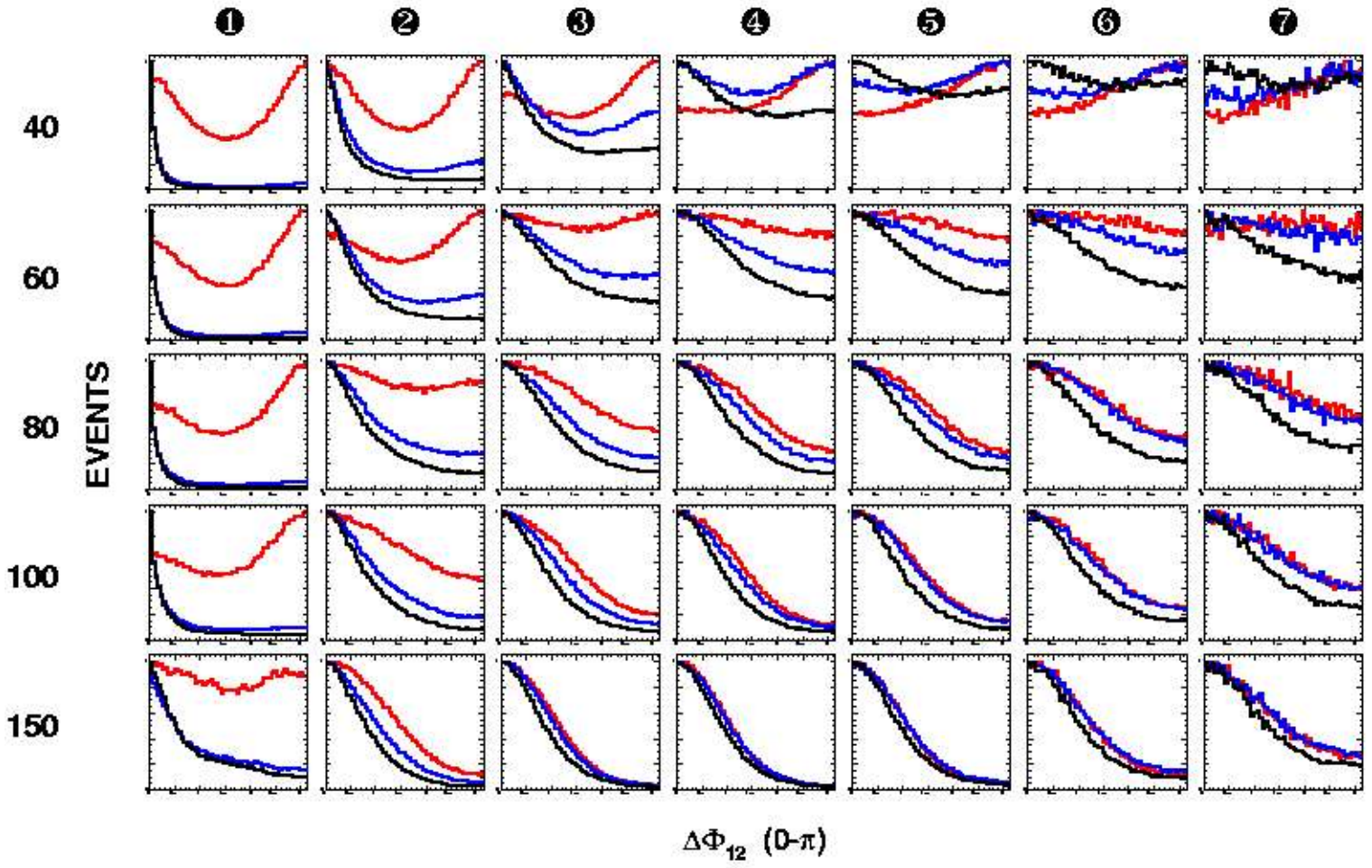
INDRA: reaction plane resolution

random subdivision

adding missing momentum



INDRA: reaction plane resolution

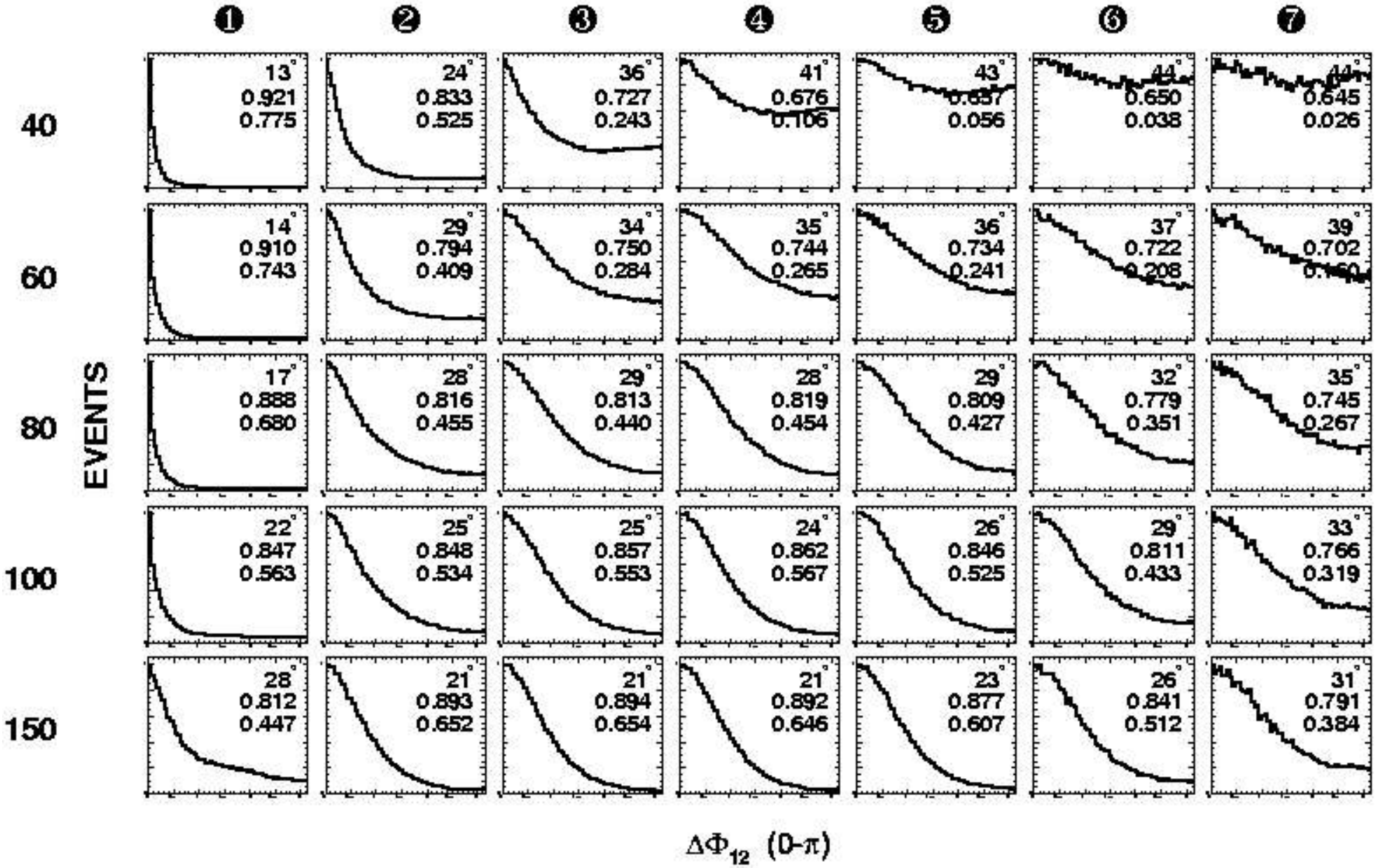


random subdivision

adding missing momentum

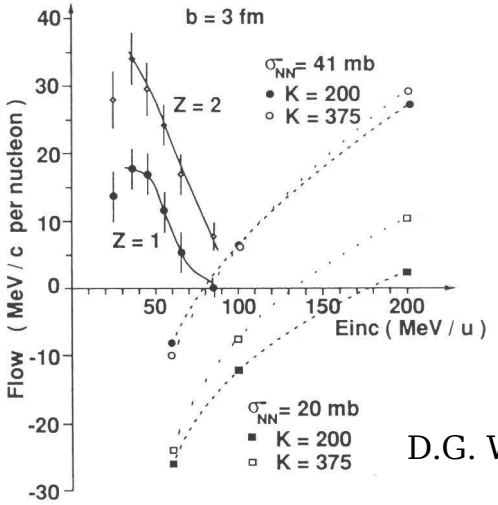
equal momentum subdivision

INDRA: reaction plane resolution

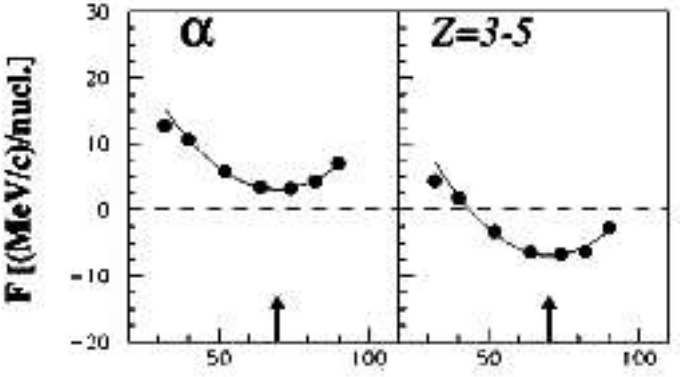


$\mathbf{v}_1$

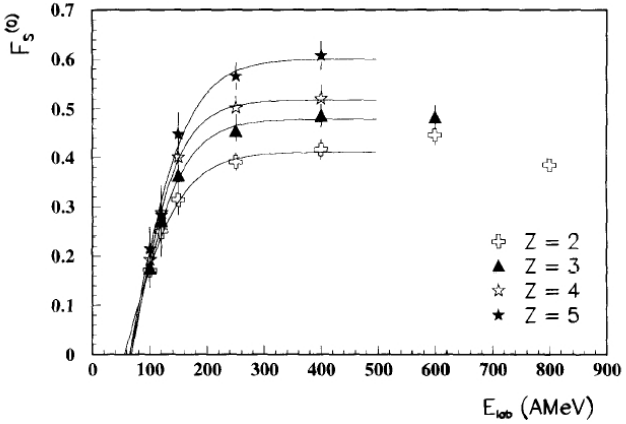
^{40}Ar+^{27}Al, Mur+Tonneau
J.P. Sullivan et al. PLB 249(90)8



^{58}Ni+^{58}Ni, INDRA
D. Cussol et al. PRC 65(02)44604

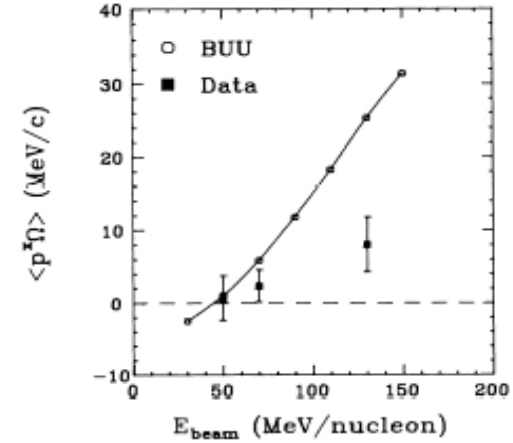


^{197}Au+^{197}Au, FOPI
P. Crochet et al. NPA 624(97)755

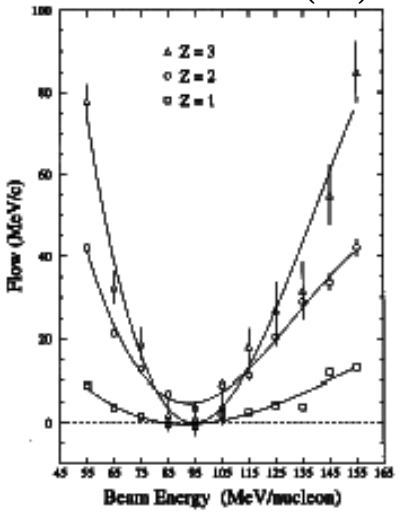


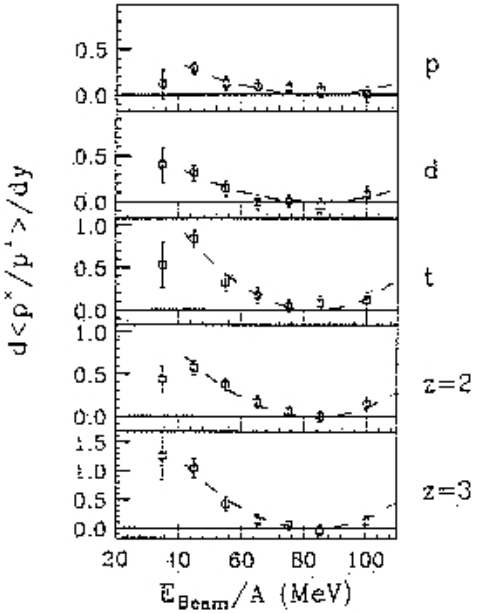
^{40}Ar+^{51}V, MSU 4π
D.G. Westfall et al. NPA 519(90)141c

^{139}La+^{139}La, LBL Streamer Chamber
D. Krofcheck et al. PRL 63(89)2028

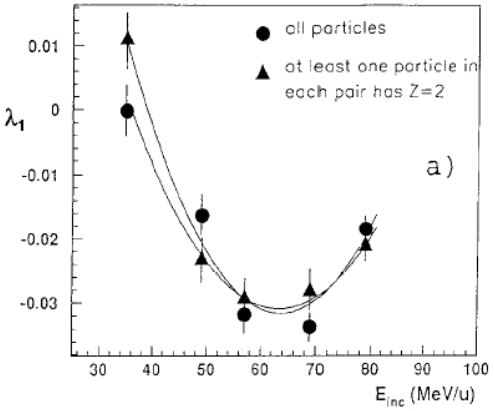


^{40}Ar+^{45}Sc, MSU 4π
R. Pak et al. PRC 54(96)2457

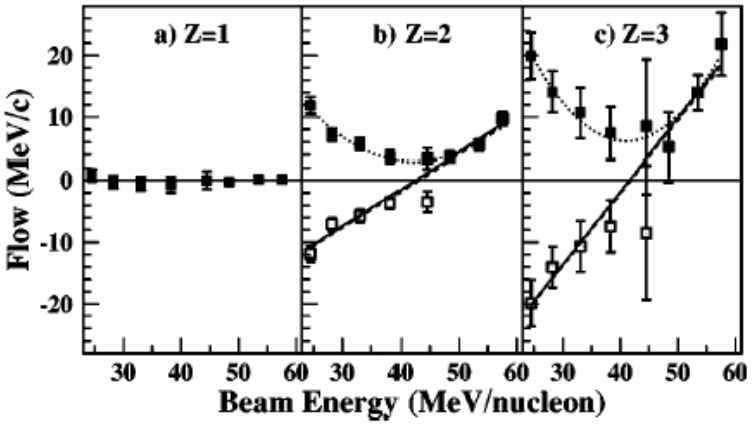




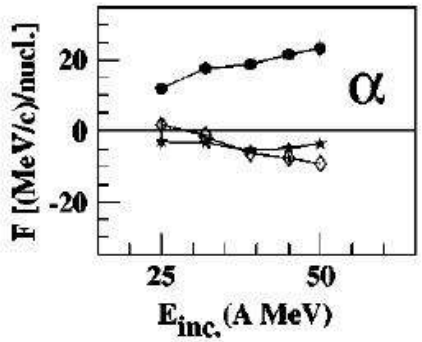
^{64}Zn+^{58}Ni, Mur+Tonneau
A. Buta et al. NPA 584(95)397

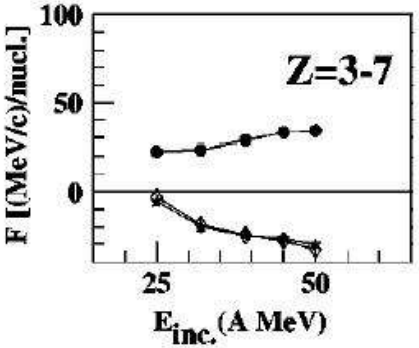


^{197}Au+^{197}Au, MSU 4π
D.J. Magestro et al. PRC 61(00)21602

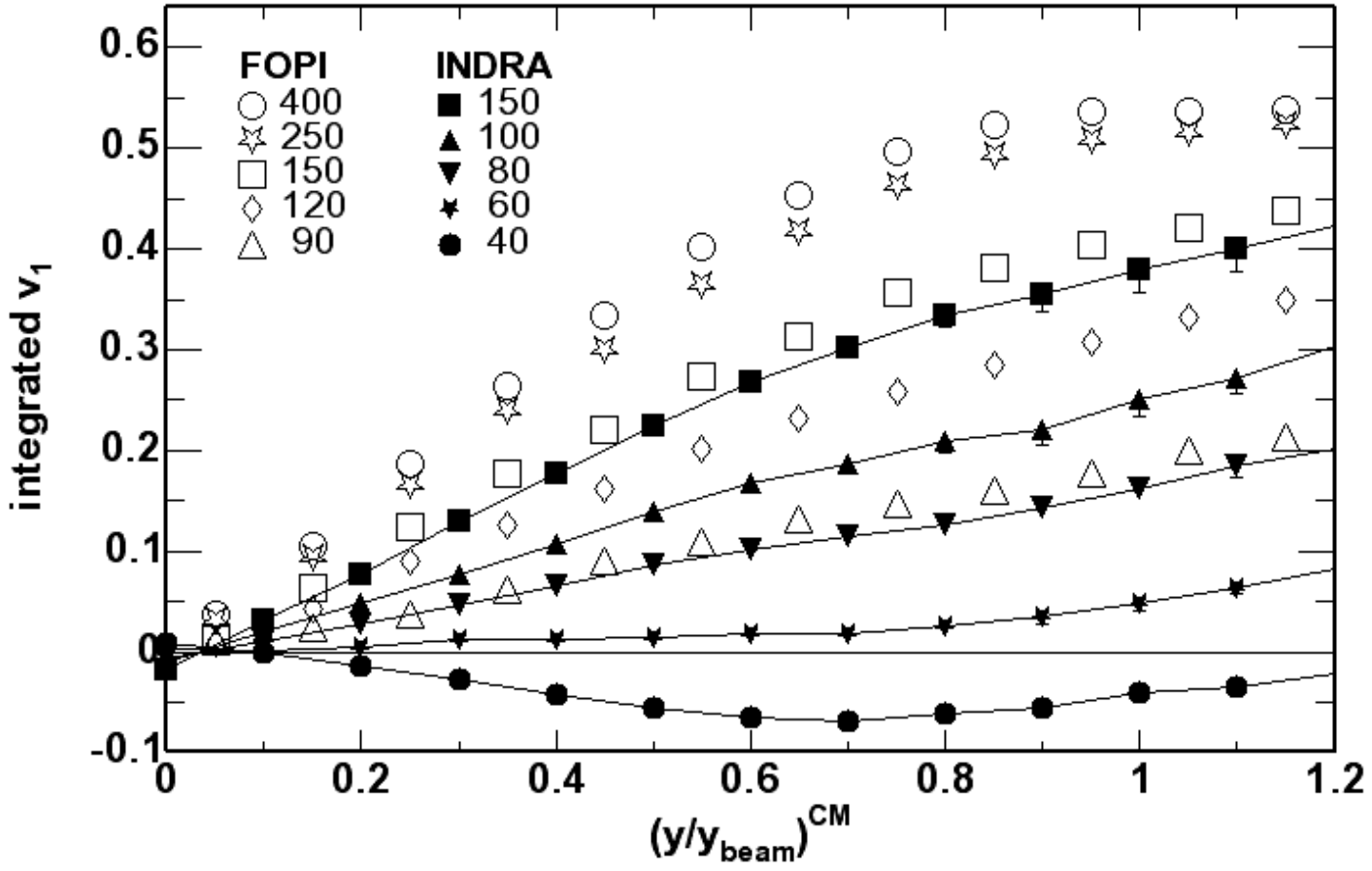


^{129}Xe+^{nat}Sn,
INDRA
D. Cussol et al.
PRC 65(02)44604

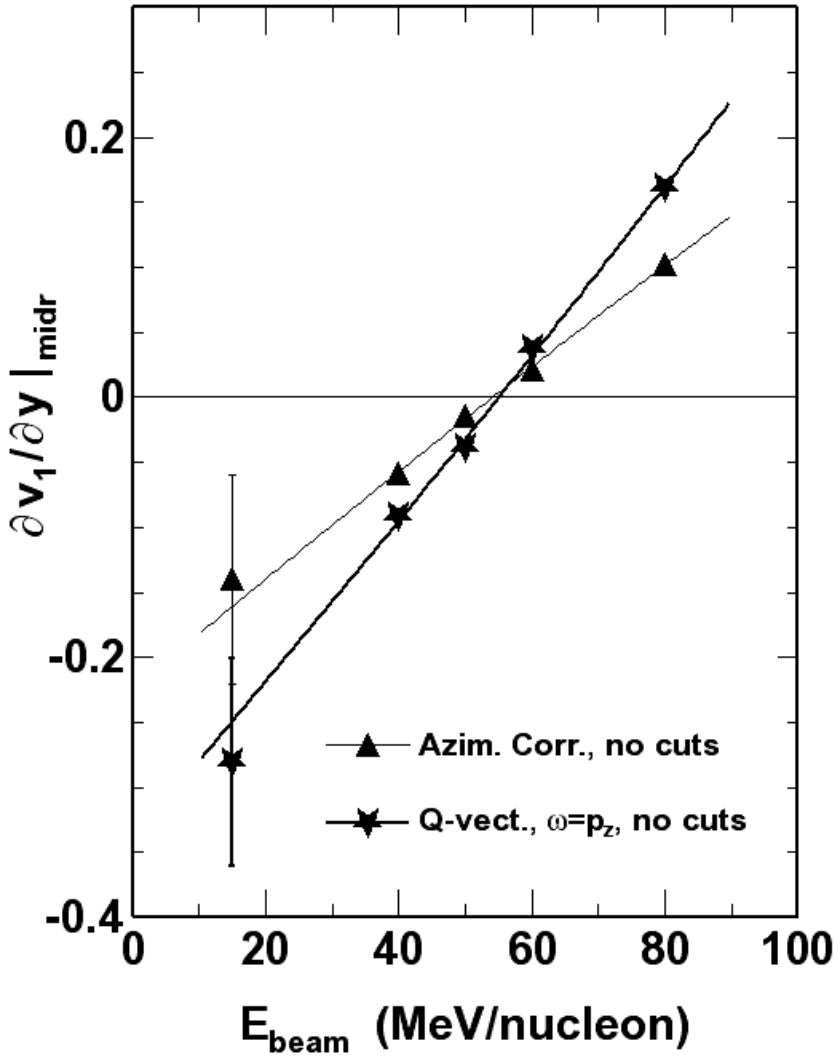




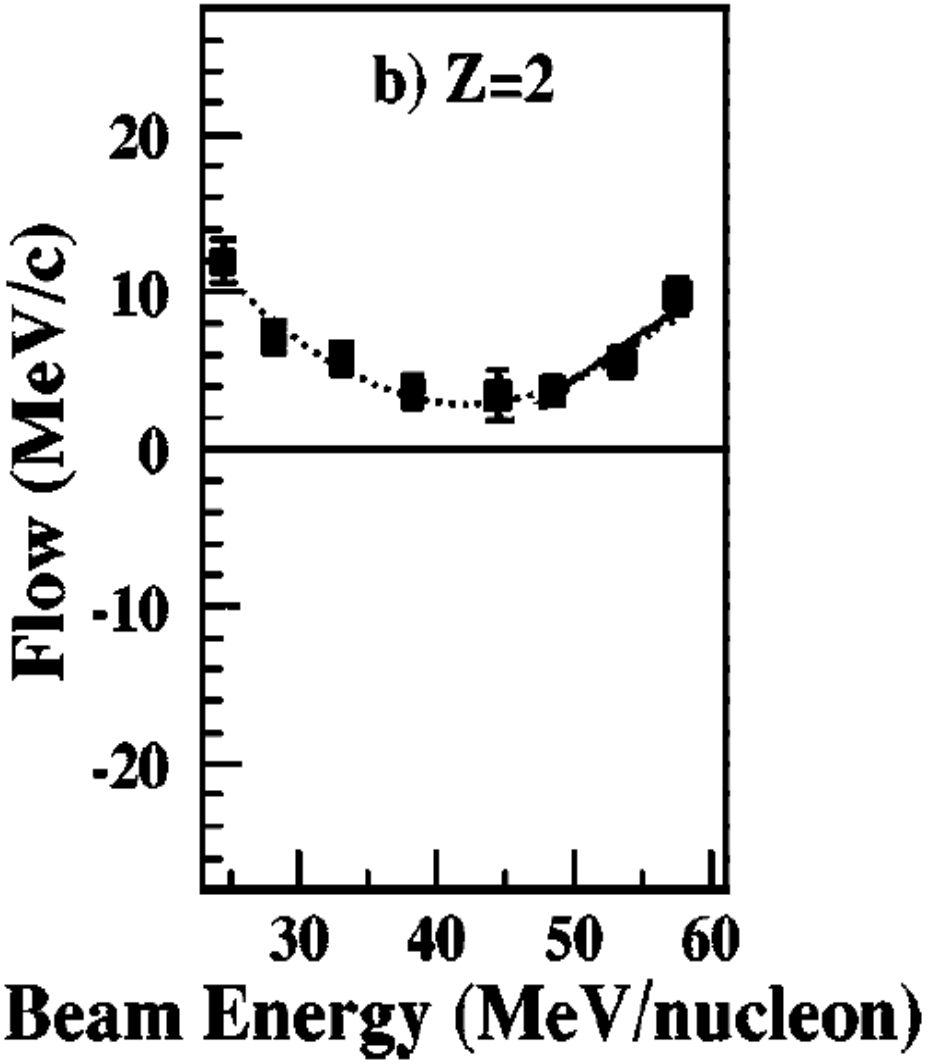
$^{197}Au+^{197}Au$, Z=2, b=2-5.3 fm



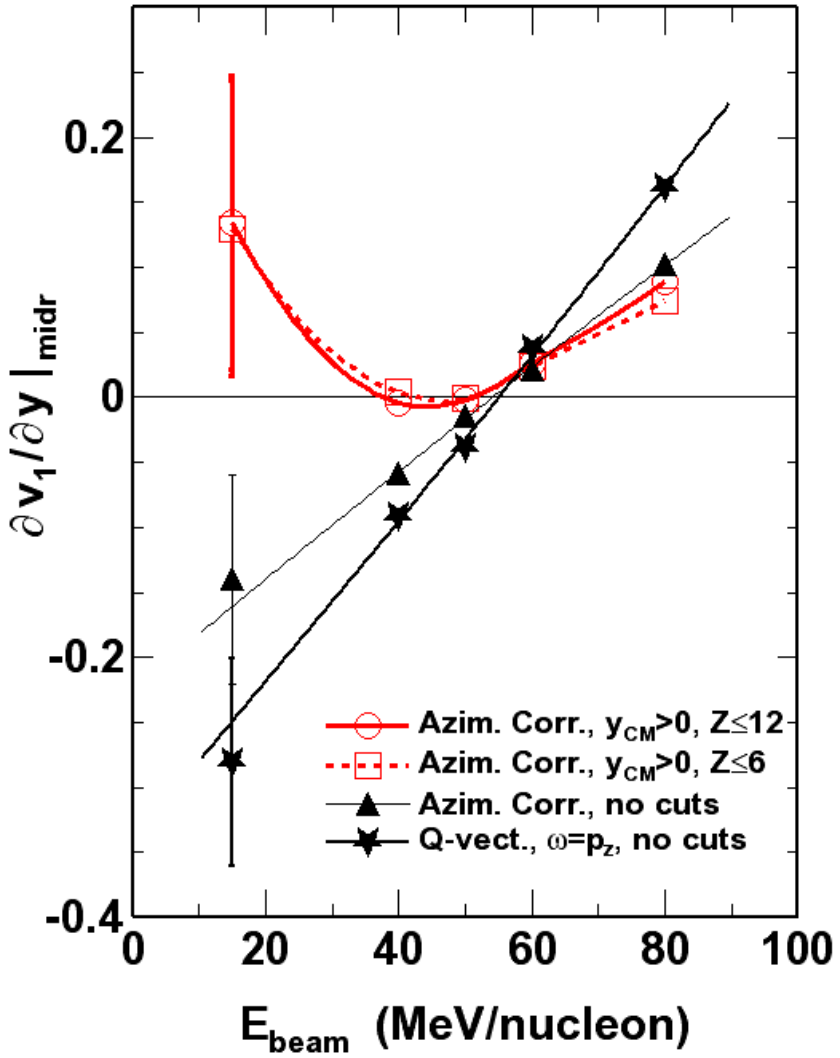
^{192}Au+^{192}Au, INDRA
Z=2, b<4 fm



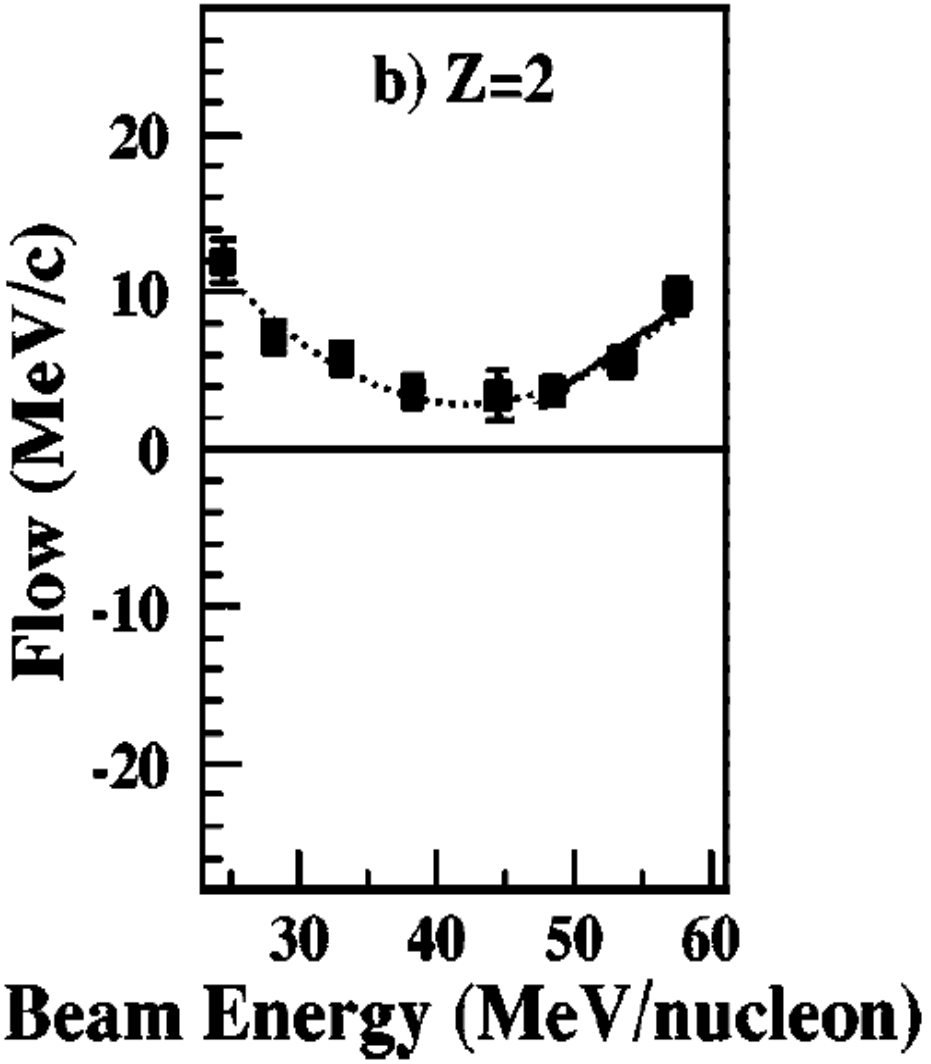
^{197}Au+^{197}Au, MSU 4π
D.J. Magestro et al.
PRC 61(00)21602



^{192}Au+^{192}Au, INDRA
Z=2, b<4 fm

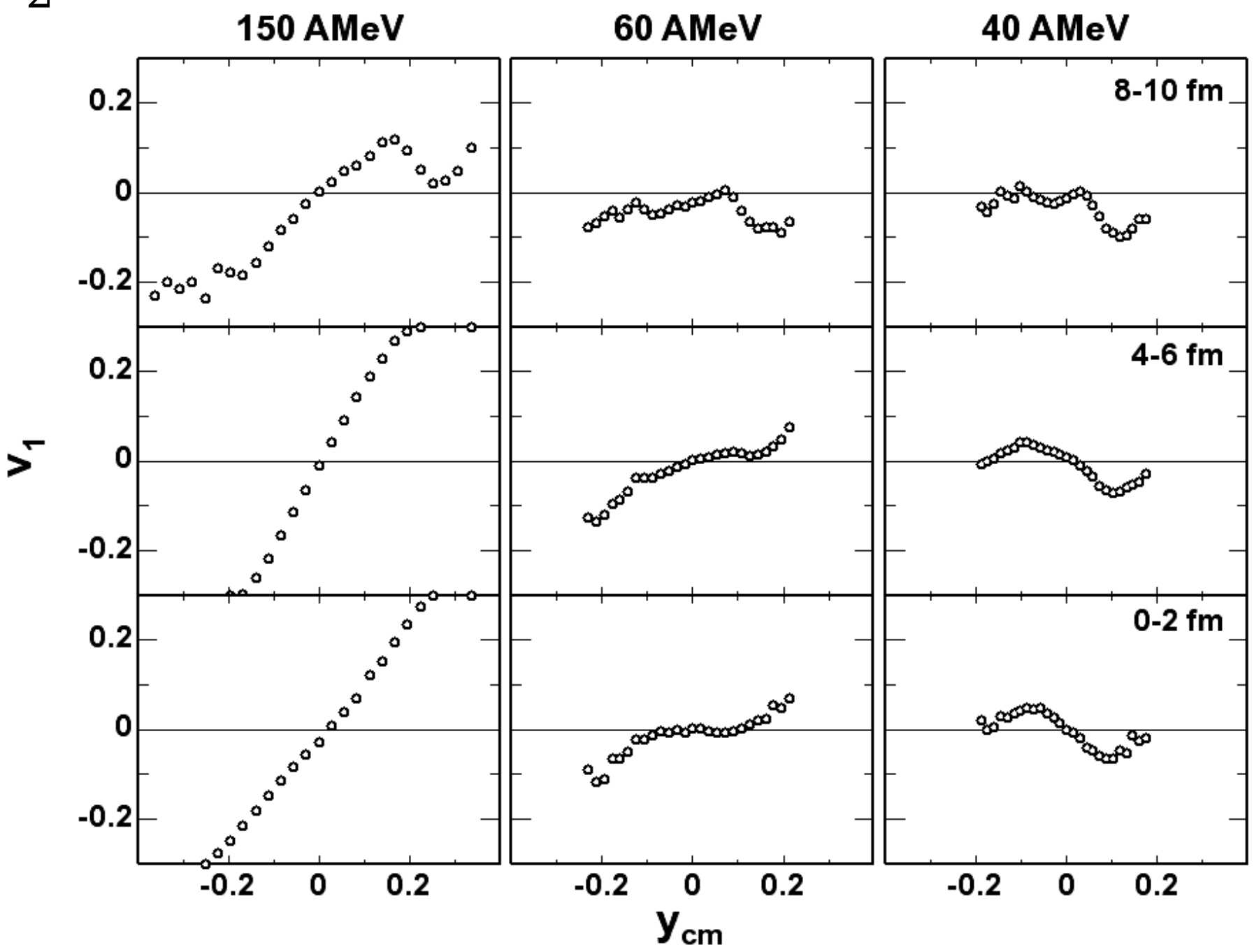


^{197}Au+^{197}Au, MSU 4π
D.J. Magestro et al.
PRC 61(00)21602

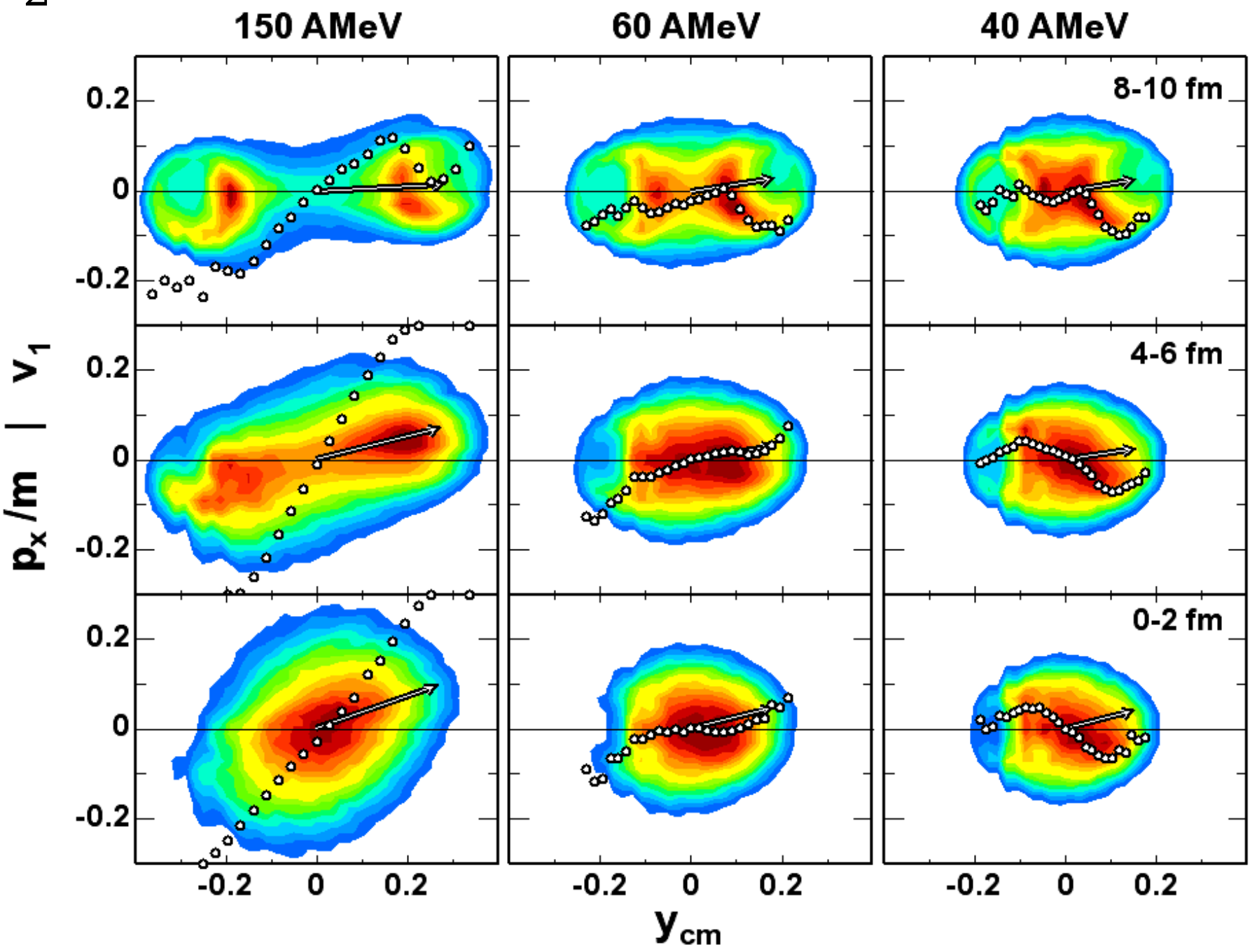


Origin of negative flow

Z=2

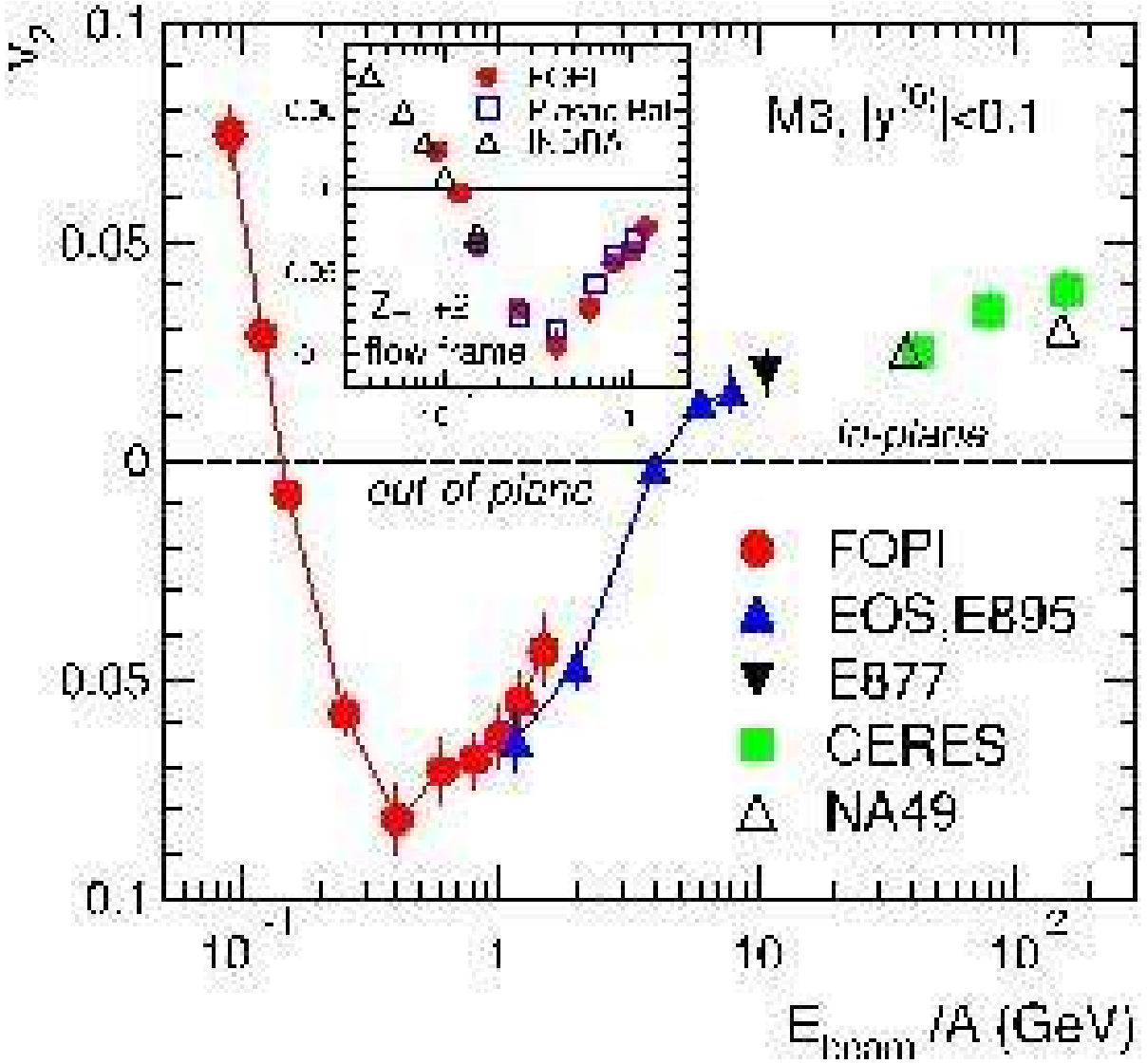


Z=2

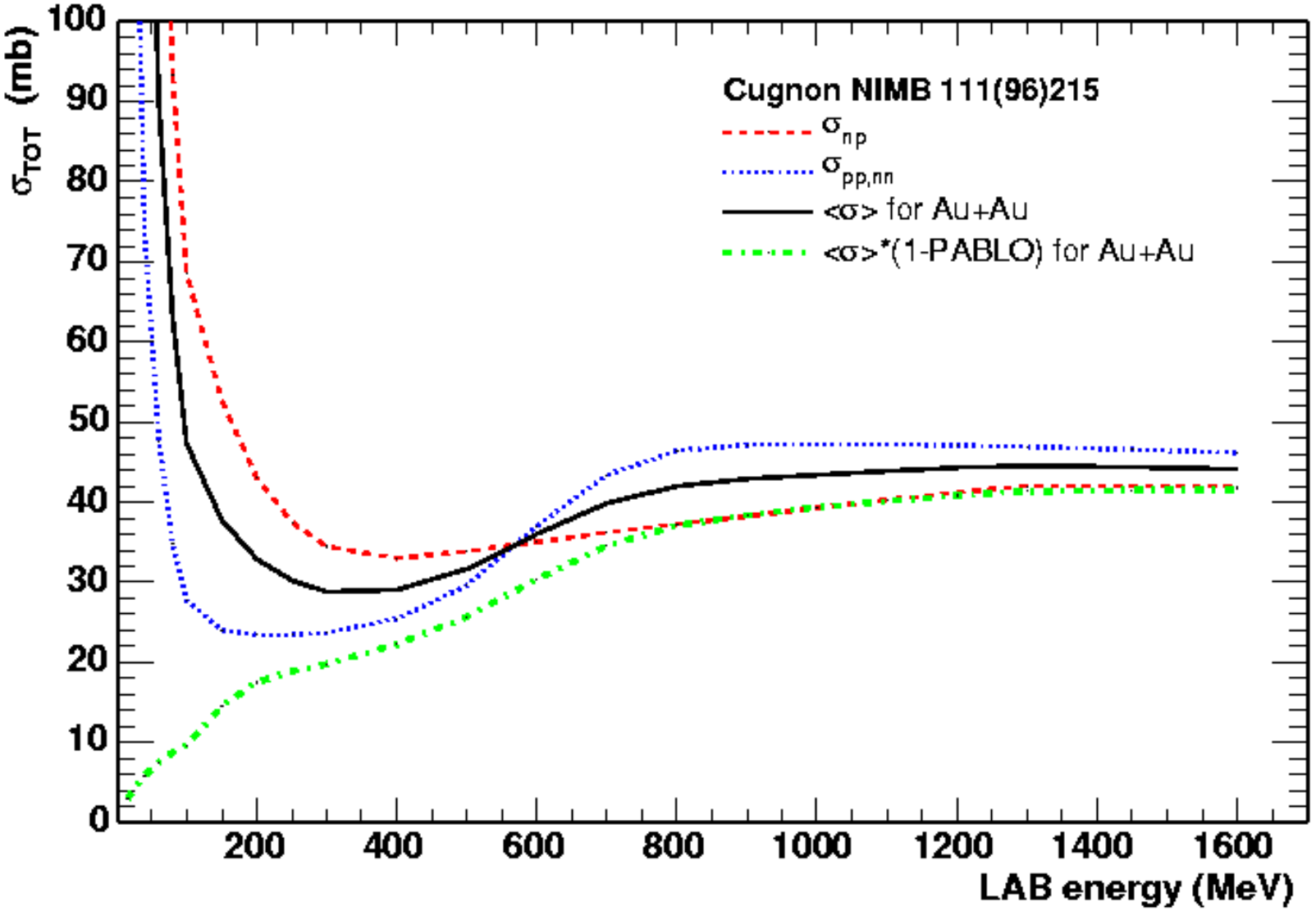


Summary

- Still not the final word. Absolute calibration of the impact parameter needs to be checked.
- Rapidity distributions, some reconstruction is needed for INDRA to get a better total Z and better low $p_{\perp}$ yield.
- vartl (stopping) - promissing, final tests needed.
- v_2 – looks better uncorrected… Some tests on reaction plane resolution needed.
- v_1 – ~10% agreement with FOPI and Plastic Ball at 150 AMeV, semi-central. Negative flow at low energies.
- Conditional agreement with MSU 4π.



A. Andronic et al.
nucl-ex/0411024


Cugnon NIMB 111(96)215
σ_{np}
$\sigma_{pp,nn}$
<σ> for Au+Au
<σ>*(1-PABLO) for Au+Au
σ_{TOT} (mb)
0
10
20
30
40
50
60
70
80
90
100
200
400
600
800
1000
1200
1400
1600
LAB energy (MeV)