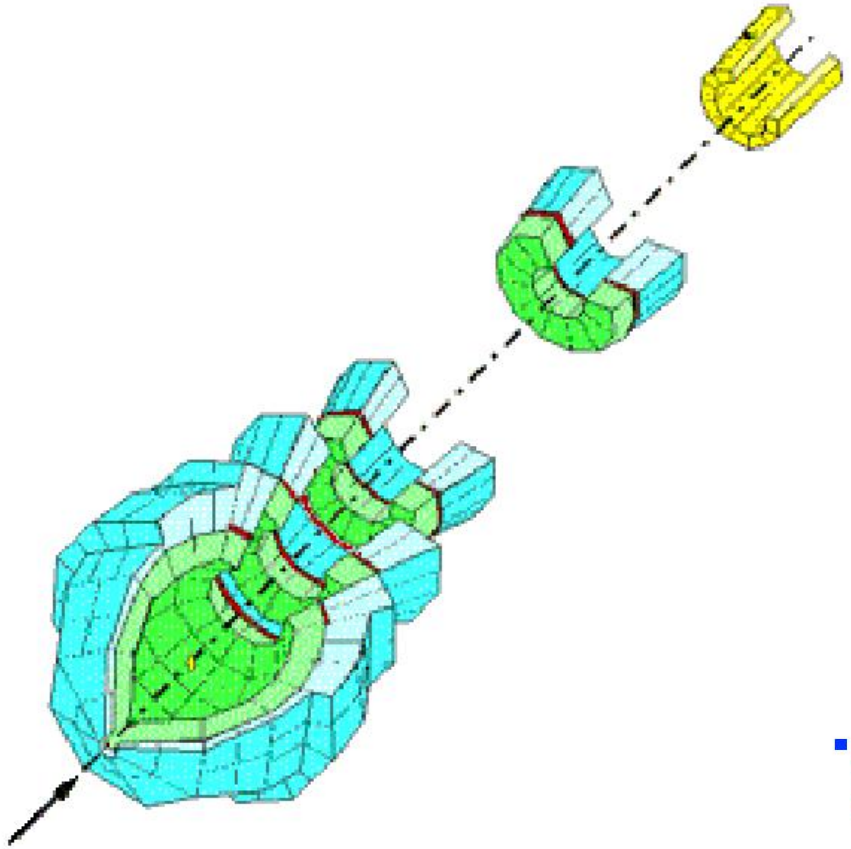
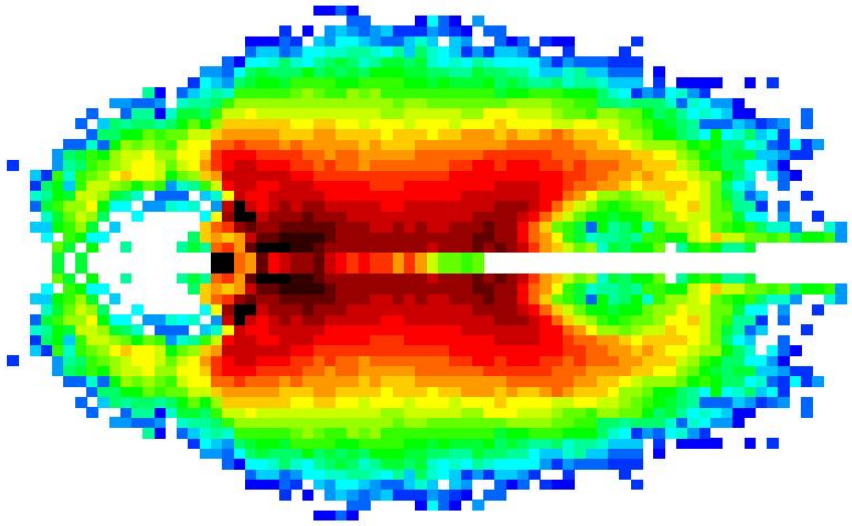
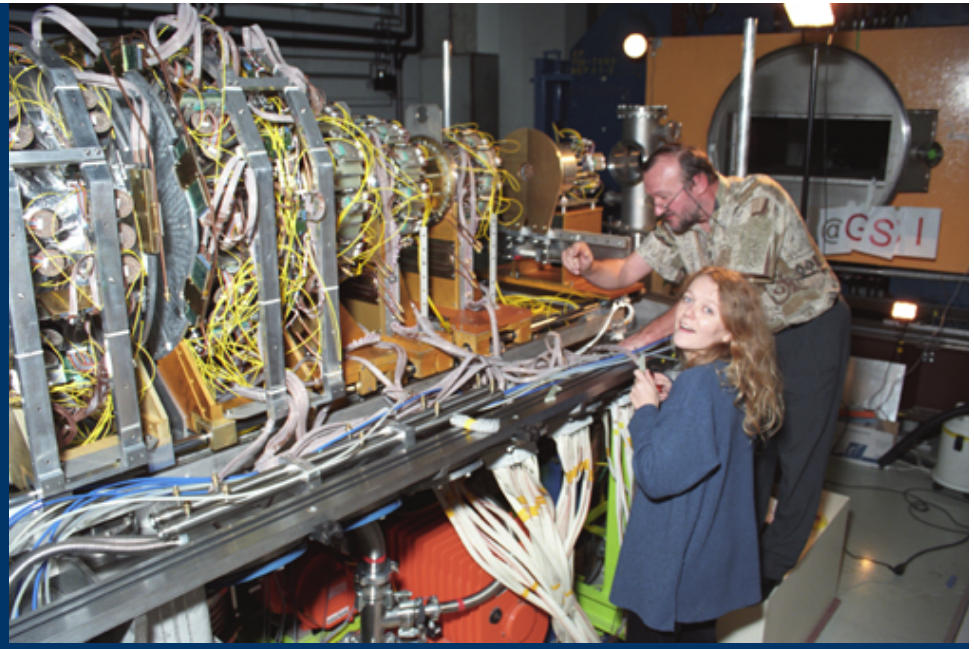
INDRA at GSI

November 1997 – April 1999



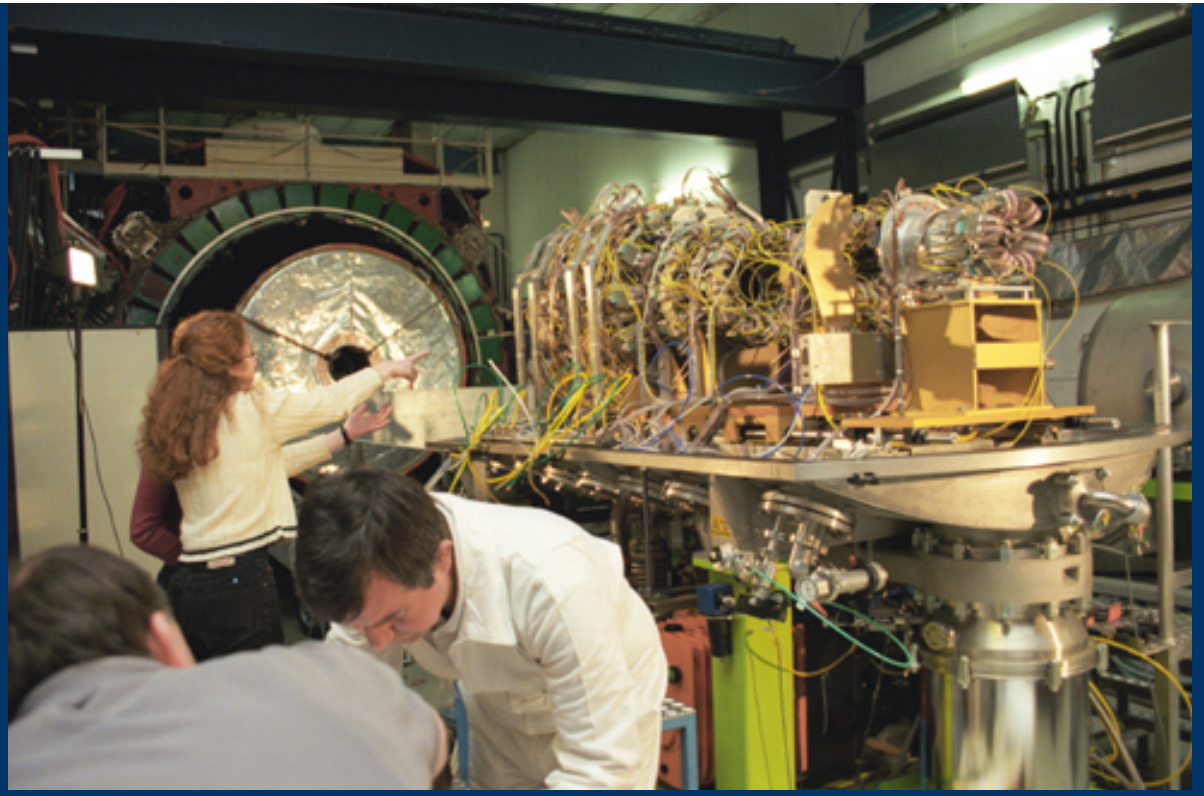
Z=3
Au + Au
80 AMeV
very peripheral



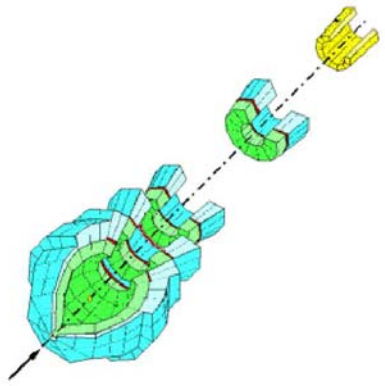


1997

1999

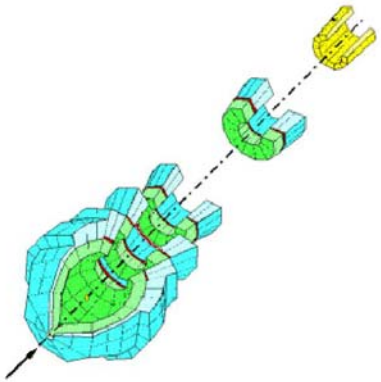


INDRA at GSI



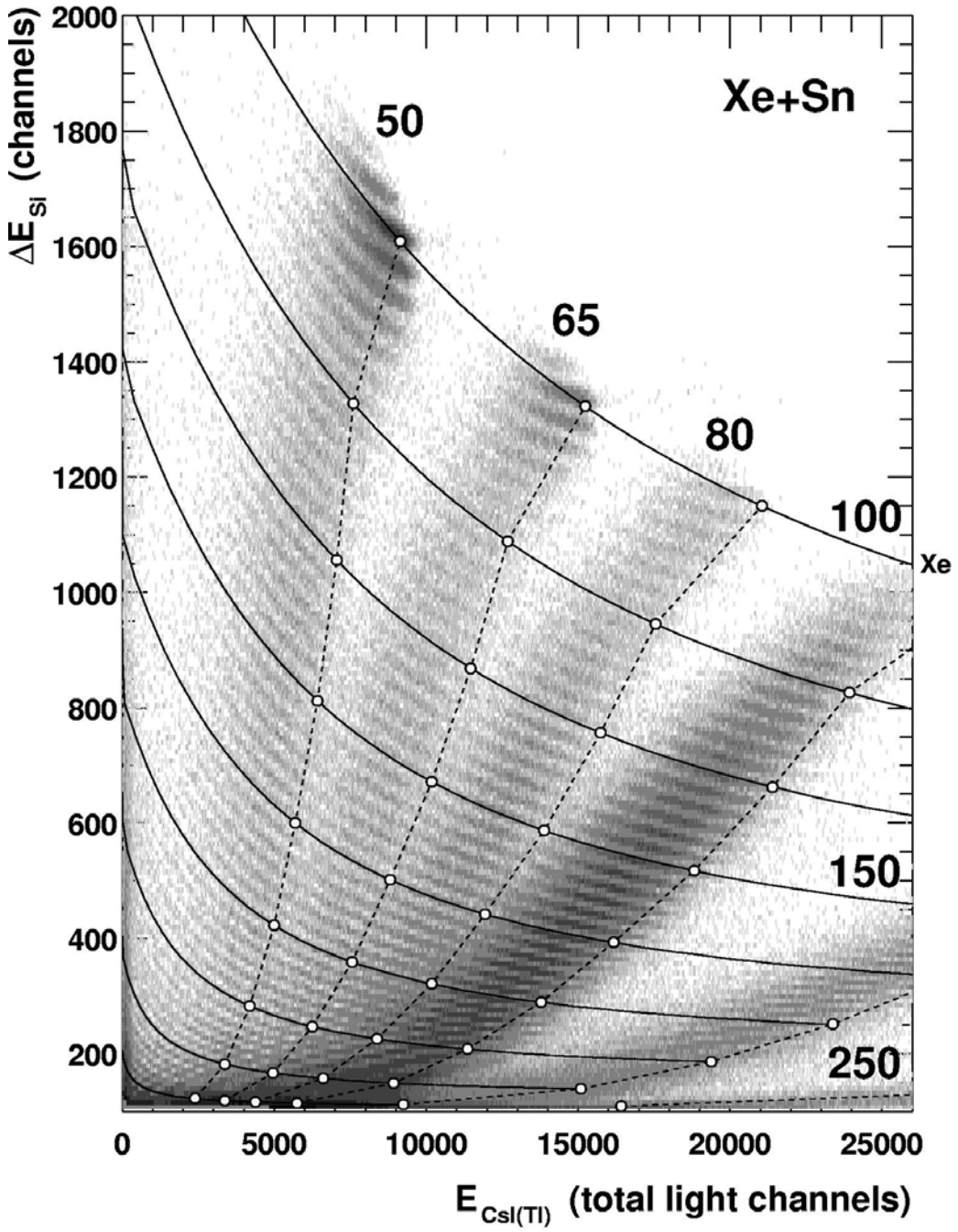
Systems:
Au + Au 40 to 150 AMeV
Xe + Sn 50 to 250 AMeV
C + Au 95 to 1800 AMeV

Identification



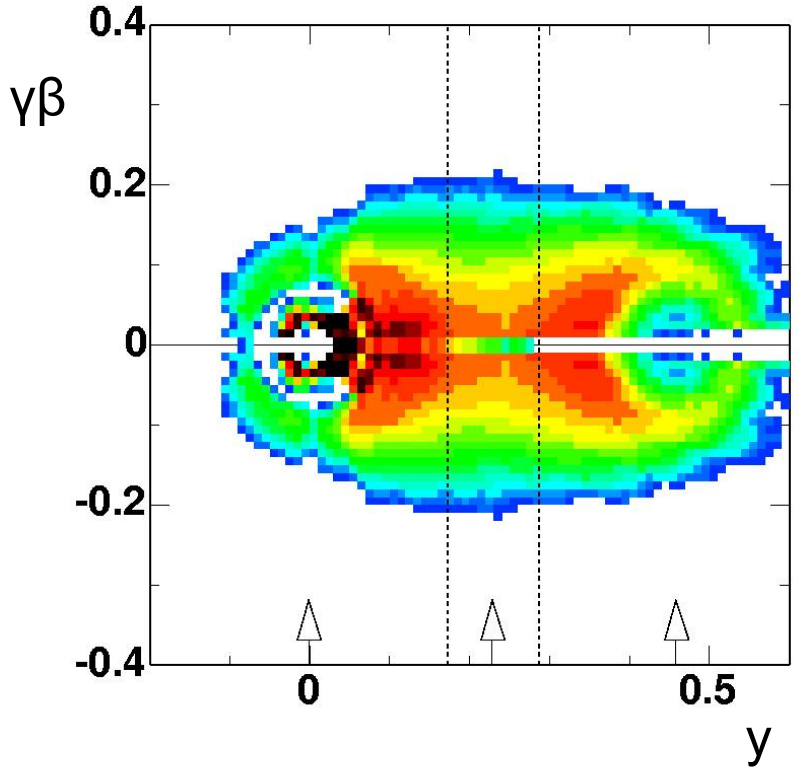
Ring 1

Pârlog parameterization



Part I:

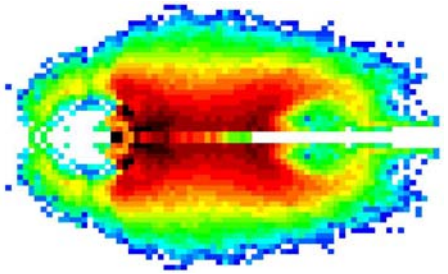
Au + Au



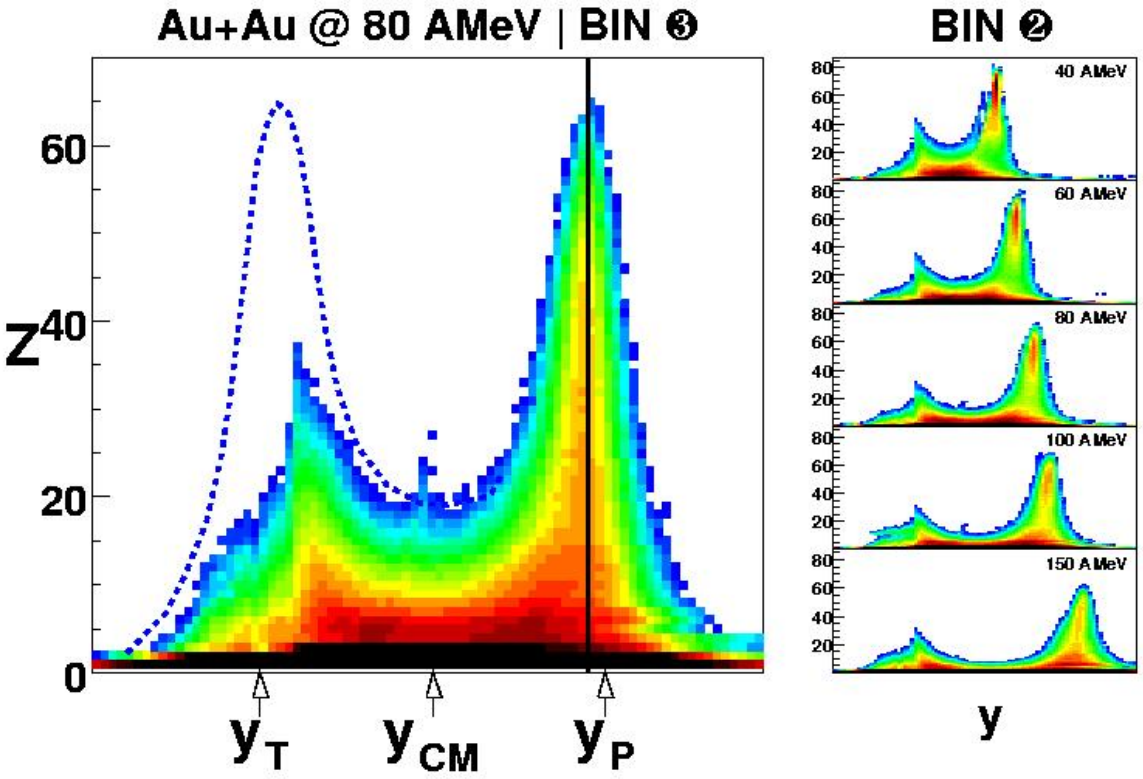
Z = 3 at 100 A MeV

Peripheral

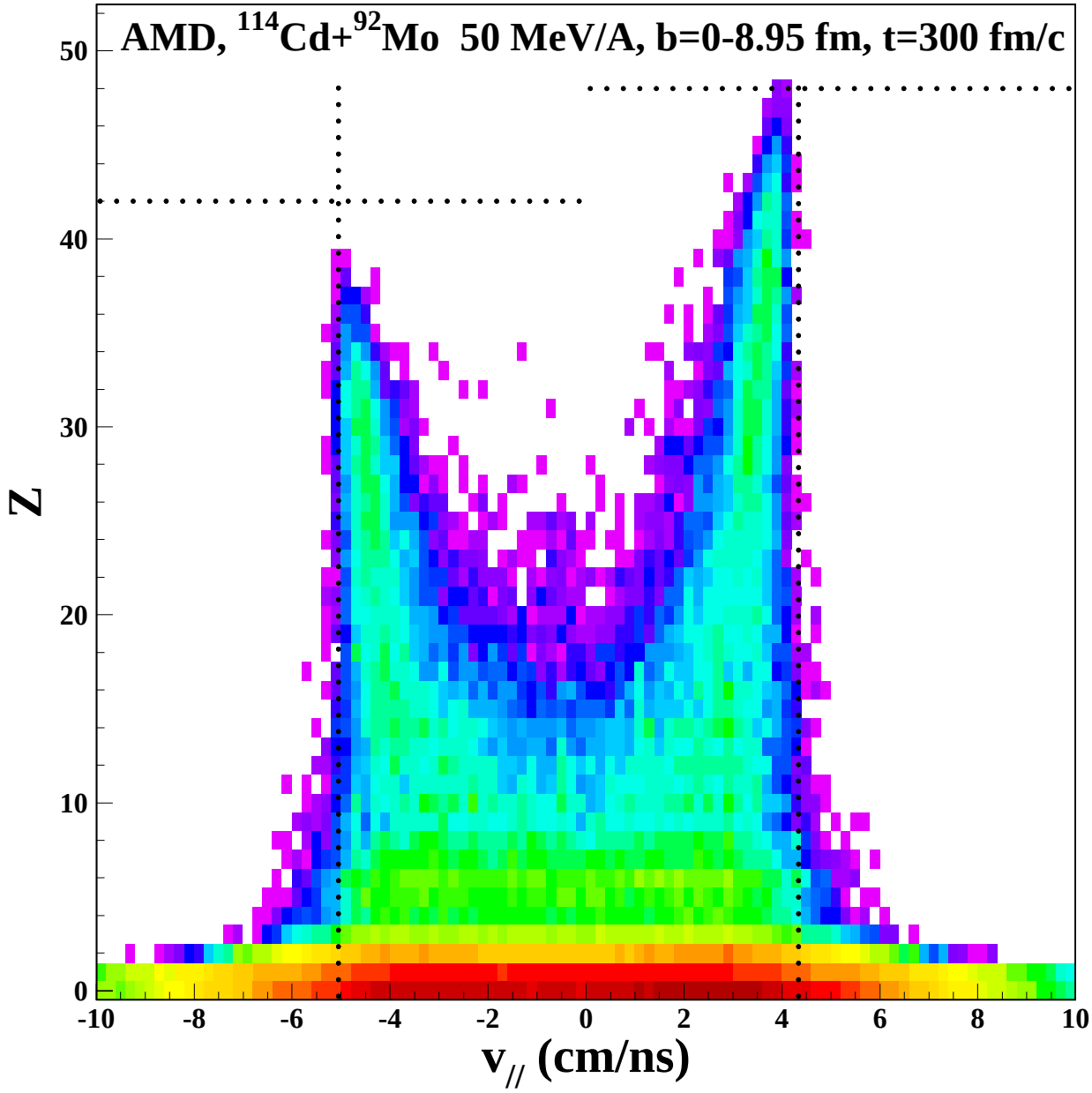
Rapidity distributions



Z = 3 at 80 A MeV



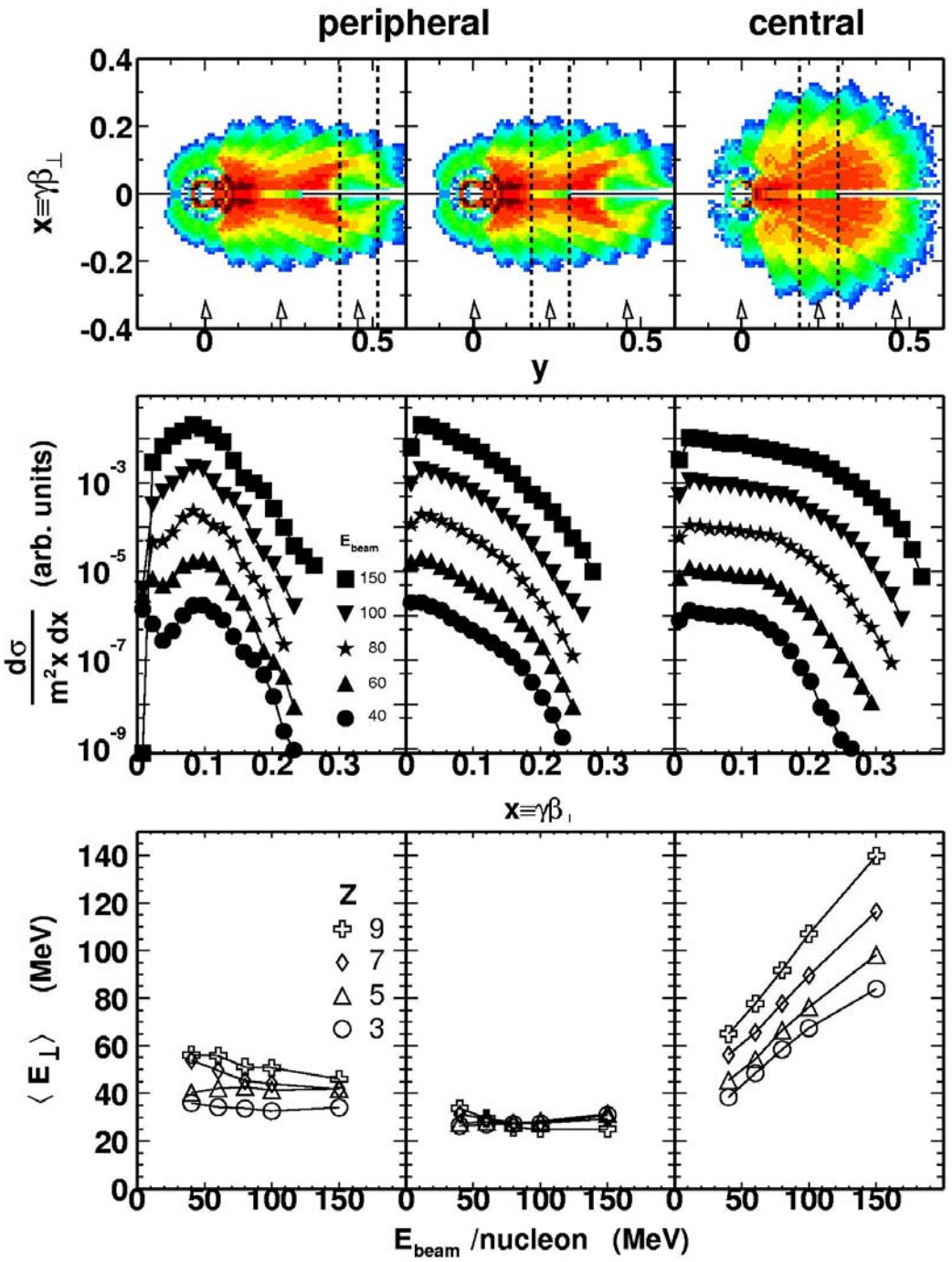
AMD



from Sylvie Hudan, Indiana University

see also:
A. Ono, S. Hudan, A. Chbihi, and J. D. Frankland, PRC 66, 014603 (2002)

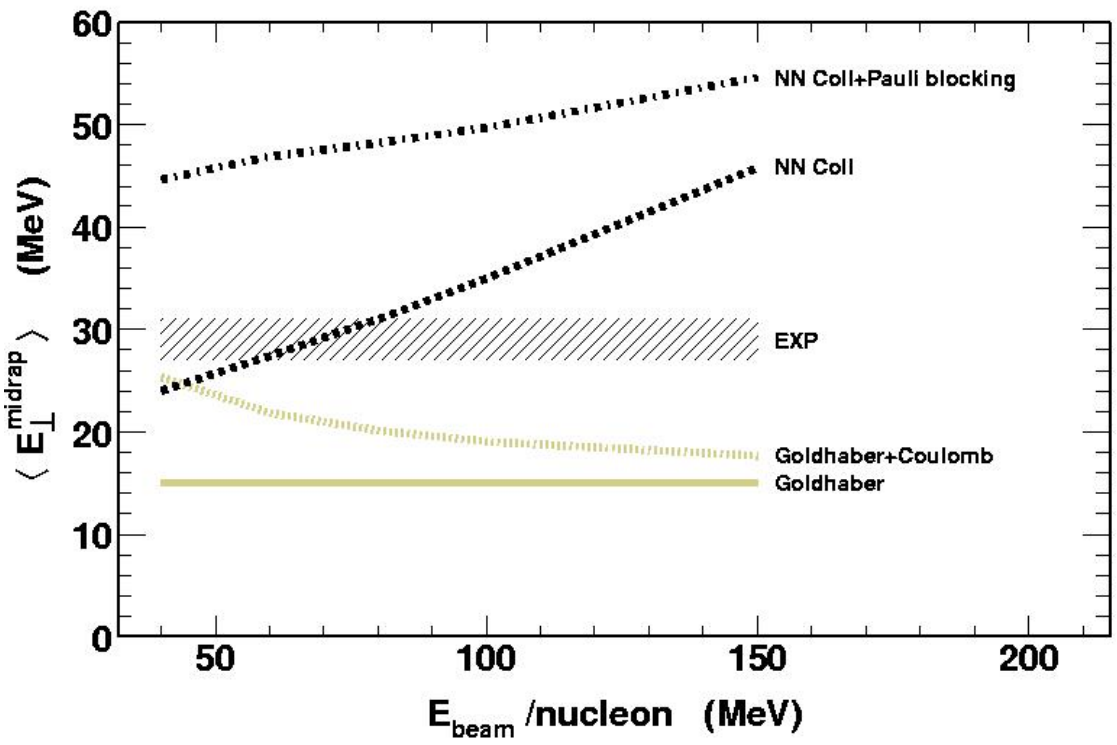
Transverse velocity spectra



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

Contributions to transverse energies

at midrapidity



Fermi motion is not enough

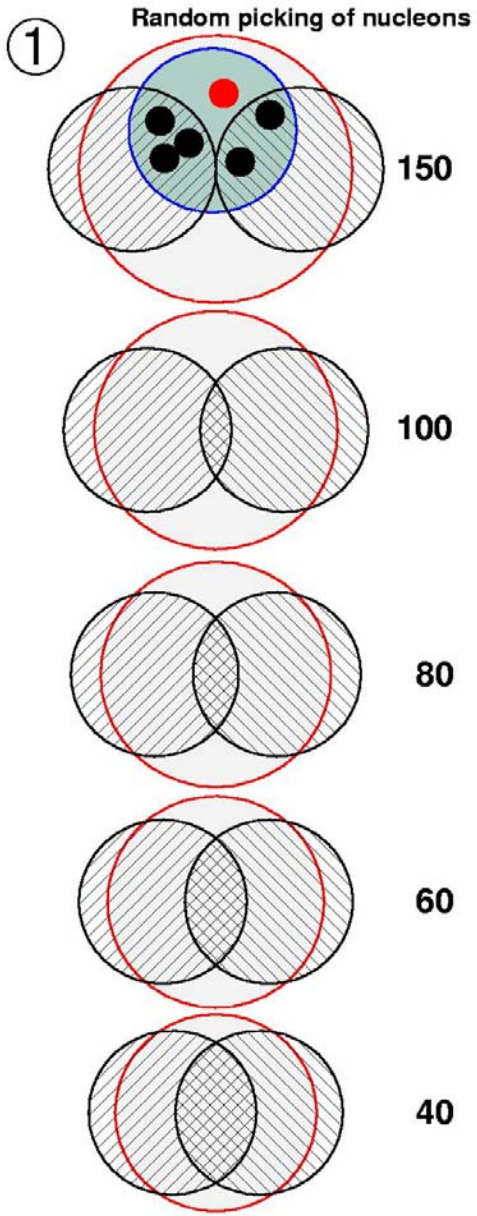
N-N scattering is too much

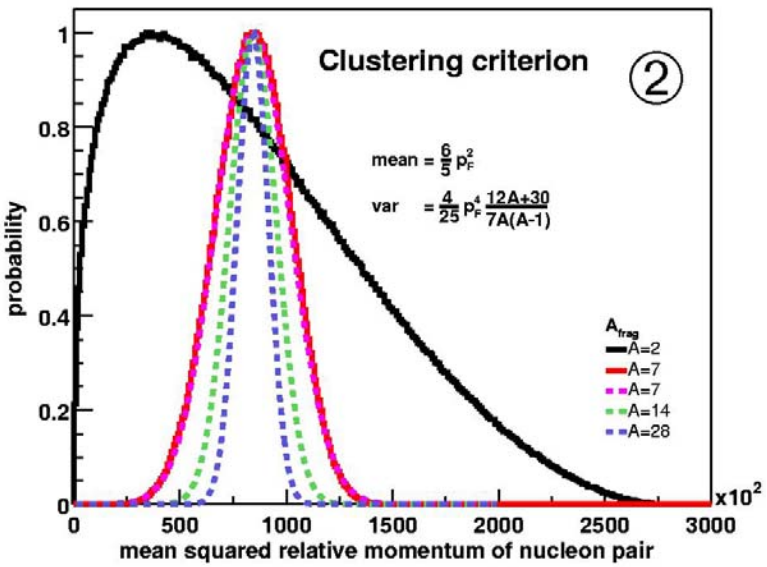
Compensation due to Coulomb

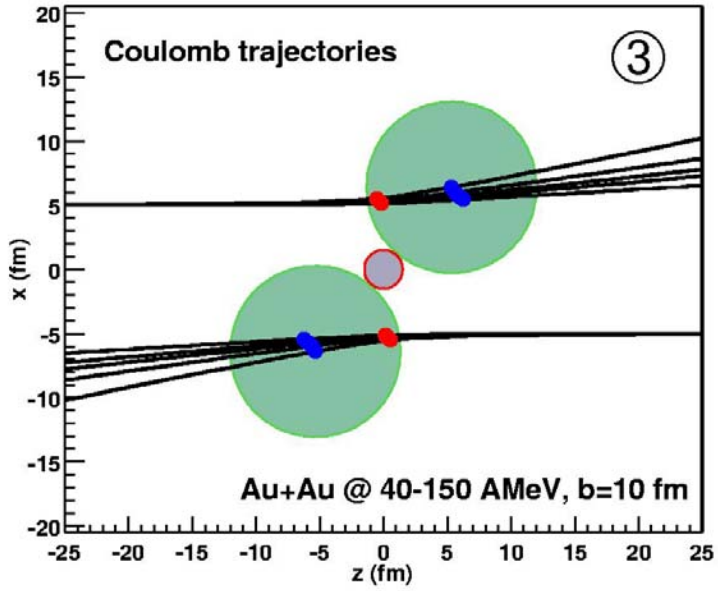
Extended Goldhaber model

in 3 steps

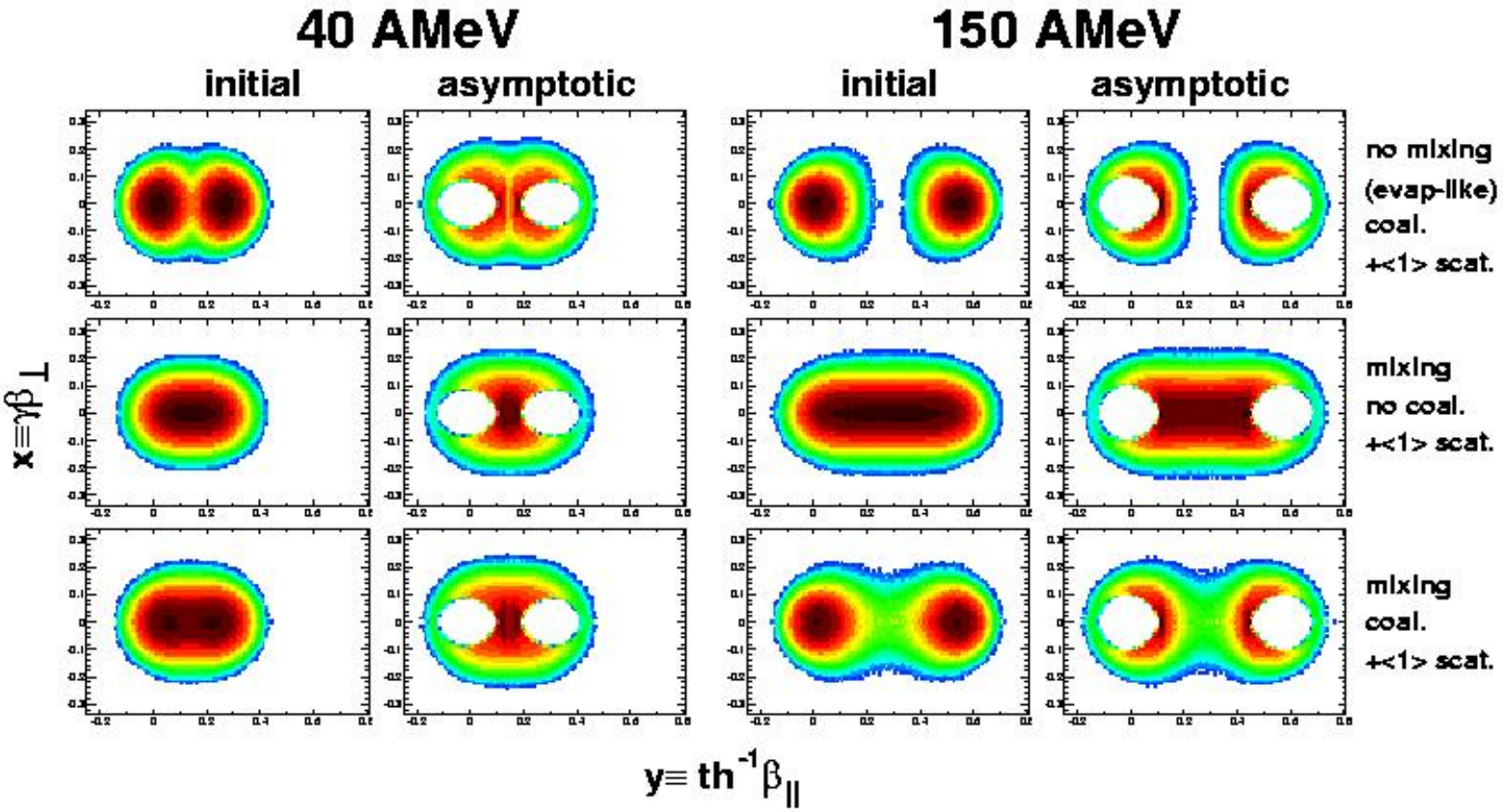
J. Łukasik et al., Phys. Lett. B 566 (2003) 76



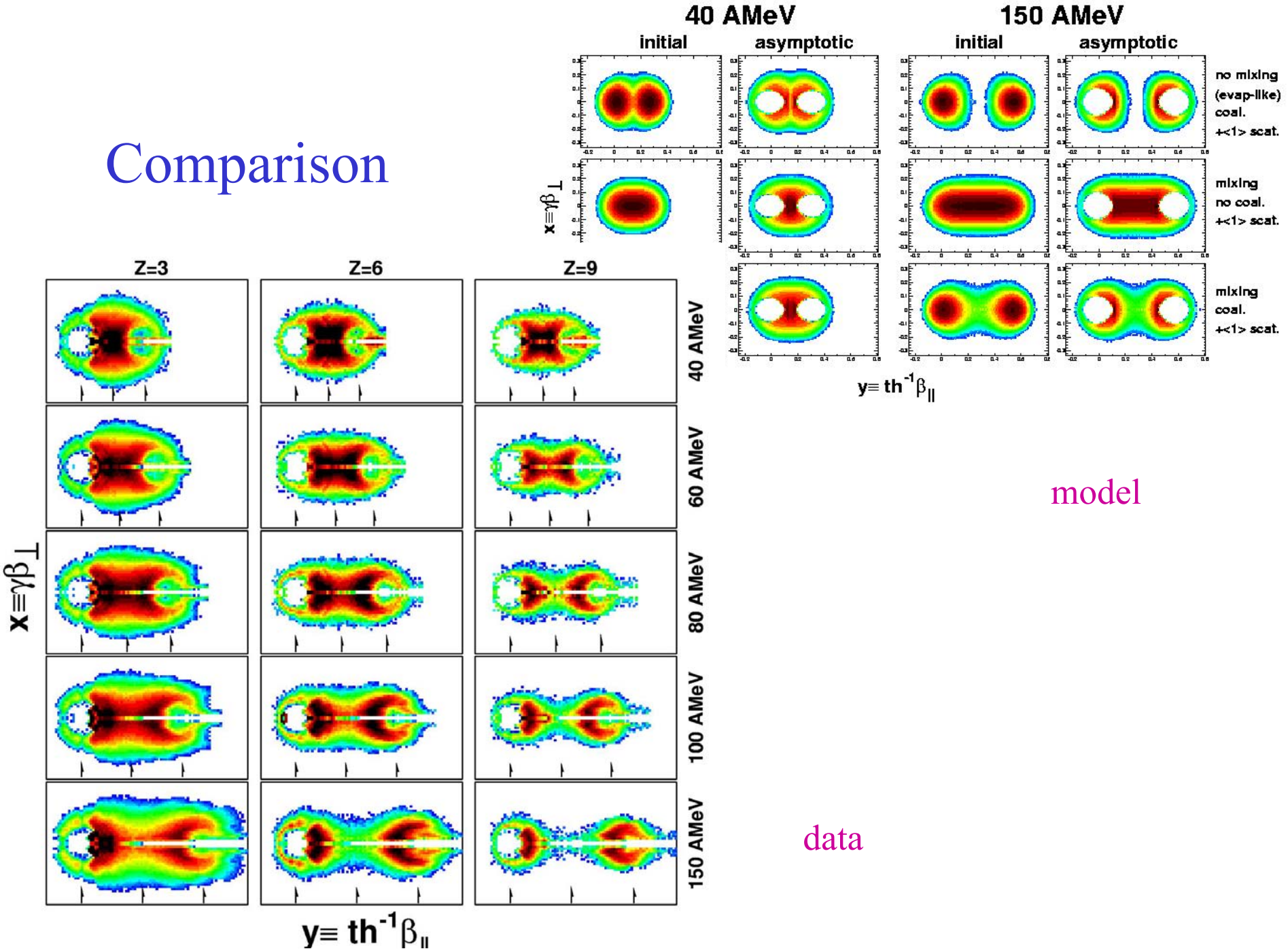




Model results



Comparison

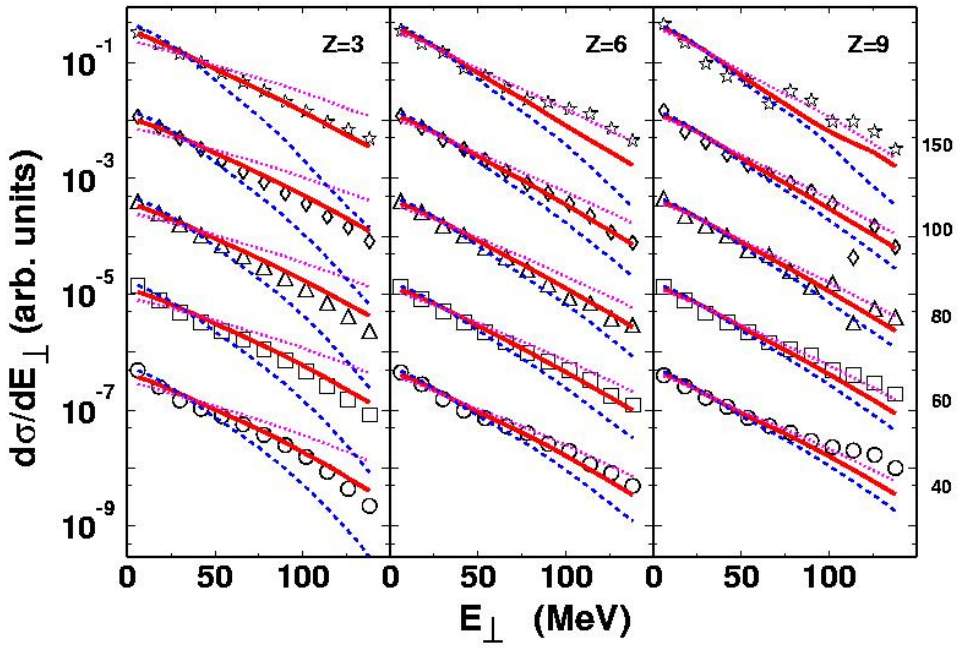


model

data

Quantitative description of data

Transverse energy spectra



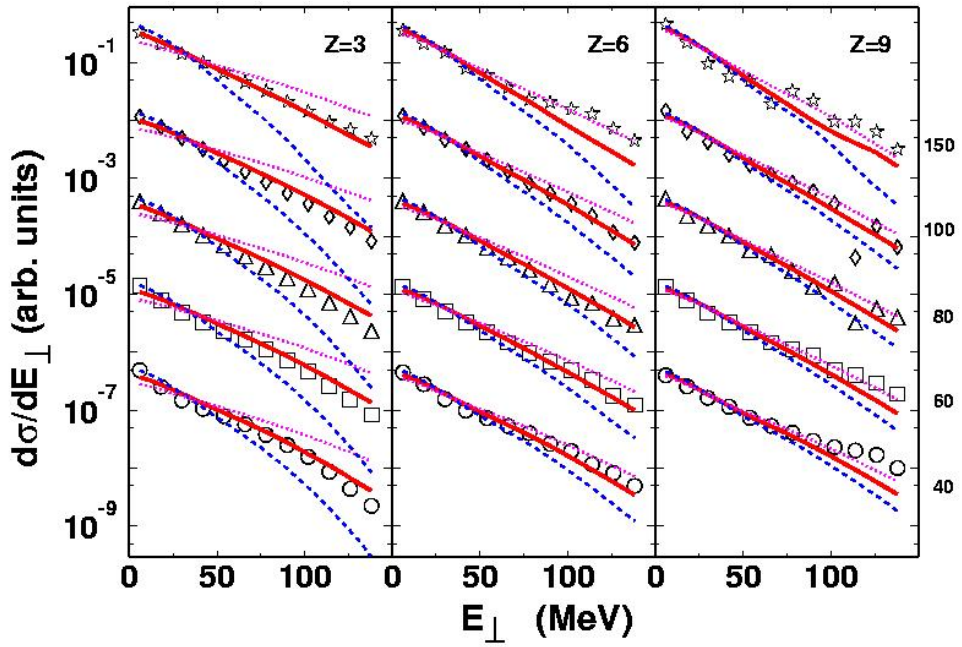
2 hard scattered

1 nucleons

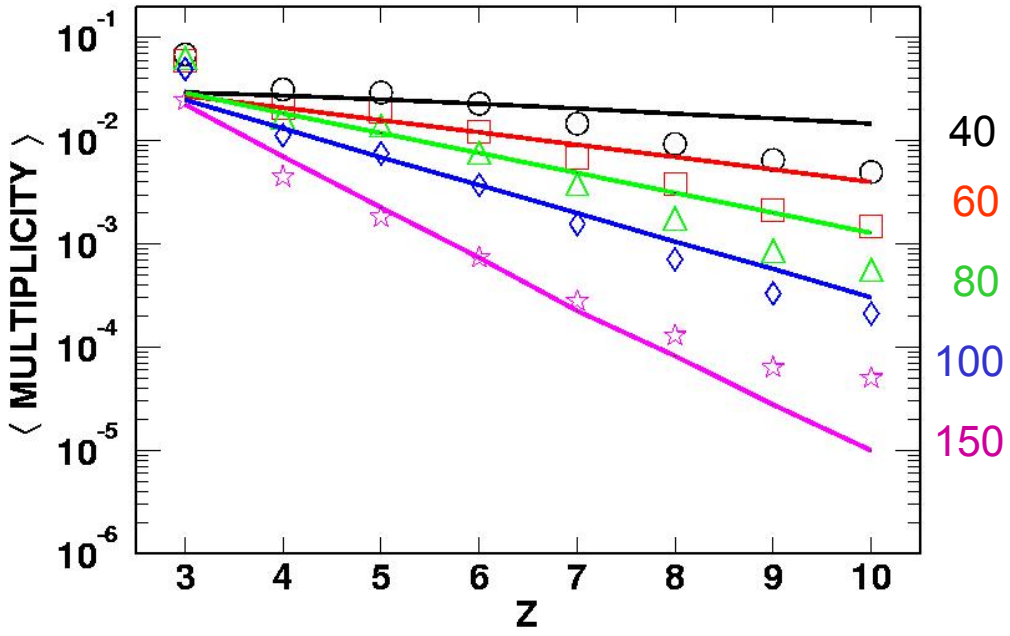
0

Quantitative description of data

Transverse energy spectra



Atomic number Z spectra



Questions/Conclusions

1) Where is the equilibrated neck ?

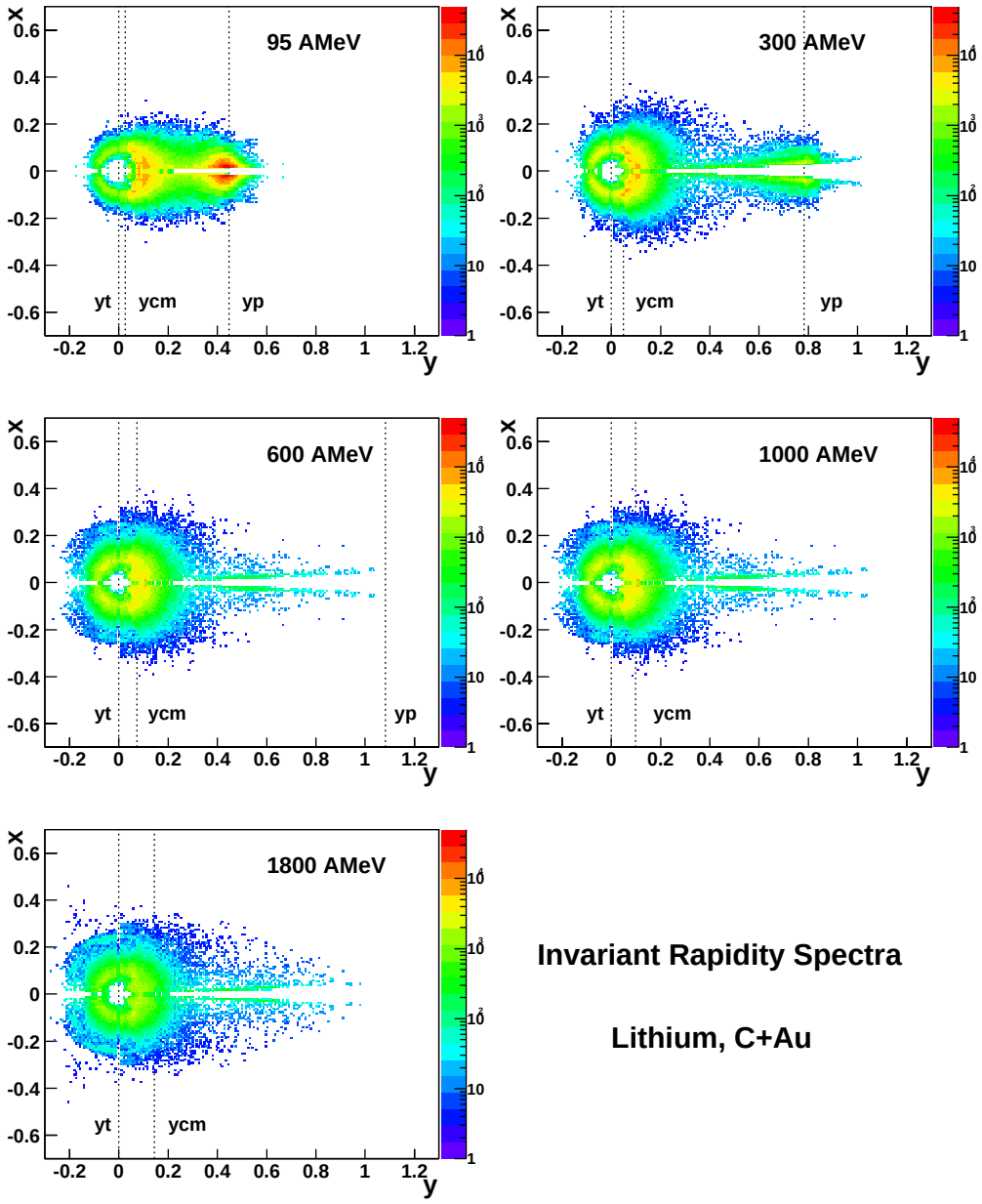
2) Where is the equilibrated target/projectile residue ?

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

see also Gaitanos et al., Odeh et al., Gadioli et al. and others

Part II:

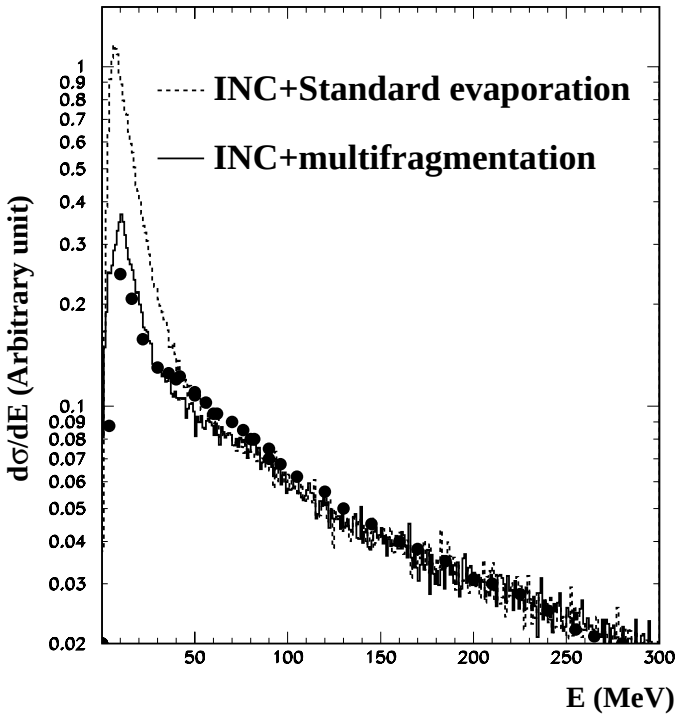
C + Au

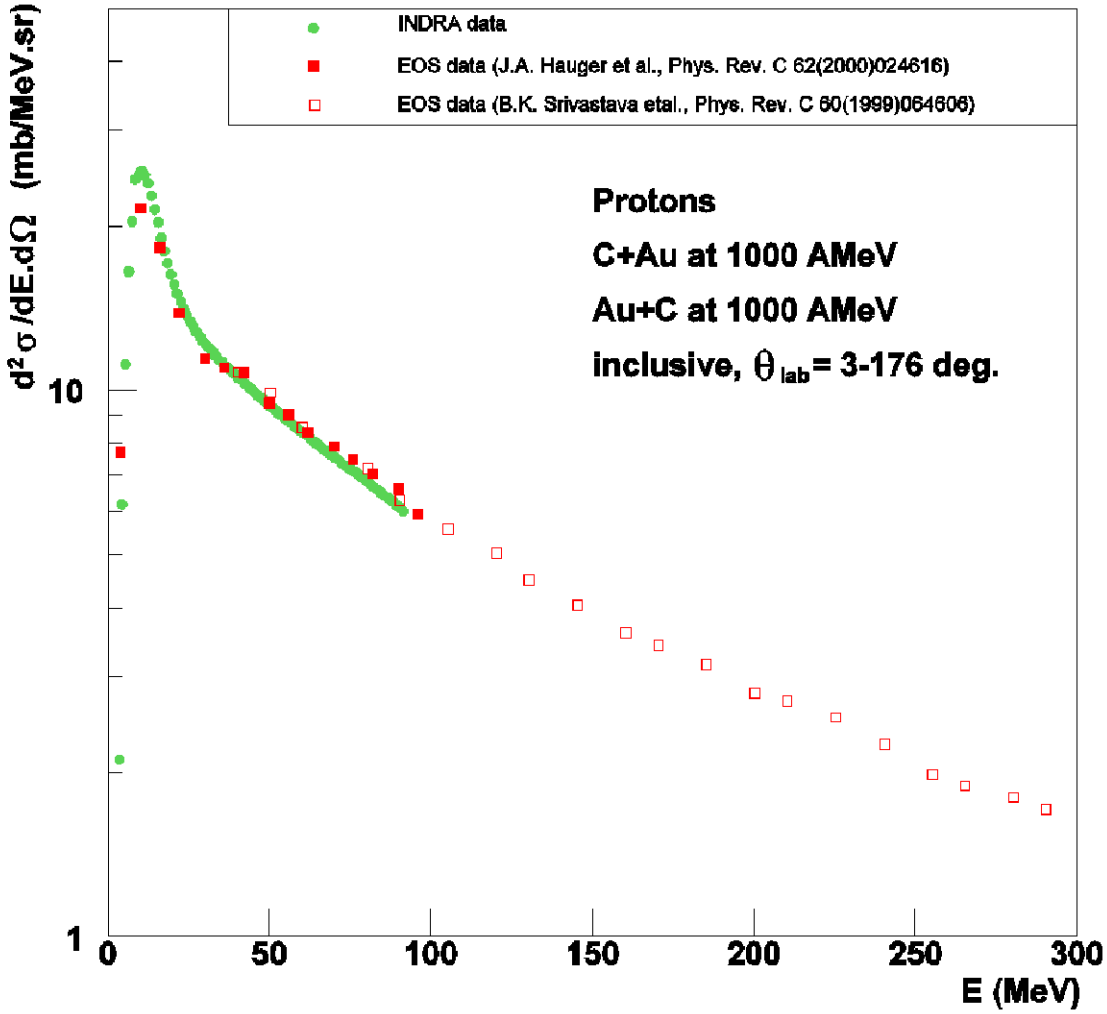


Invariant Rapidity Spectra

Lithium, C+Au

Protons with INDRA

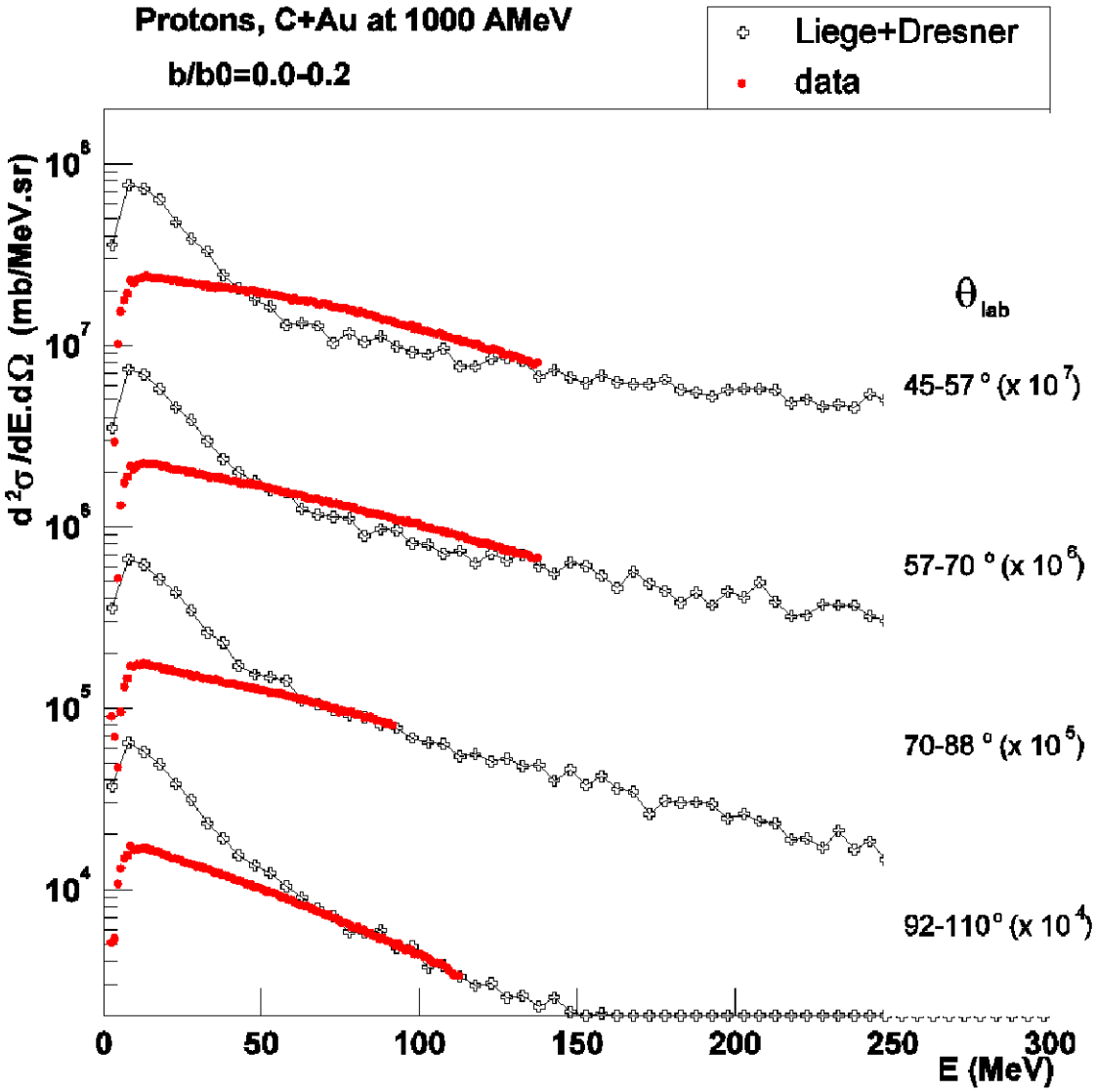




Evaporation overestimated by standard models

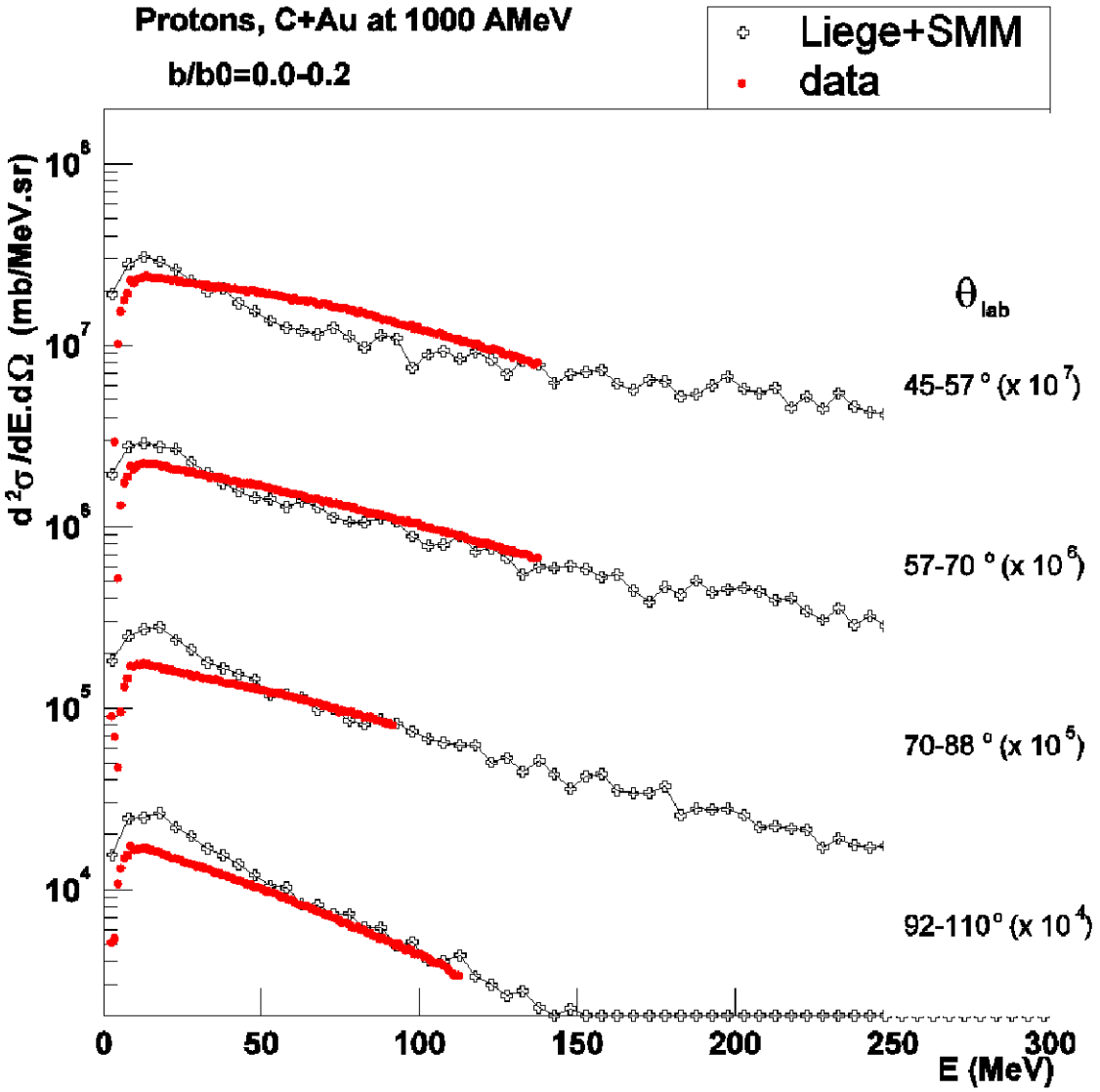
Protons

45^0 to 110^0
Dresner
central



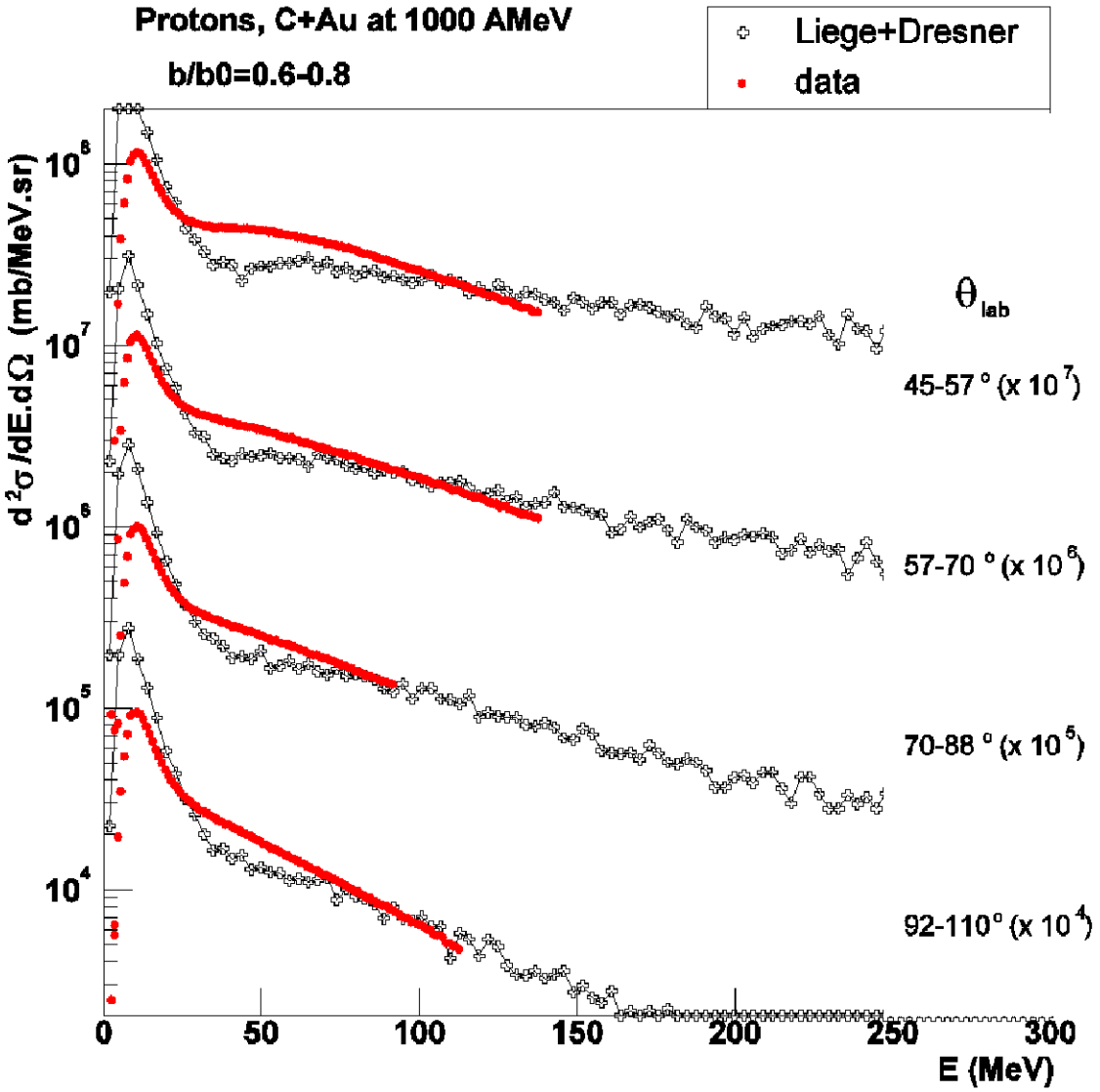
Protons

45^0 to 110^0
SMM
central



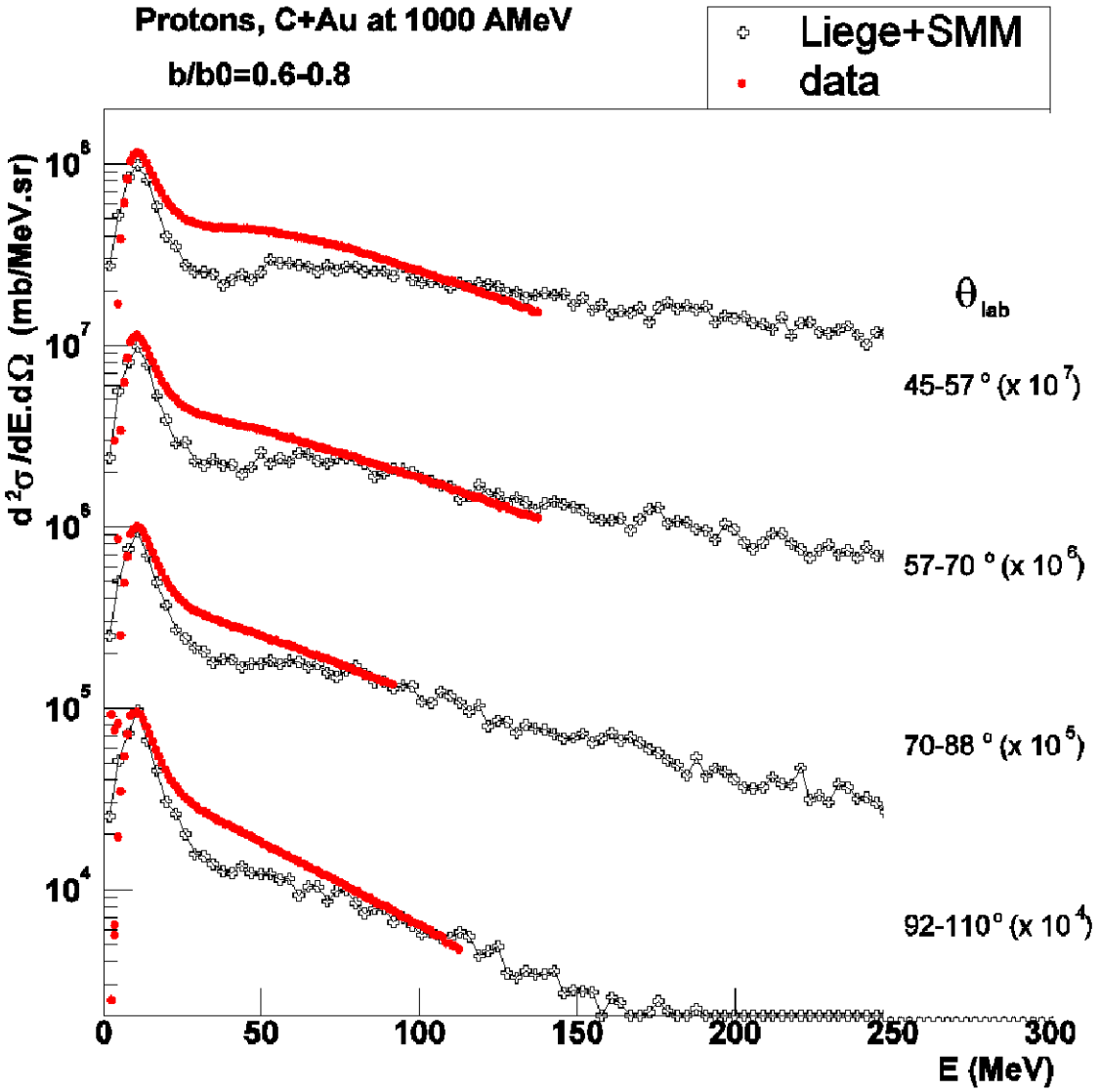
Protons

45^0 to 110^0
Dresner
fairly peripheral

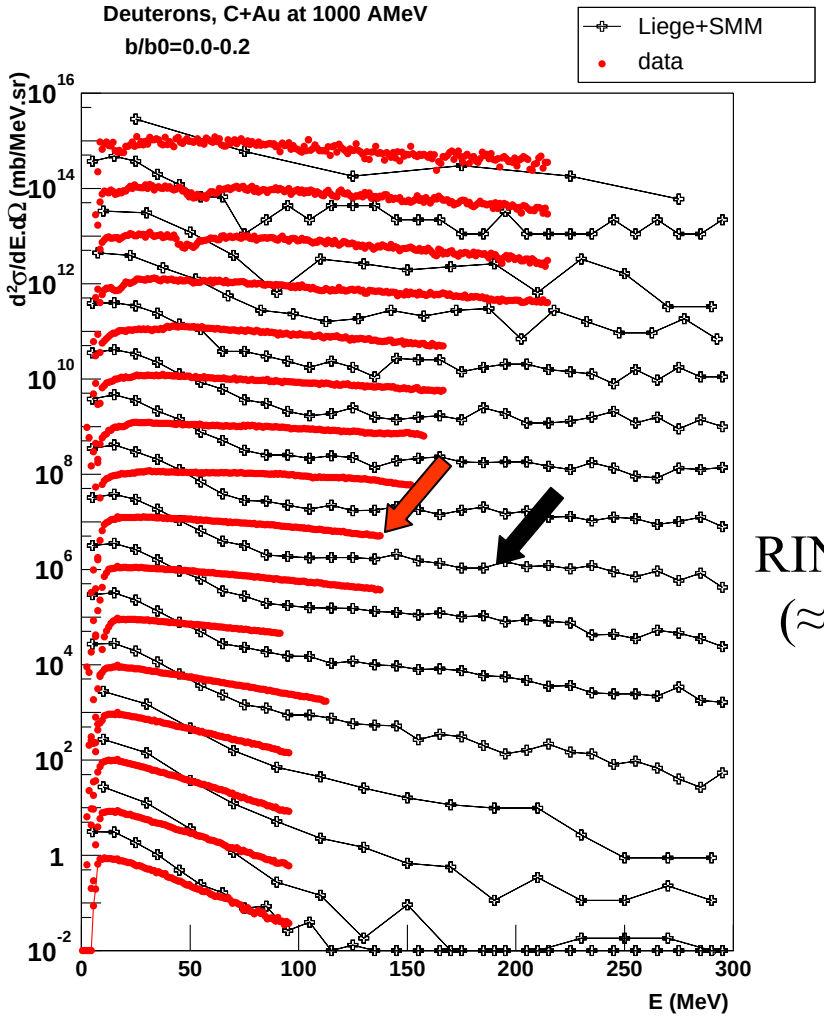


Protons

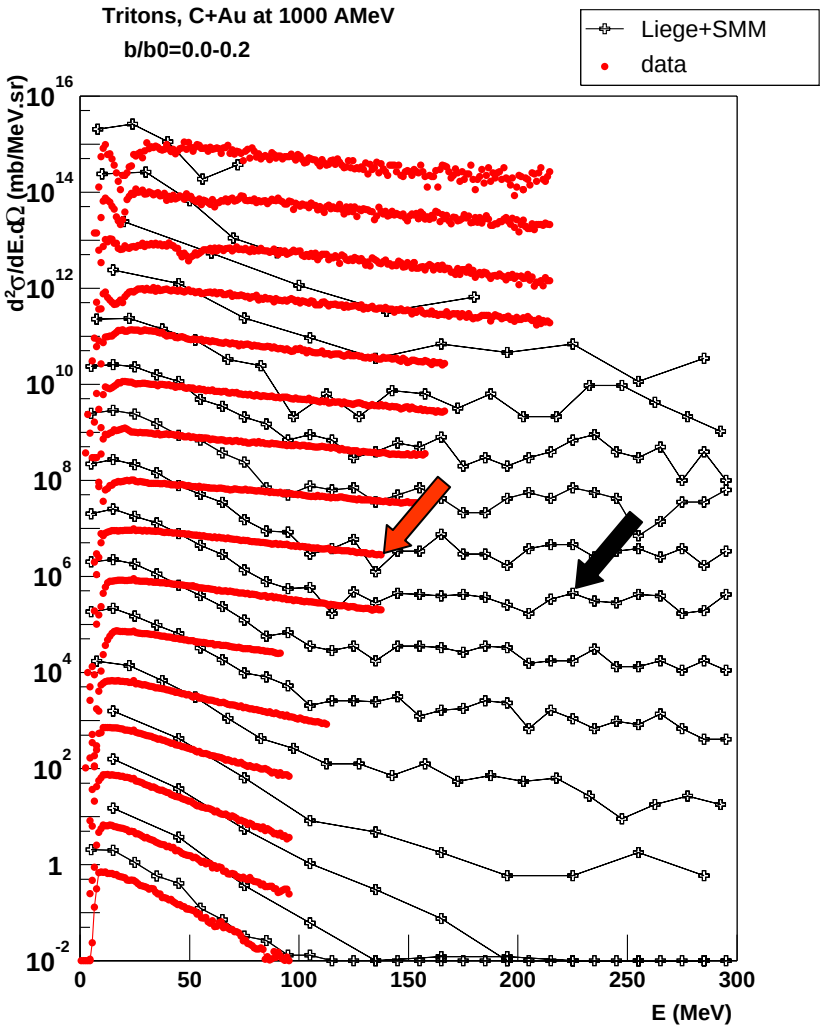
45^0 to 110^0
SMM
fairly peripheral



Deuterons and Tritons

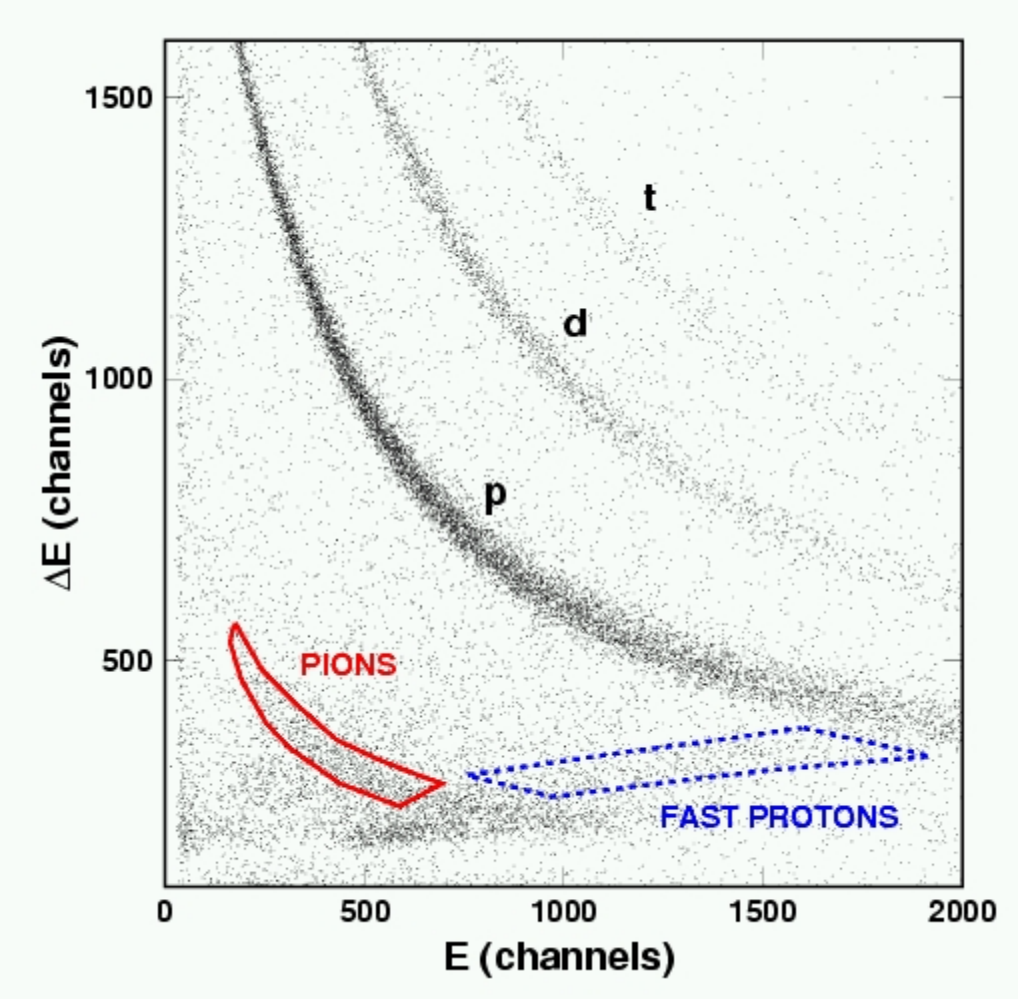


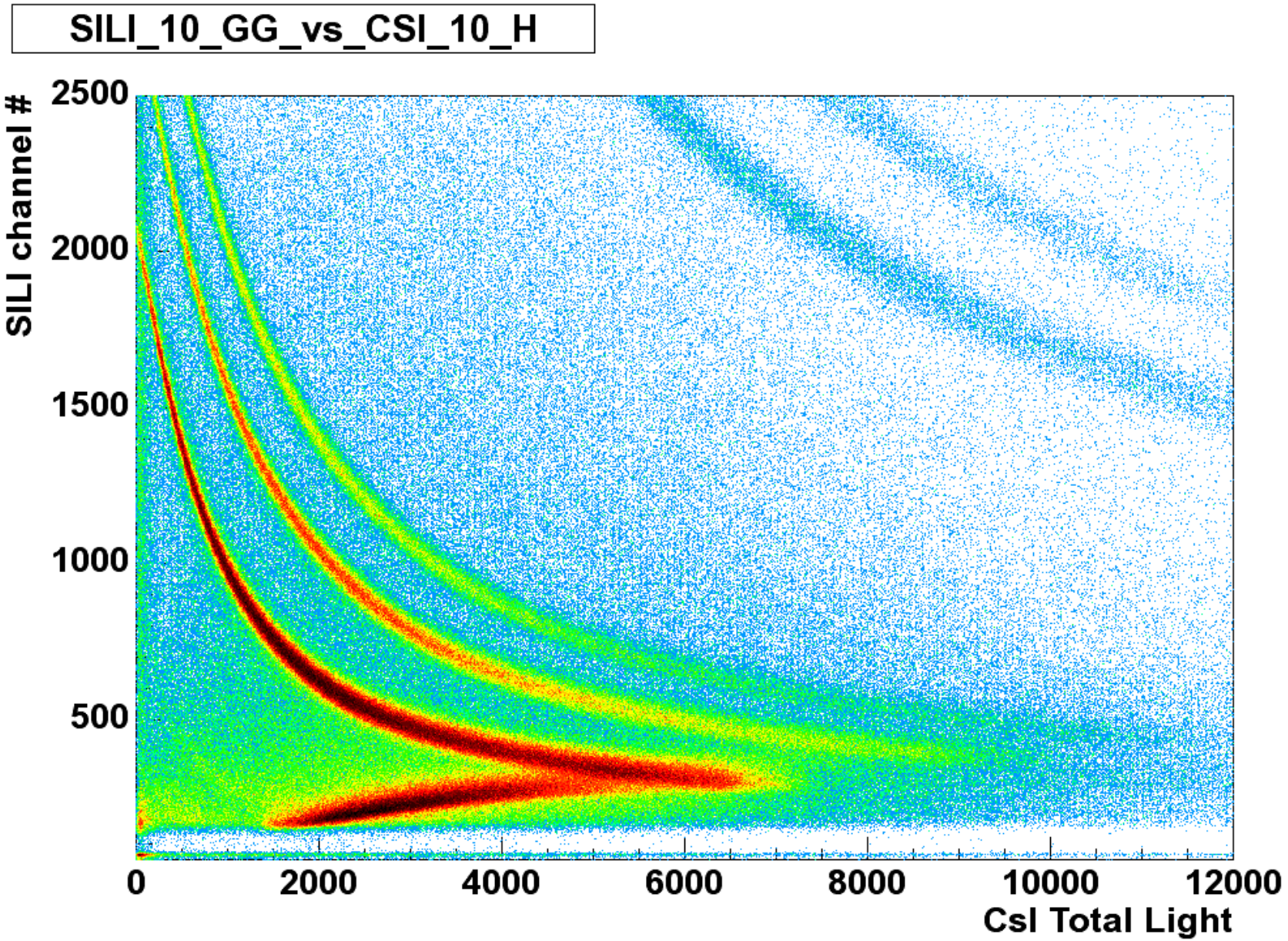
RING 10
($\approx 50^0$)

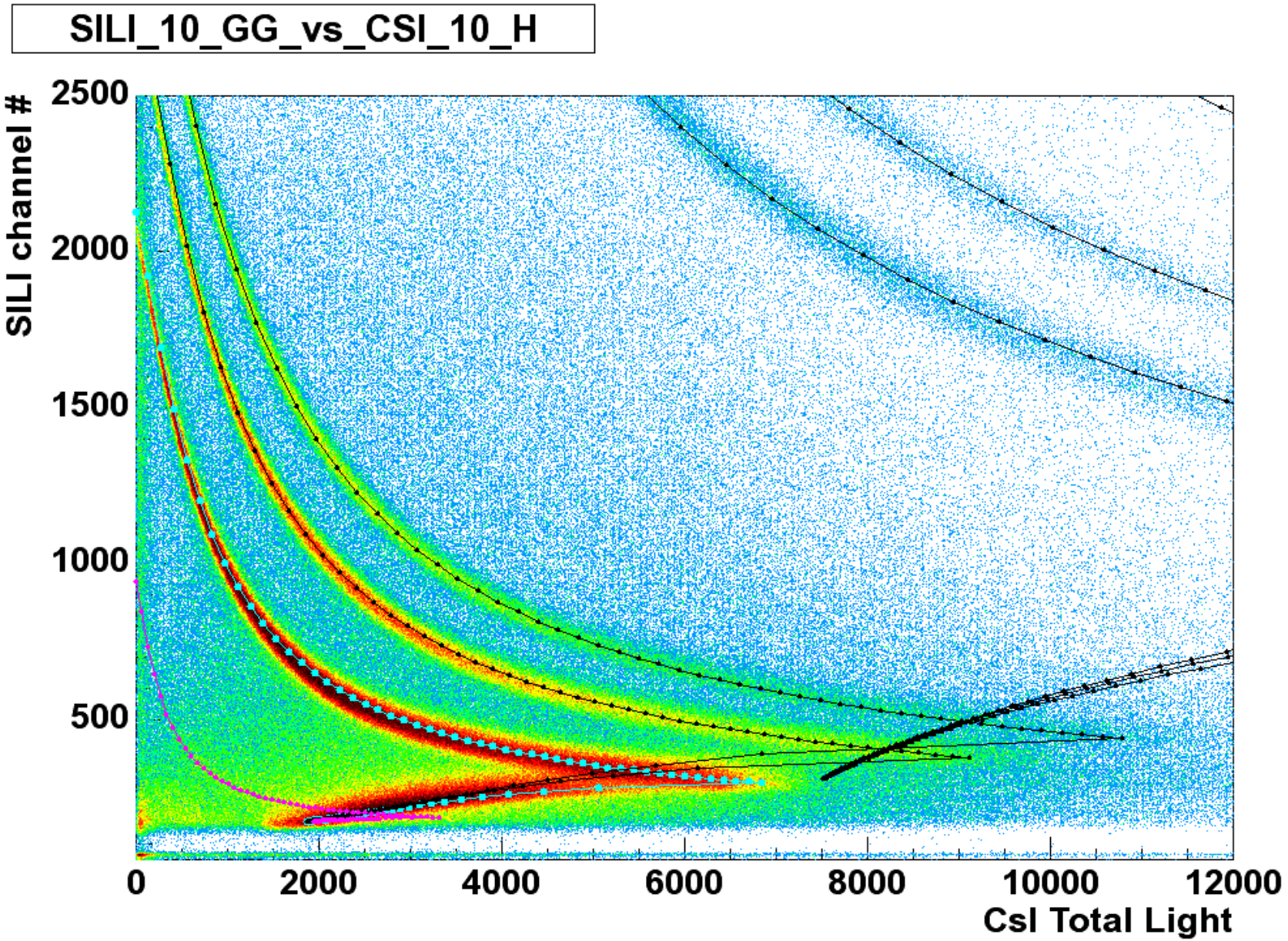


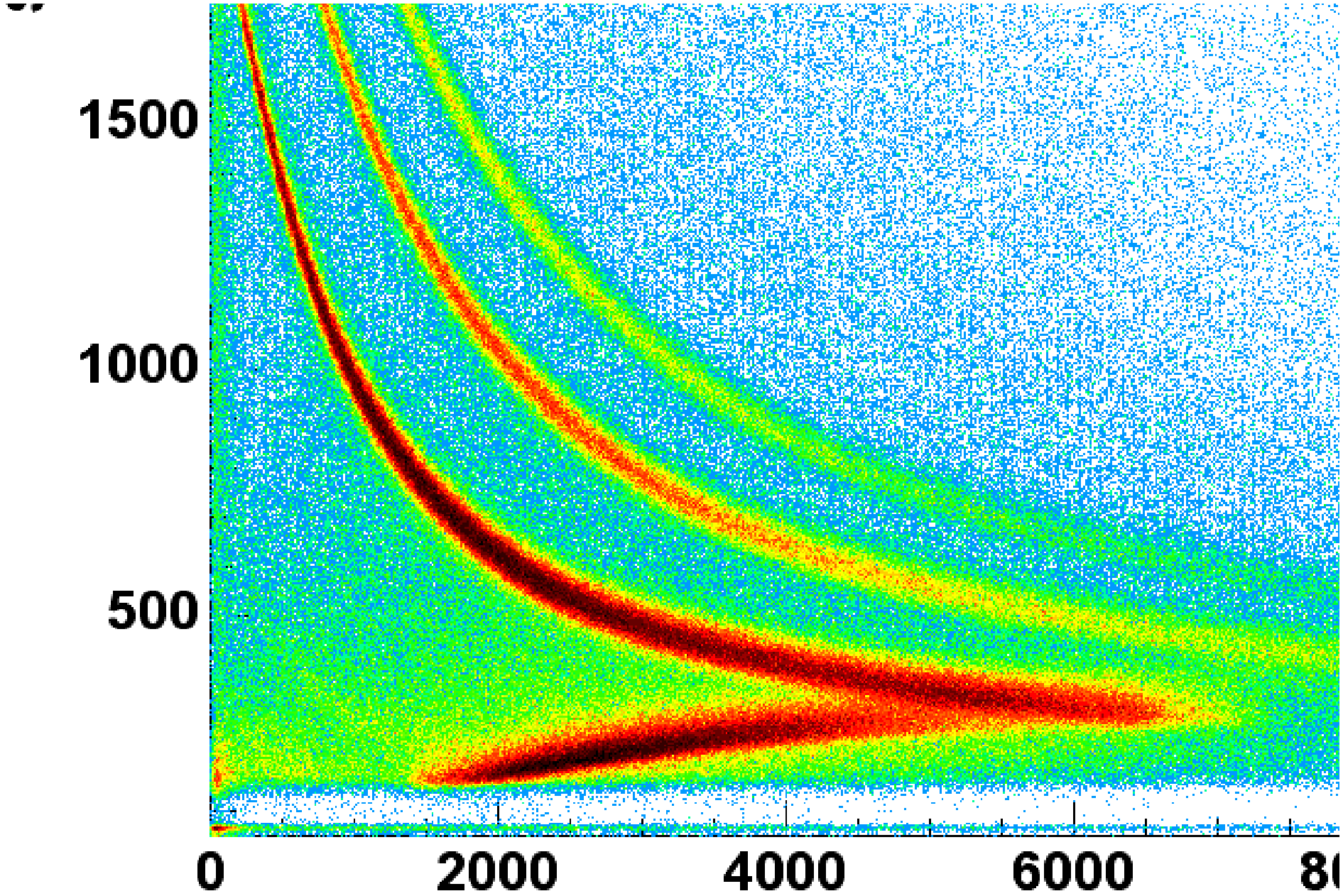
Pions with INDRA

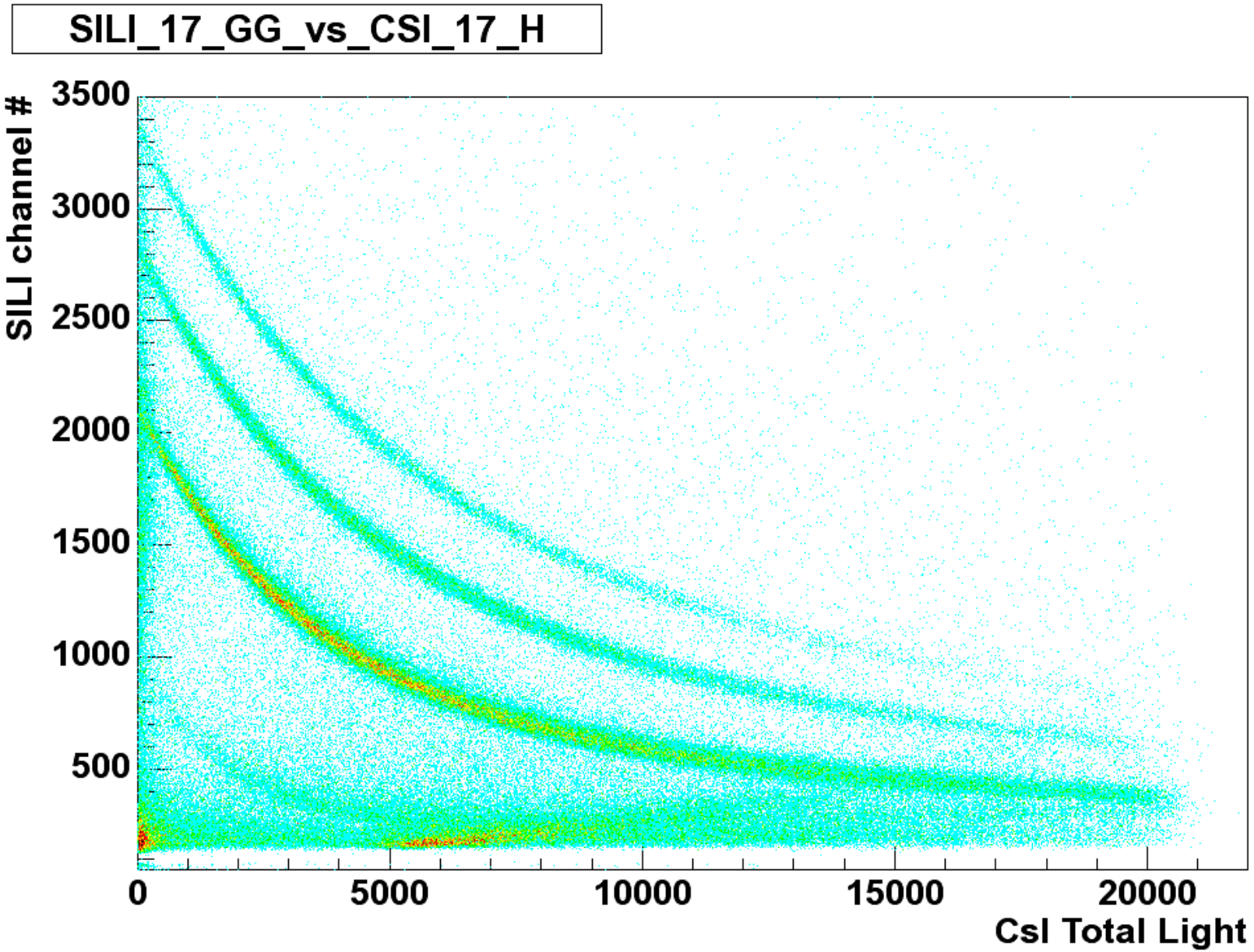
Etalons
Si(Li) 2mm / CsI(Tl)
Ring 13




SILI_10_GG_vs_CSI_10_H
SILI channel #
2500
2000
1500
1000
500
0
2000
4000
6000
8000
10000
12000
CsI Total Light


SILI_10_GG_vs_CSI_10_H
SILI channel #
2500
2000
1500
1000
500
0
2000
4000
6000
8000
10000
12000
CsI Total Light


1500
1000
500
0
2000
4000
6000


SILI_17_GG_vs_CSI_17_H
SILI channel #
3500
3000
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1500
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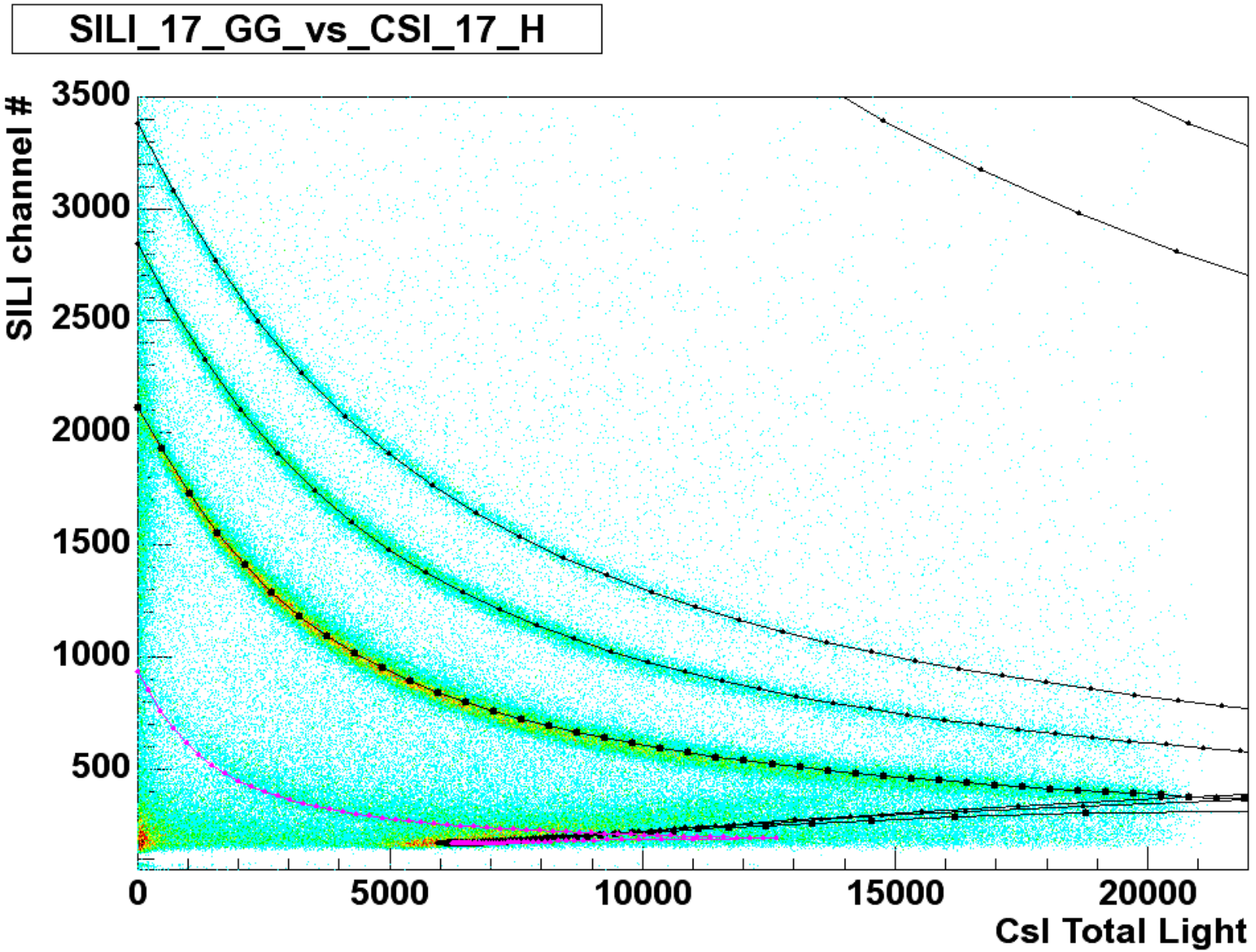
500
0
5000
10000
15000
20000
CsI Total Light


SILI_17_GG_vs_CSI_17_H
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500
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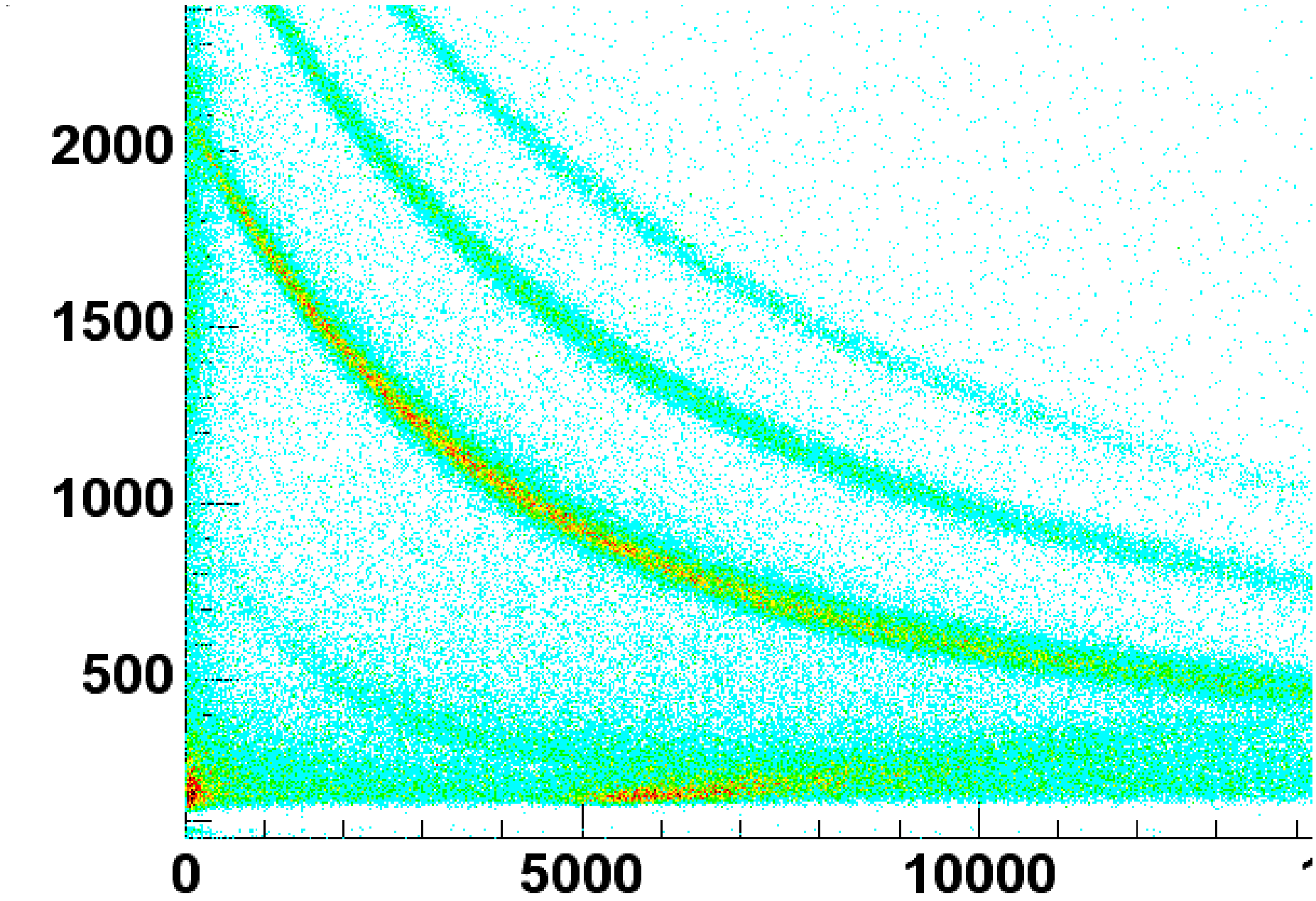
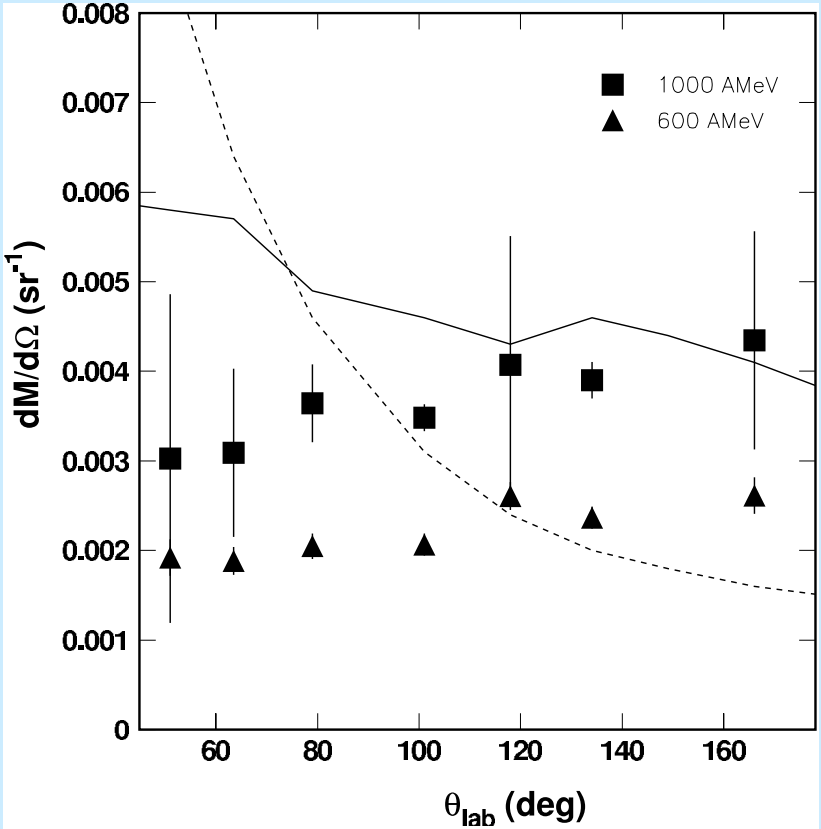
5000
10000
15000
20000
CsI Total Light

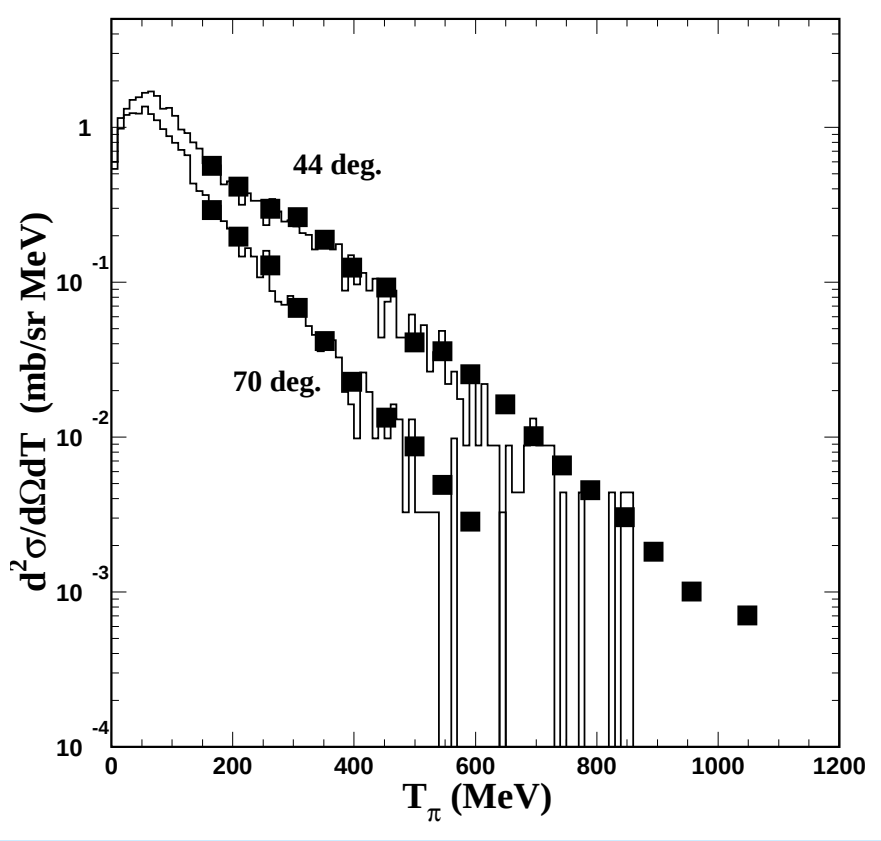

2000
1500
1000
500
0
5000
10000

Pion yields

Indra

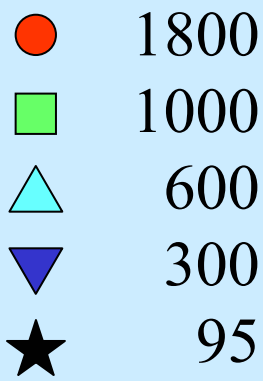


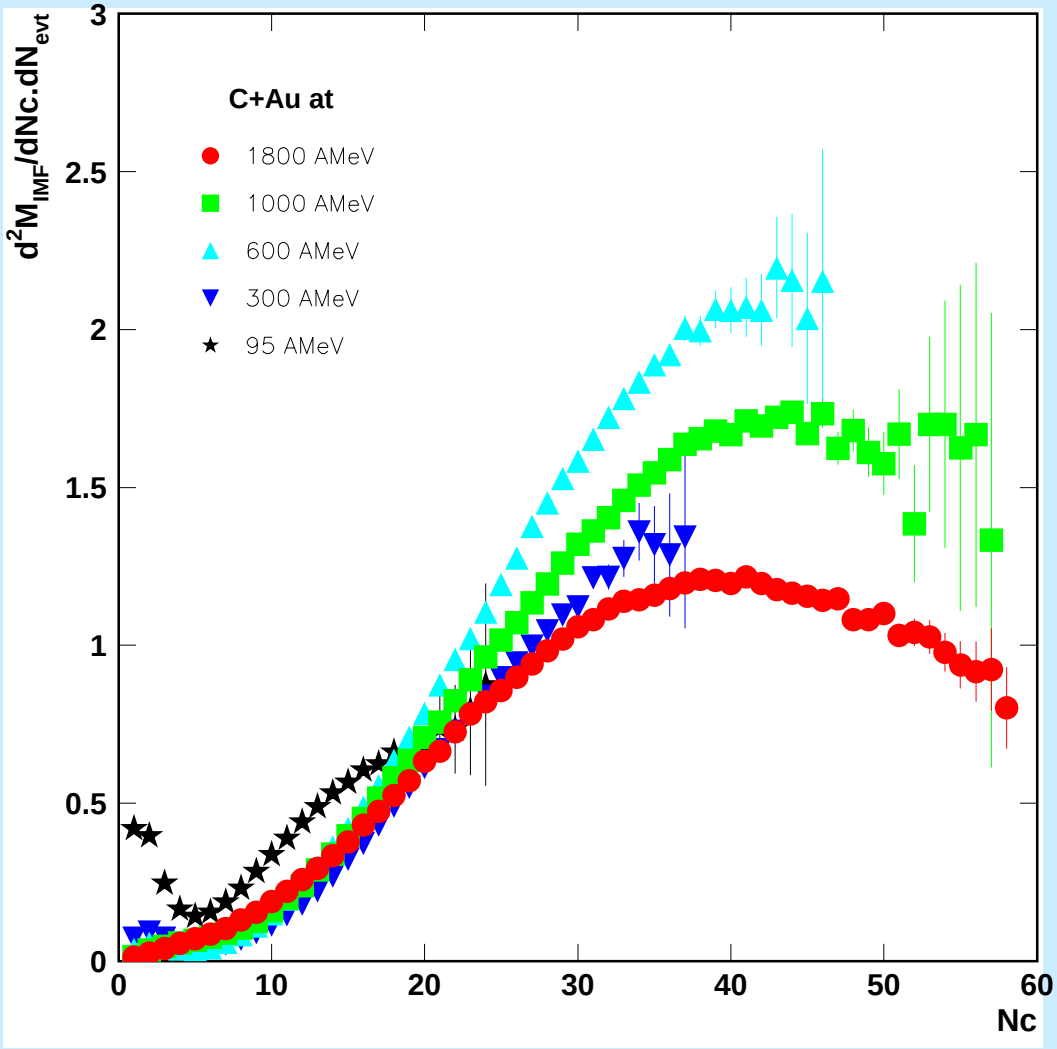
Kaos



Liège Intranuclear Cascade

Fragment multiplicities

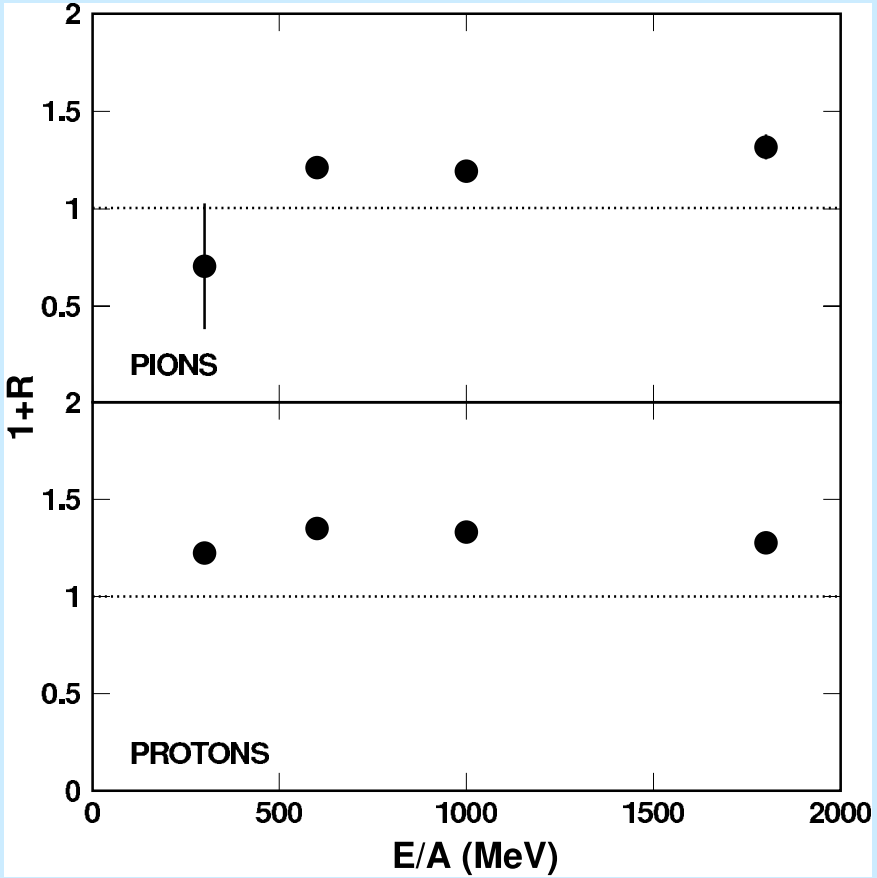




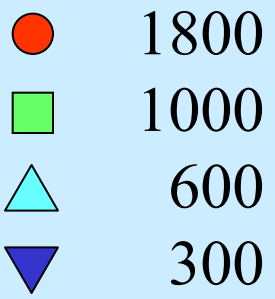
Multiplicity correlations

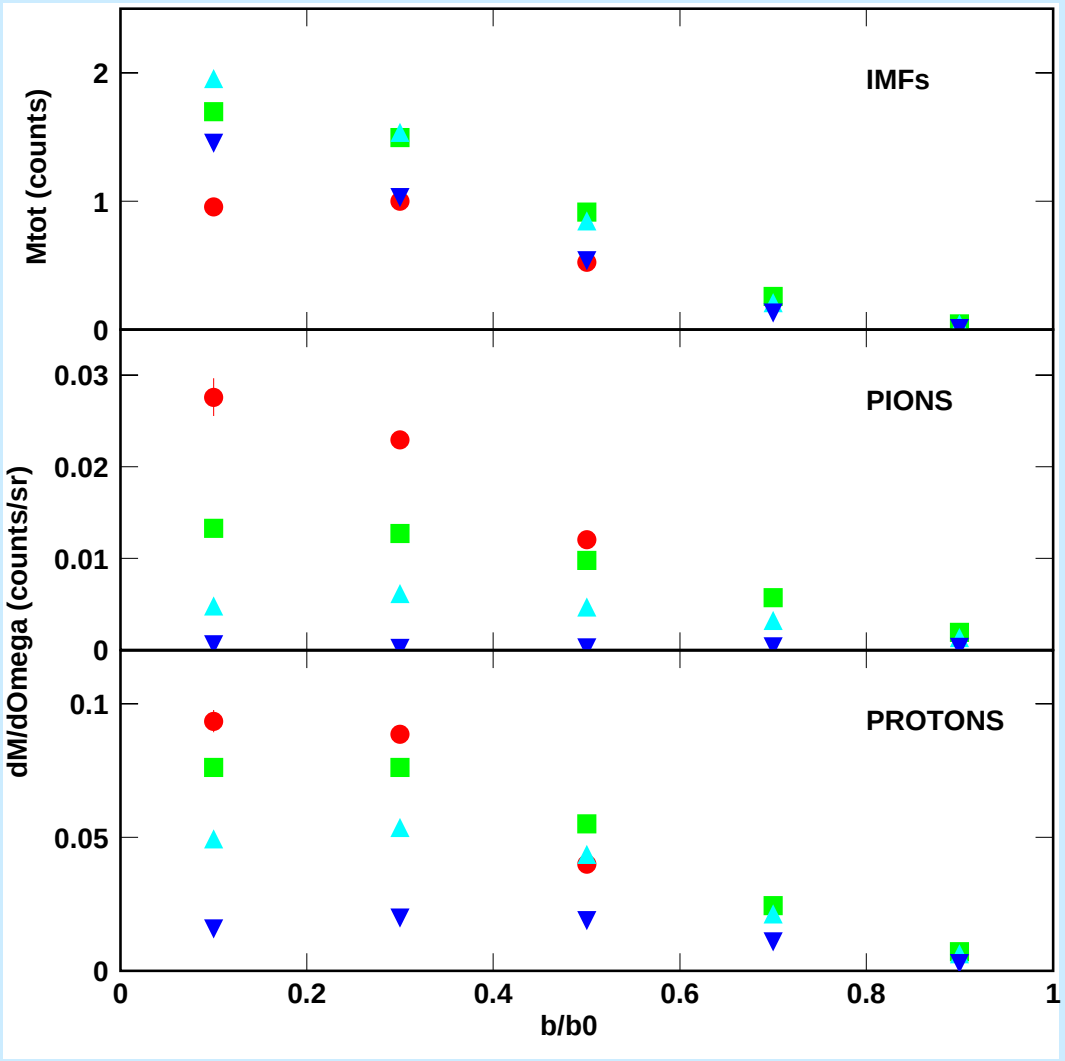
$$1 + R = \frac{\langle M_\pi \cdot M_{\mathrm{IMF}} \rangle}{\langle M_\pi \rangle \cdot \langle M_{\mathrm{IMF}} \rangle}$$

slow pions E<30 MeV
fast protons E>150 MeV

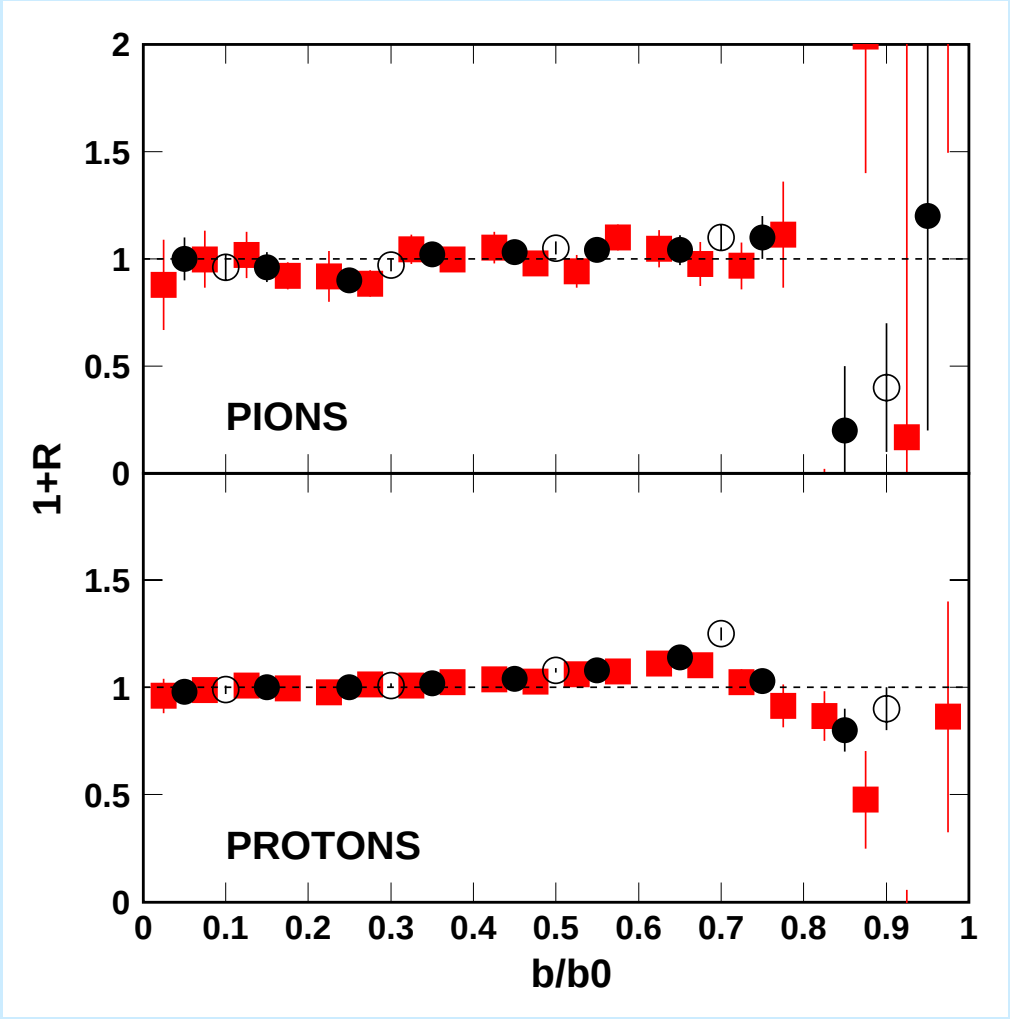


Multiplicities vs. impact parameter

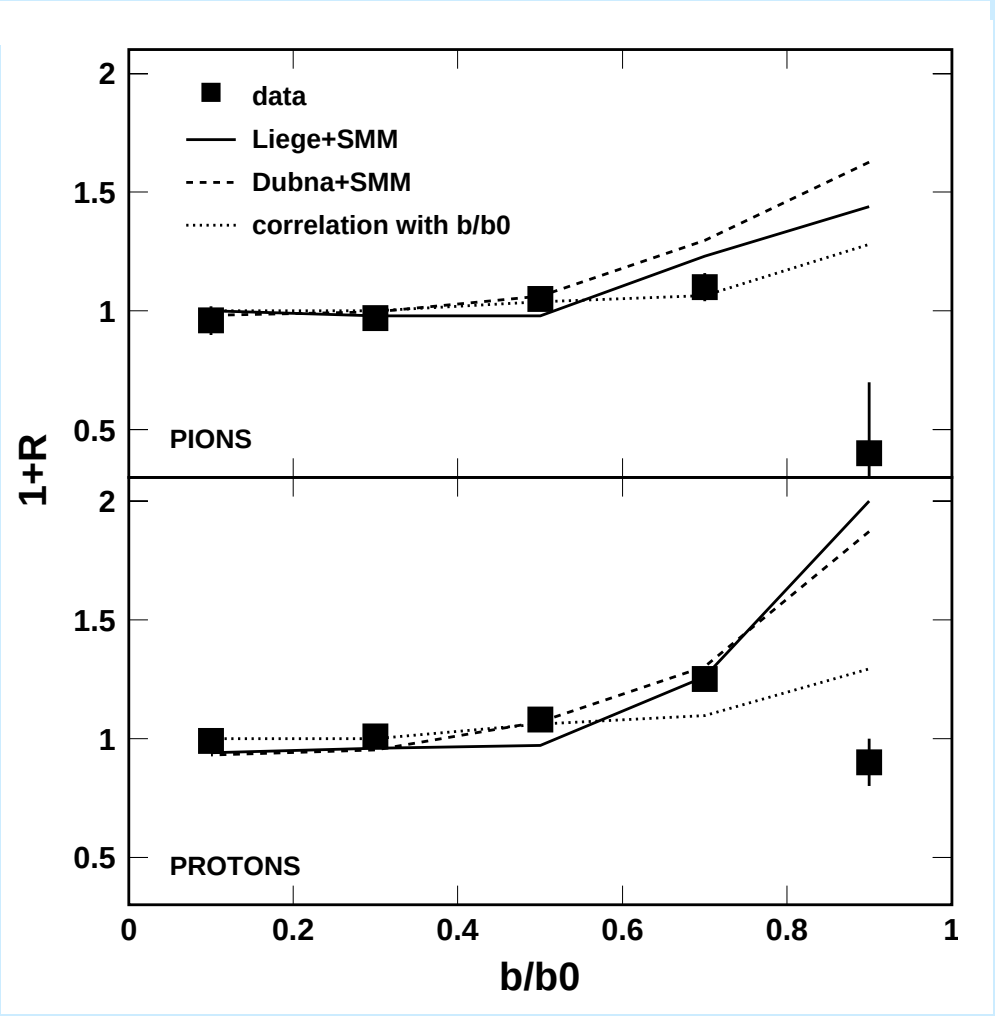




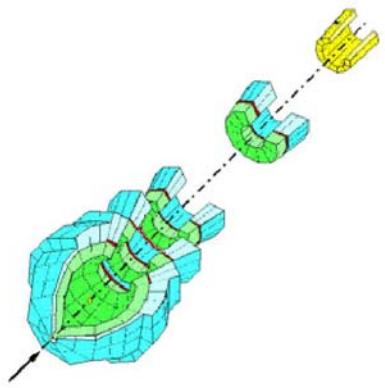
Impact parameter binning



Impact parameter binning



Some conclusions

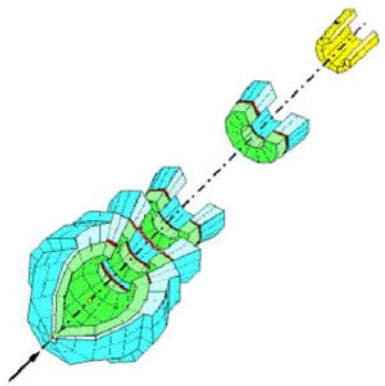


1) Peripheral Au+Au:
Good description with extended Goldhaber model (clustering criterion!).

2) Protons in C+Au:
Need fragmentation models to describe evaporation peak.

3) Pions in C+Au:
Strong rescattering and weak direct multiplicity correlations.

the end



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