Recent Results from CERES

D. Miśkowiec, GSI Darmstadt

Hirschegg, January 2002

- Experiment
- Electrons at 40 GeV
- Hadrons at 40,80,158 GeV
- Current activities and plans

UrQMD 160 GeV Au+Au

Sources of e^+e^- pairs

Drel – Yan

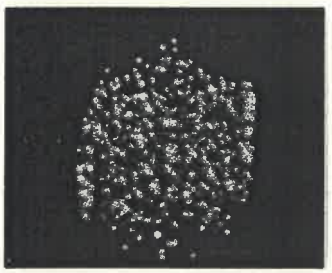
$q\bar{q} \rightarrow \gamma^* \rightarrow e^+e^-$

$qg \rightarrow q\gamma^* \rightarrow qe^+e^-$ 0 fm/c

$q\bar{q} \rightarrow g\gamma^* \rightarrow ge^+e^-$

QGP radiation

$q\bar{q} \rightarrow \gamma^* \rightarrow e^+e^-$ 2 fm/c



pion annihilation

$\pi\pi \rightarrow e^+e^-$ 8 fm/c

meson decays

$\rho \rightarrow e^+e^-$ 10 fm/c

$\omega \rightarrow e^+e^-,\ e^+e^-\pi^0$ 30 fm/c

$phi \rightarrow e^+e^-$ 50 fm/c

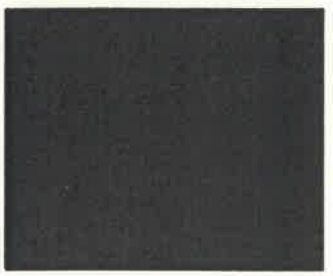
$\eta' \rightarrow e^+e^-\gamma$ 1 pm/c

$J/\Psi \rightarrow e^+e^-$ 2 pm/c

$Ups \rightarrow e^+e^-$ 4 pm/c

$\eta \rightarrow e^+e^-\gamma$ 0.2 nm/c

$\pi^0 \rightarrow e^+e^-\gamma$ 25 nm/c



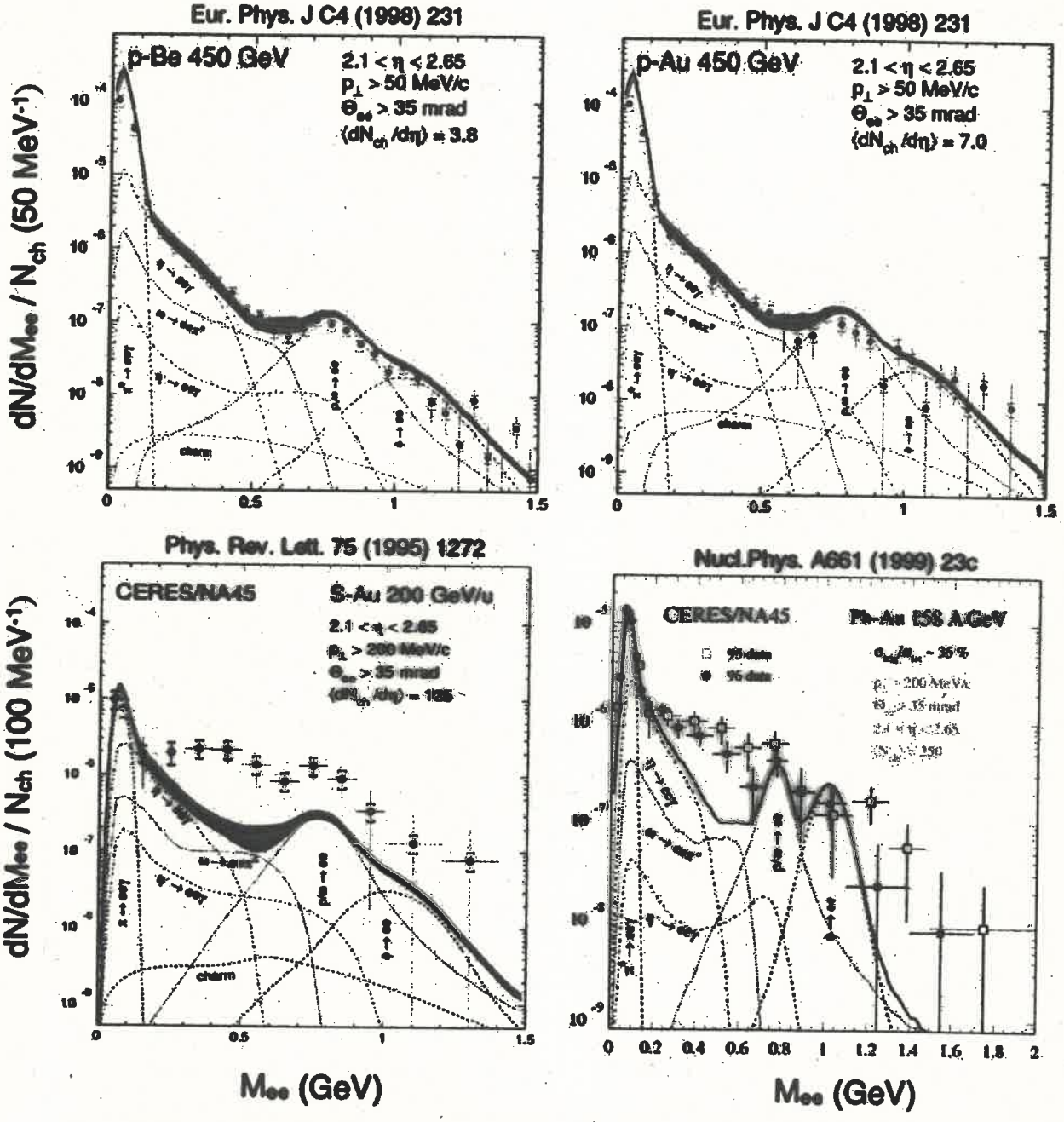
open charm

$c\bar{c} \rightarrow D\bar{D}, D \rightarrow e^+X, \bar{D} \rightarrow e^-Y$ 0.1 mm/c

gamma conversion

$\gamma X \rightarrow e^+e^-X$ 10 cm/c

CERES results 92-96

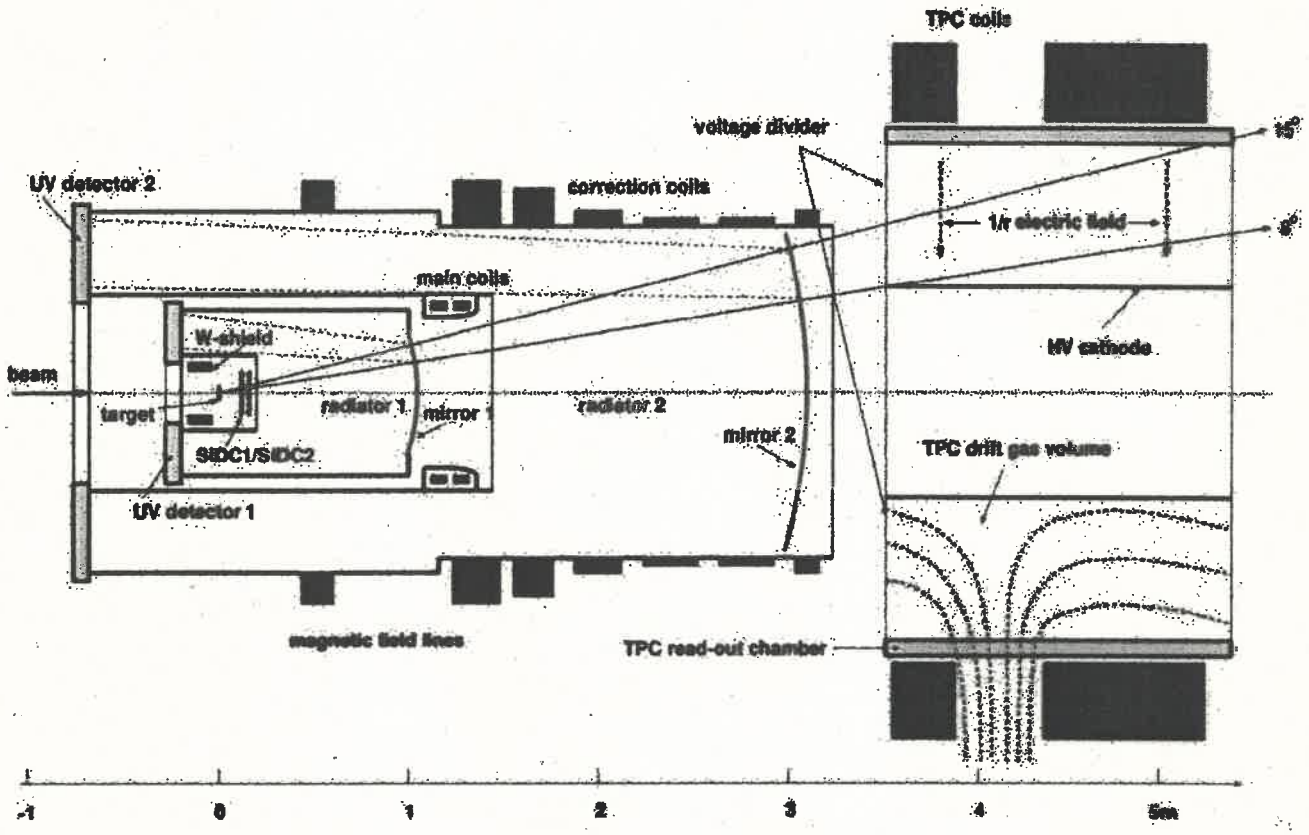


→ excess of e^+e^- pairs in heavy ion collisions

CERES run history

1990	installation	
1991	completed	
1992	200 GeV S+Au	4M central 3M pairs
1993	450 GeV p+Be 450 GeV p+Au	10M pairs 3M pairs
1995	158 GeV Pb+Au	10M central
1996	158 GeV Pb+Au	50M central
1997	TPC construction	
1998	TPC installation	
1999	40 GeV Pb+Au	10M central
2000	80 GeV Pb+Au 158 GeV Pb+Au	1M central 30M central
2002 ?	20 GeV Pb+Au ? 30 GeV Pb+Au ?	

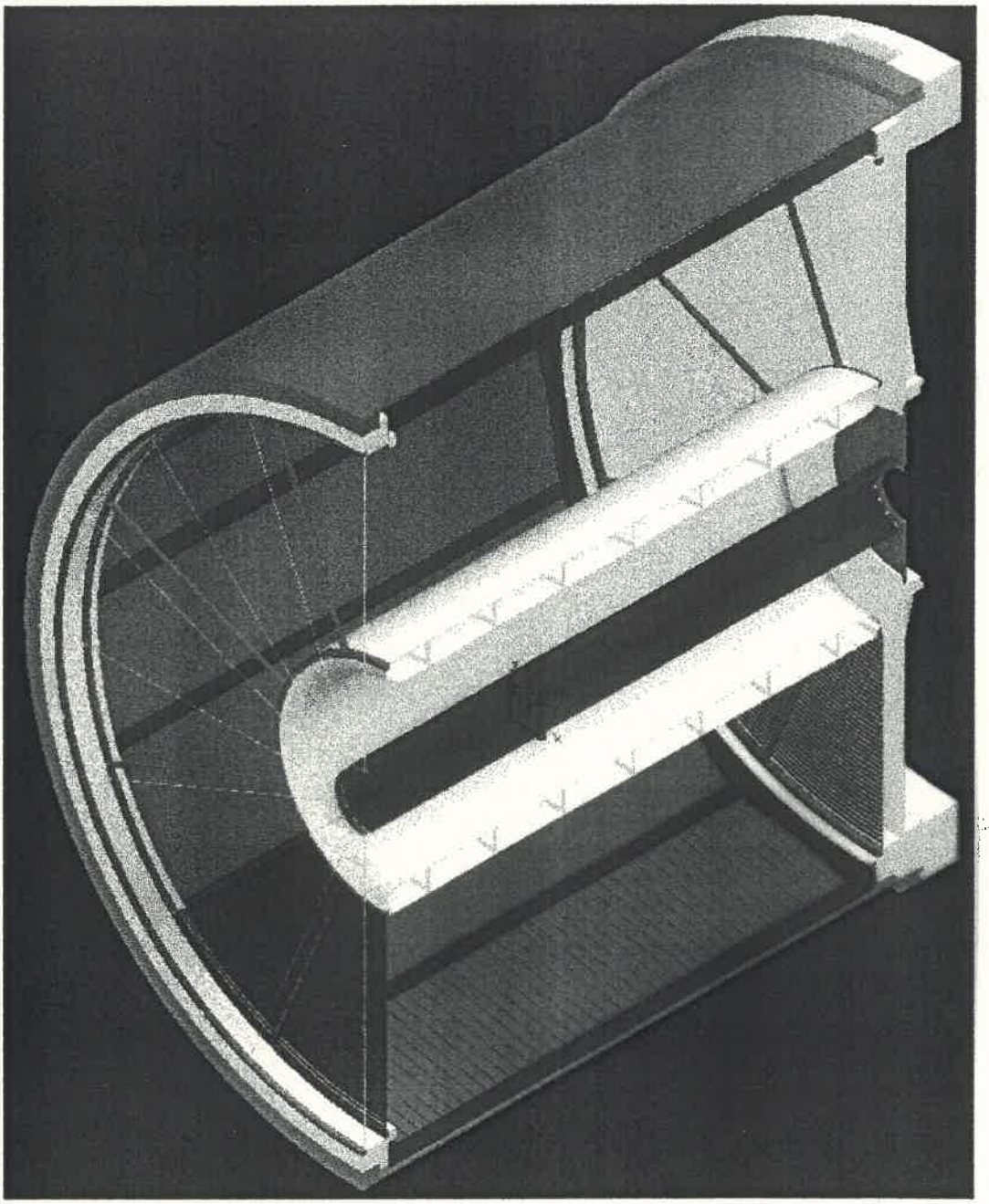
CERES setup 1999-2000



SD's: angle | RICH's: electron PID | TPC: momentum, dE/dx

- better mass resolution (2% at ω mass)
- better electron PID
- hadron measurement

CERES TPC



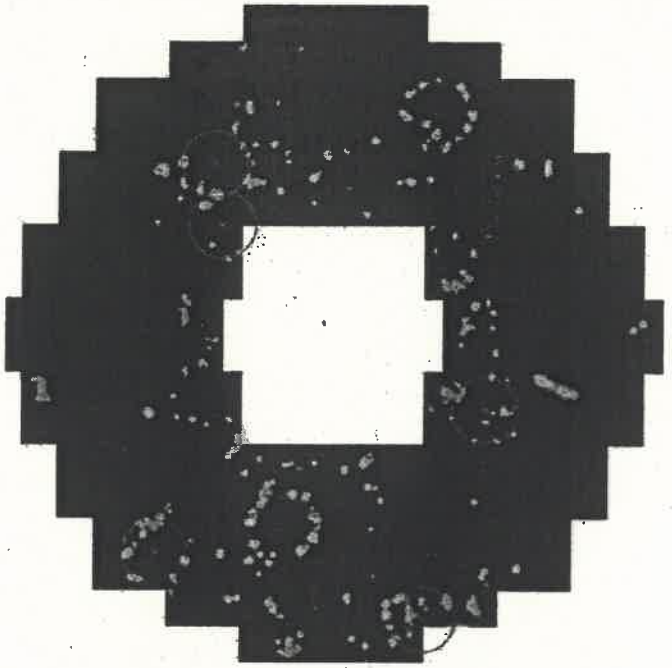
- cylinder Φ 2.6 m x 2 m
- gas Ne:CO_2 (80:20)
- radial E-field E_R~1/r with E=200-600 V/cm
- radial drift with v=0.7-2.4 cm/μs

CERES 1999-2000
Pb+Au results

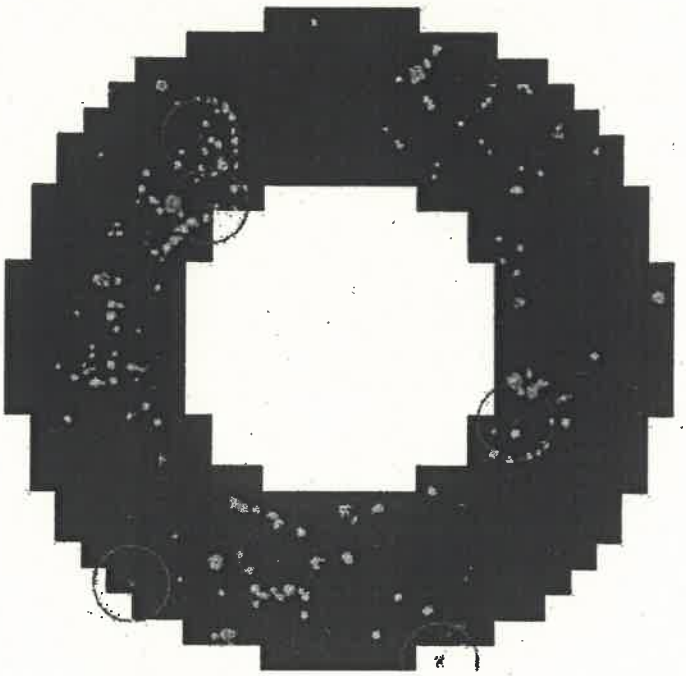
- 40 GeV dileptons

- 40 GeV hadrons vs centrality
- 40 GeV Λ
- 40,80,158 GeV pt fluctuations
- 158 GeV charge fluctuations

Event in RICH



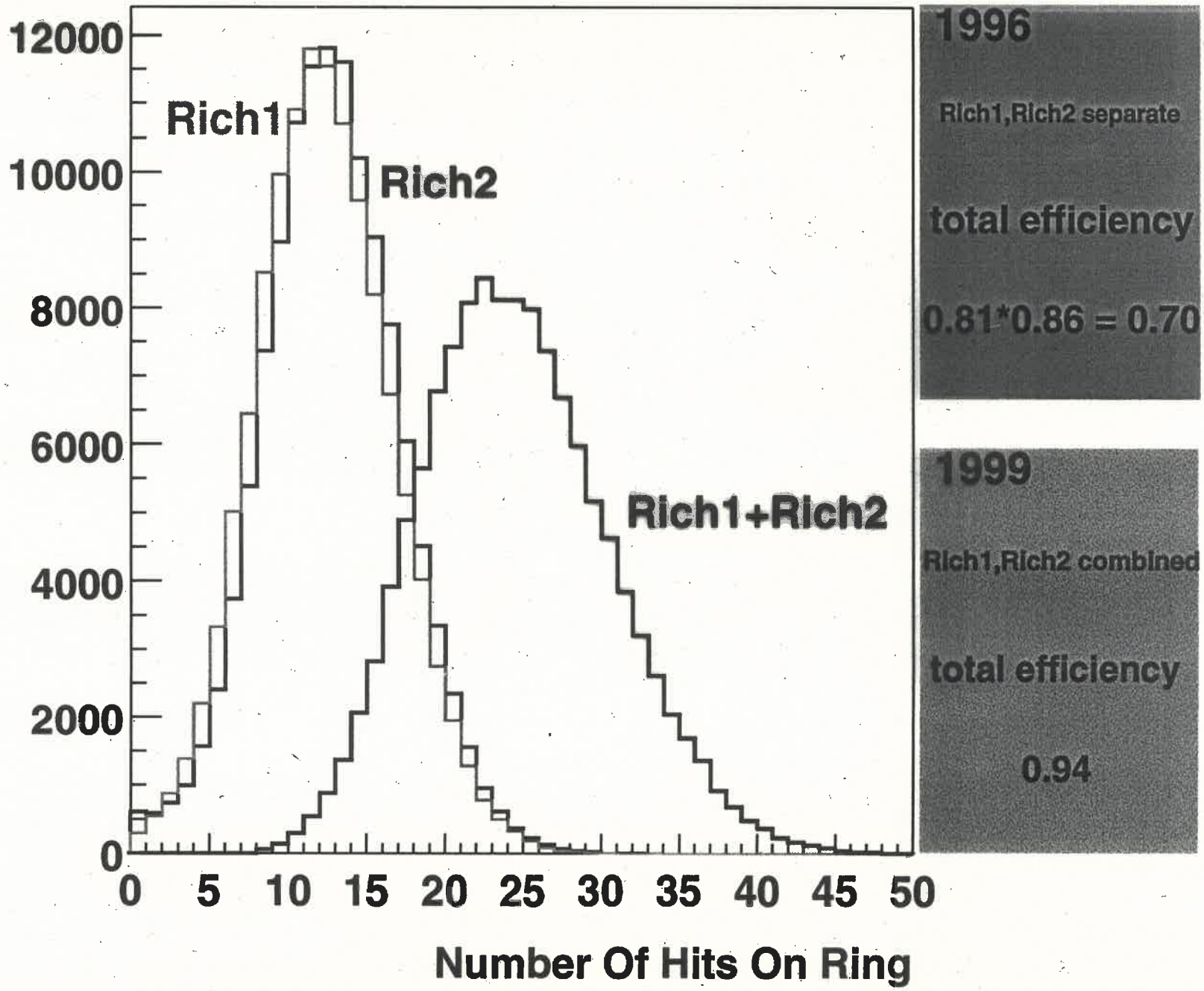
RICH 1



RICH 2

RICH Efficiency

SANJA DAMJANOVIĆ



1996

Rich1,Rich2 separate

total efficiency

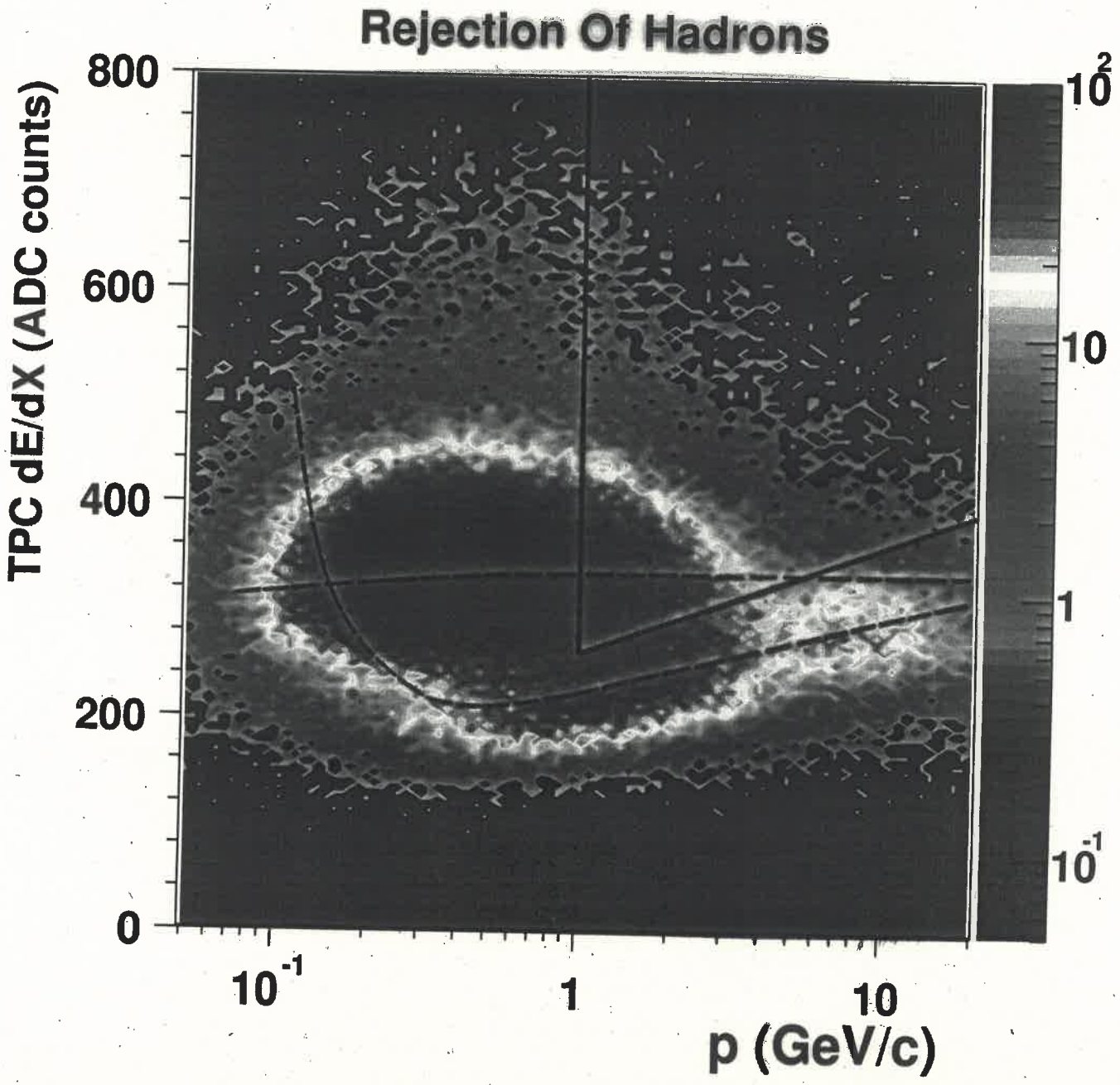
0.81*0.86 = 0.70

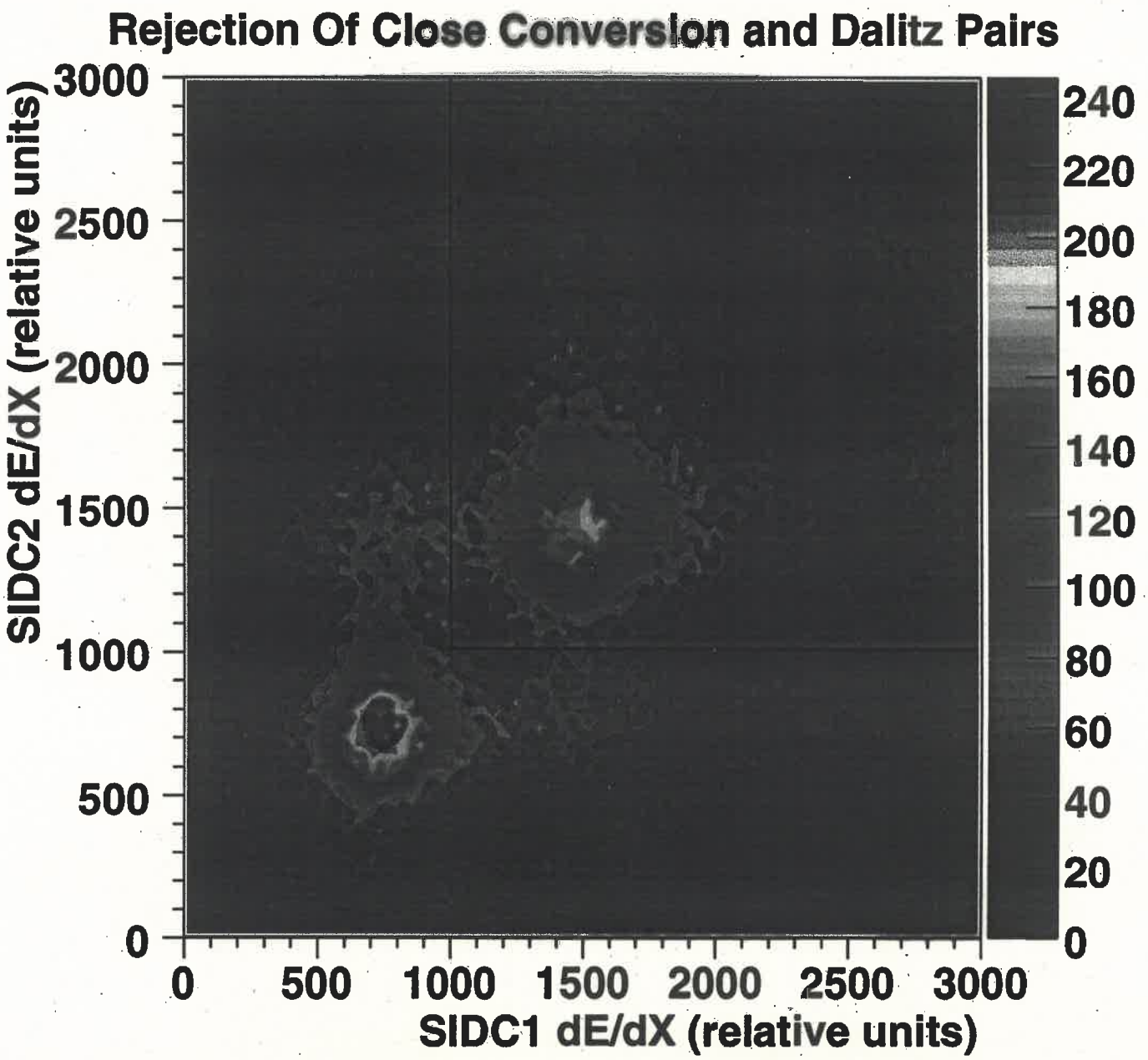
1999

Rich1,Rich2 combined

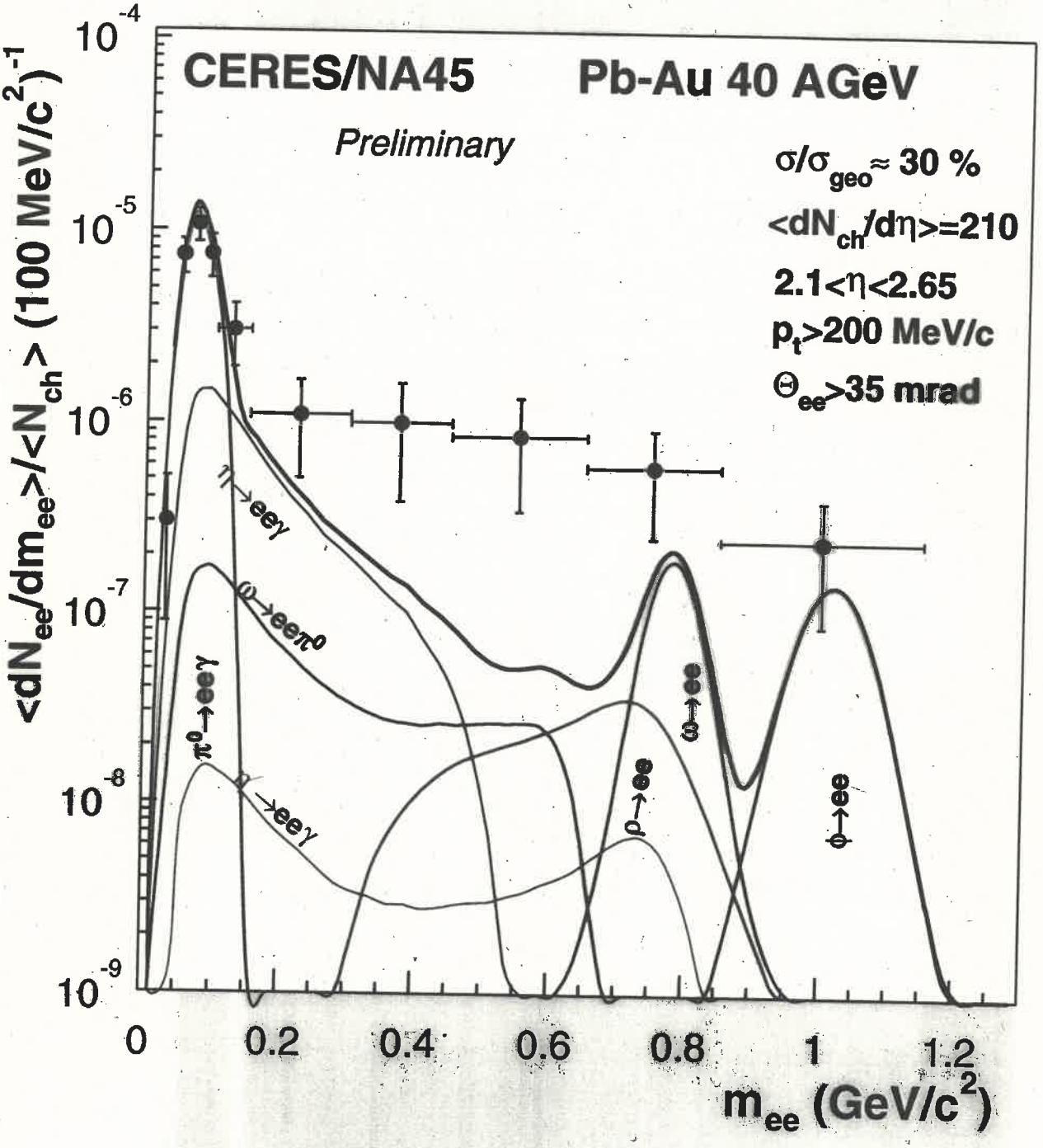
total efficiency

0.94


Rejection Of Hadrons
TPC dE/dX (ADC counts)
800
600
400
200
0
10^{-1}
1
10
p (GeV/c)
10^{2}
10
1
10^{-1}


Rejection Of Close Conversion and Dalitz Pairs
SIDC2 dE/dX (relative units)
3000
2500
2000
1500
1000
500
0
0
500
1000
1500
2000
2500
3000
SIDC1 dE/dX (relative units)
240
220
200
180
160
140
120
100
80
60
40
20
0

S. DAMJANOVIĆ
K. FILIMONOV
H. SPECHT



Number of pairs for m>0.2 GeV/c2: 180+-48
Ratio Signal/Background: 1/6

Hadronic decay cocktail:
- particle ratios taken from thermal model for Pb-Pb
-rapidity and pt distributions from systematics in Pb-Pb

Enhancement: measured pairs/decay cocktail: 5.0 +- 1.3

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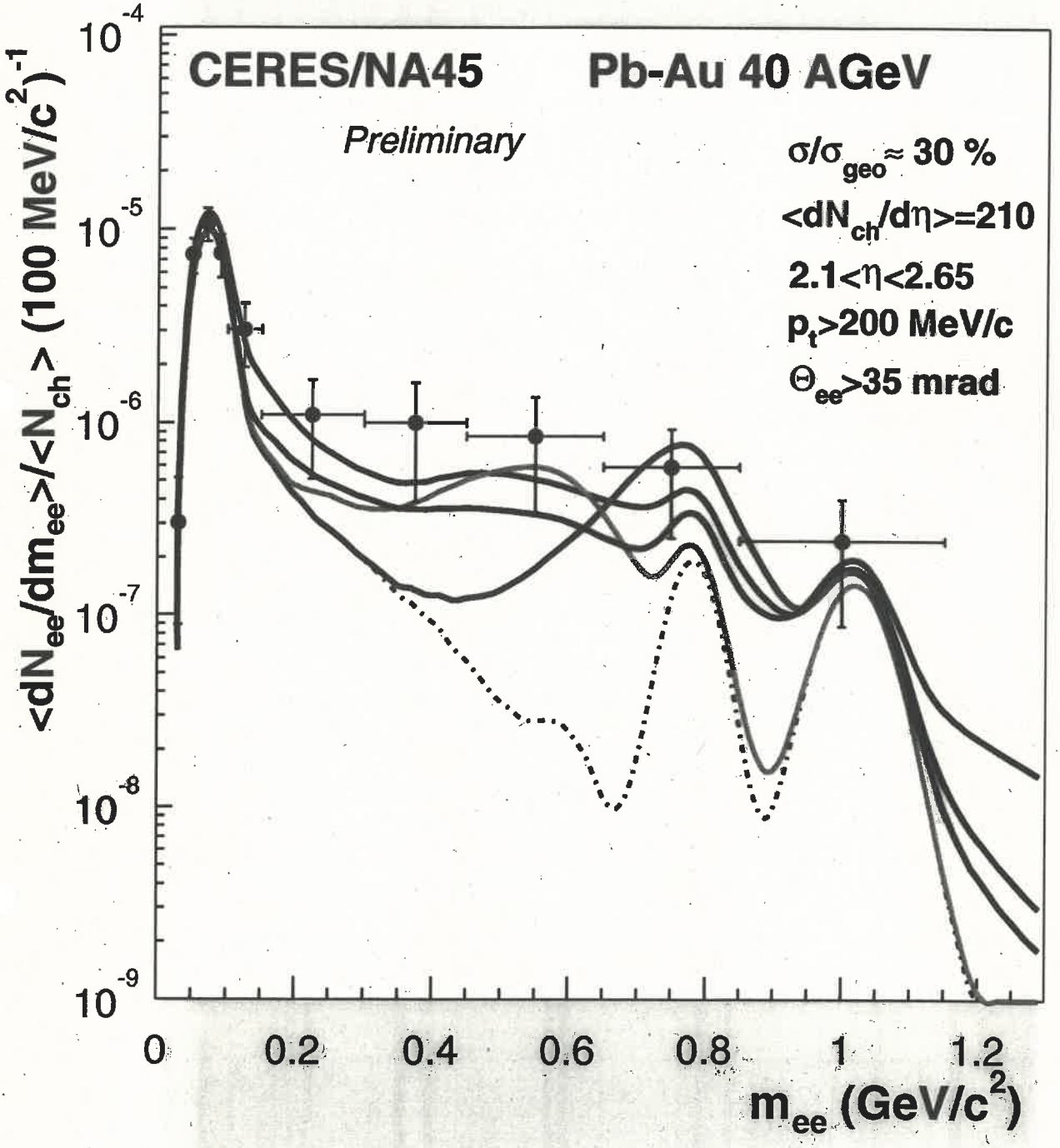


RALF RAPP

Hadronic decay cocktail

+ Vacuum rho spectral function

+ Rho spectral function with dropping mass

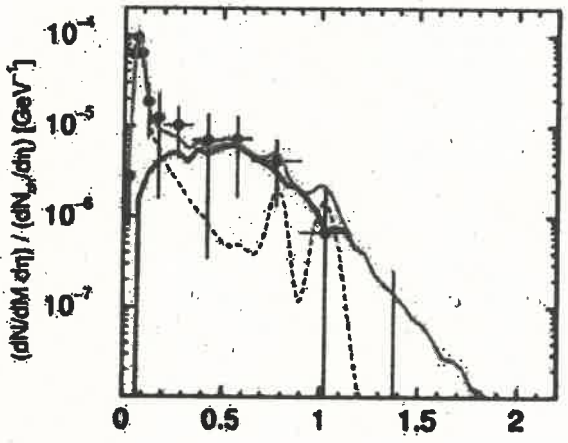
+ In-medium rho spectral function

+ Lowest order pQCD rate

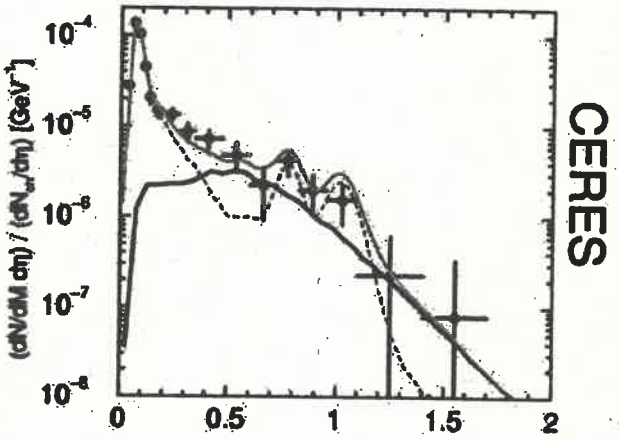
Thermal radiation from QGP

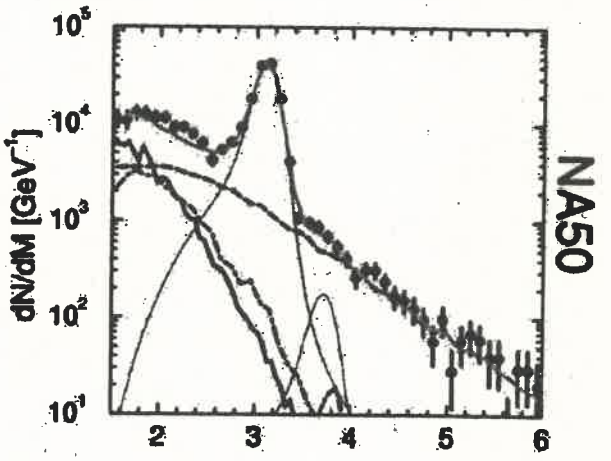
(R. Kämpfer et al, hep-ph/0102182, Feb. 2001)

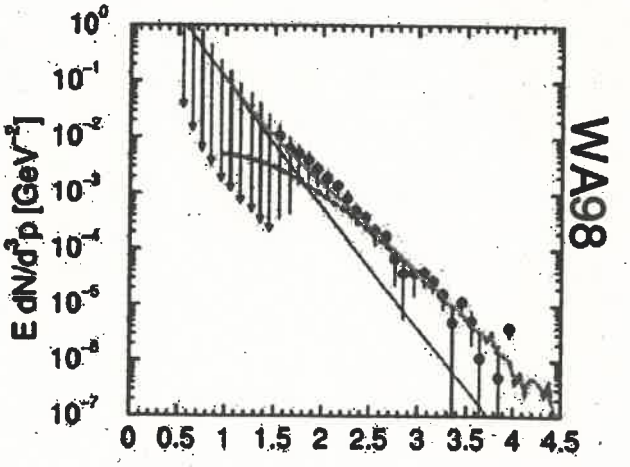
40 GeV per nucleon



160 GeV per nucleon

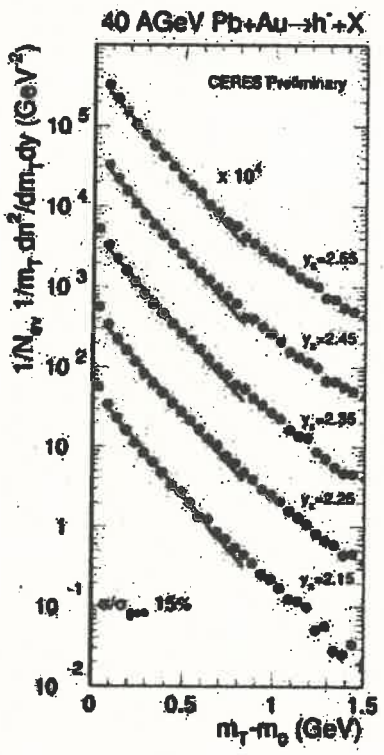


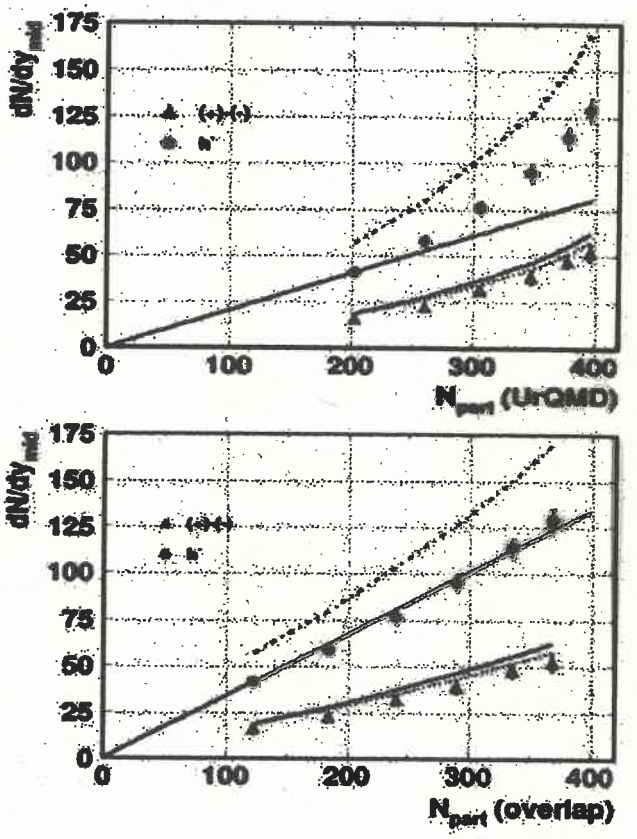




40 GeV h^- spectra

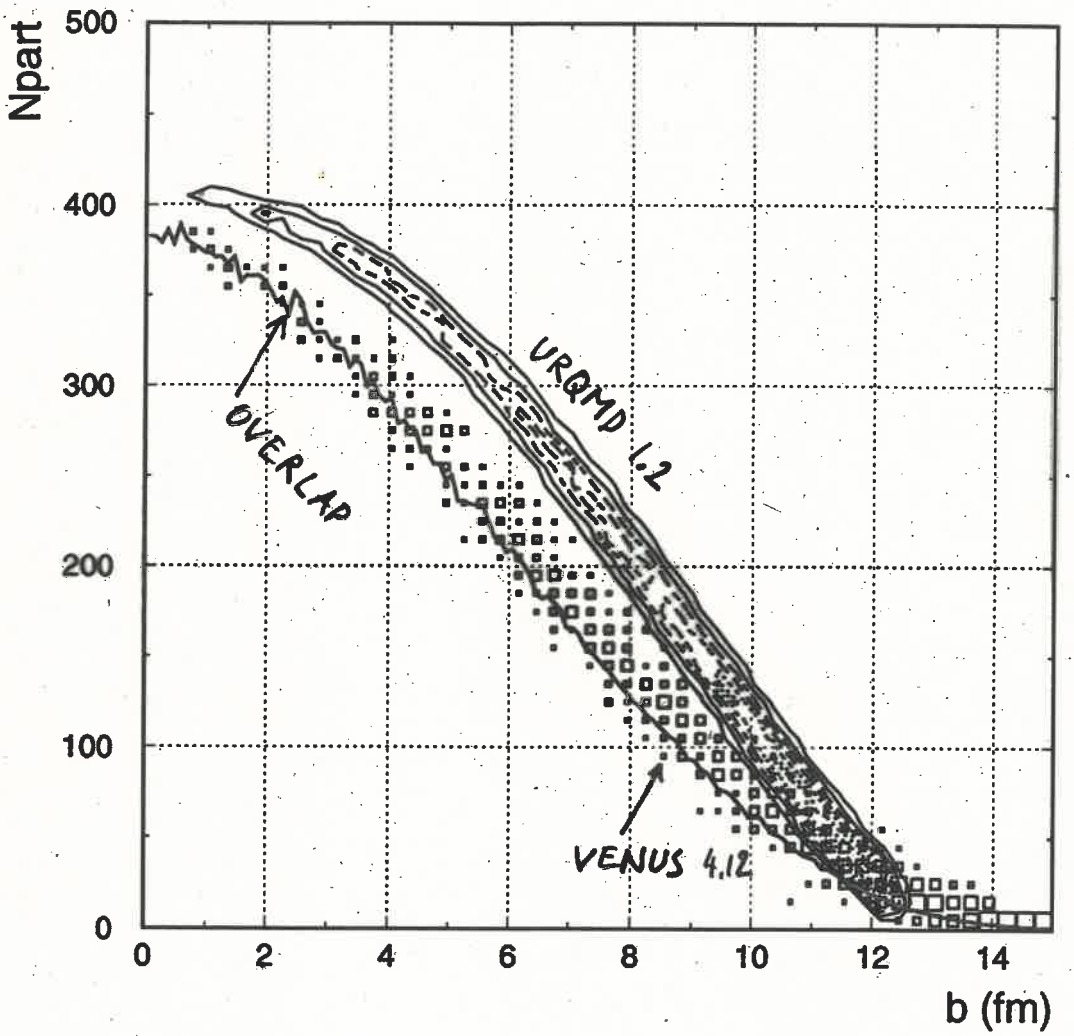
Harry Appelshäuser





VERY PRELIMINARY

http://www.gsi.de/~misko/overlap


Npart
500
400
300
200
100
0
0
2
4
6
8
10
12
14
b (fm)
URQMD 1.2
OVERLAP
VENUS 4.12

Nuclear overlap via web

http://www.gsi.de/~misko/overlap

Web interface for a nuclear overlap calculation code

This nuclear overlap code will calculate the number of participants and the number of binary collisions in an nucleus-nucleus collision via the mass distribution within the two colliding nuclei. Please enter the input parameters below.

A: 208 (mass number of the projectile nucleus)

B: 208 (mass number of the target nucleus)

Which density profile do you want?
sharp sphere
Woods-Saxon

sigma: 42 (inelastic NN cross section in mb, recomended values are 30 for 10-200 GeV LAB, 37, 41, 42, 60 for s=56, 130, 200, 5500 GeV, respectively)

Statistics: 1000 (number of trials per integral, 1000 is good for a quick test)

Submit

A lead lead collision calculation takes typically 16 seconds per thousand trials.

Web interface by Jens Elgeti, Bielefeld

Average number of participants and collisions

from: b= 0 fm or 0 centrality

to: b= 14.8 fm or 1.10266 centrality

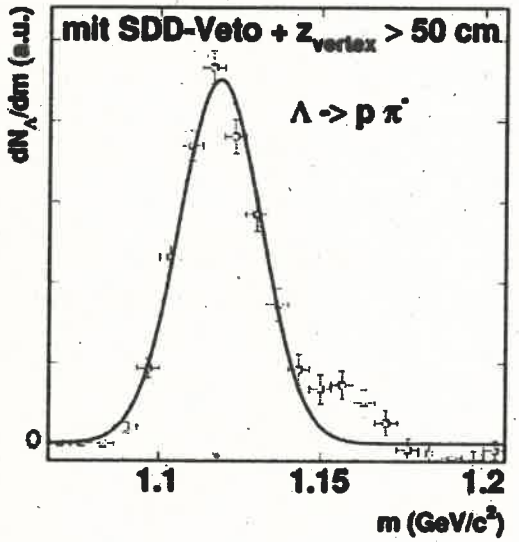
calculate

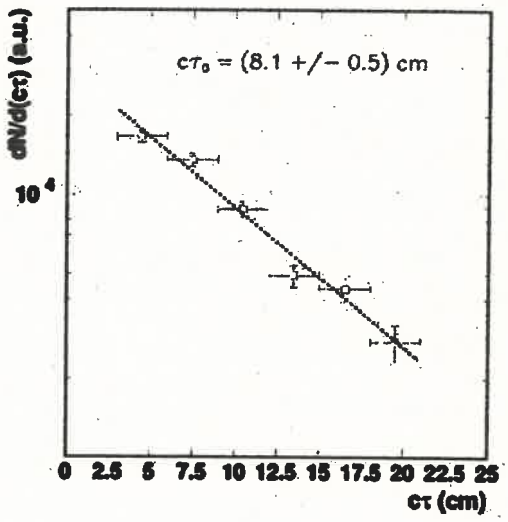
Number of participants: 324.4

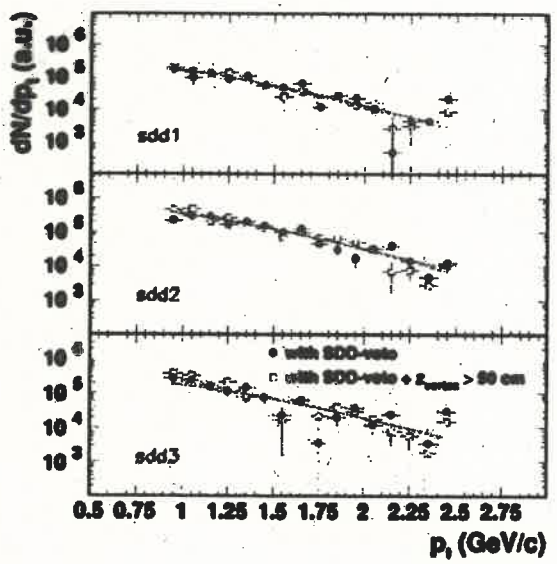
Number of collisions: 748.8

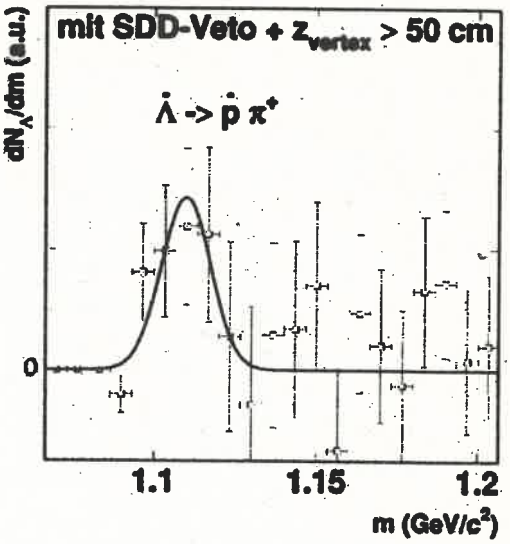
Λ Production at 40 GeV

W.Schmitz, nucl-ex/0201002, Jan. 2002

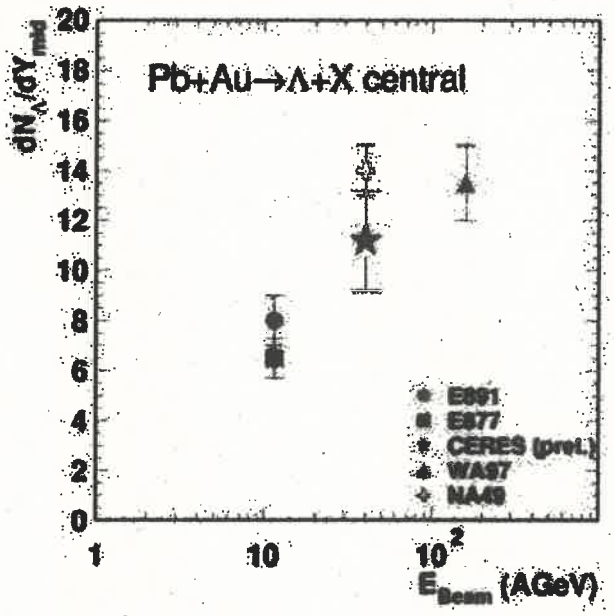


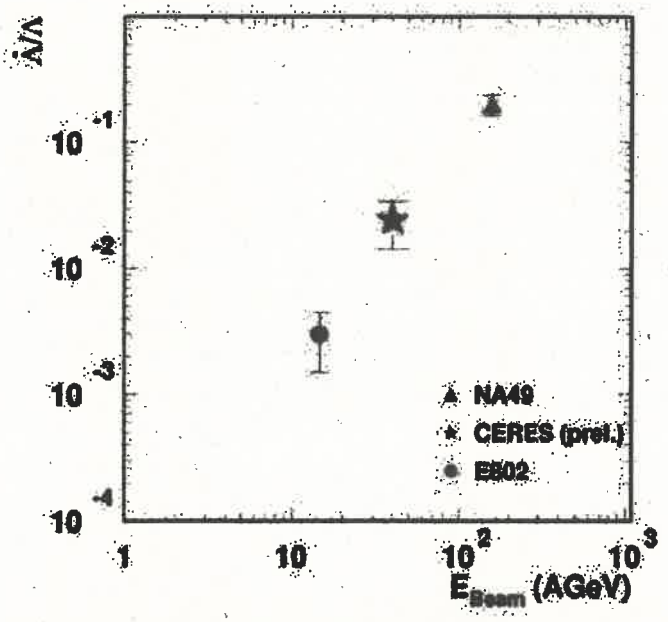






Λ Production at 40 GeV

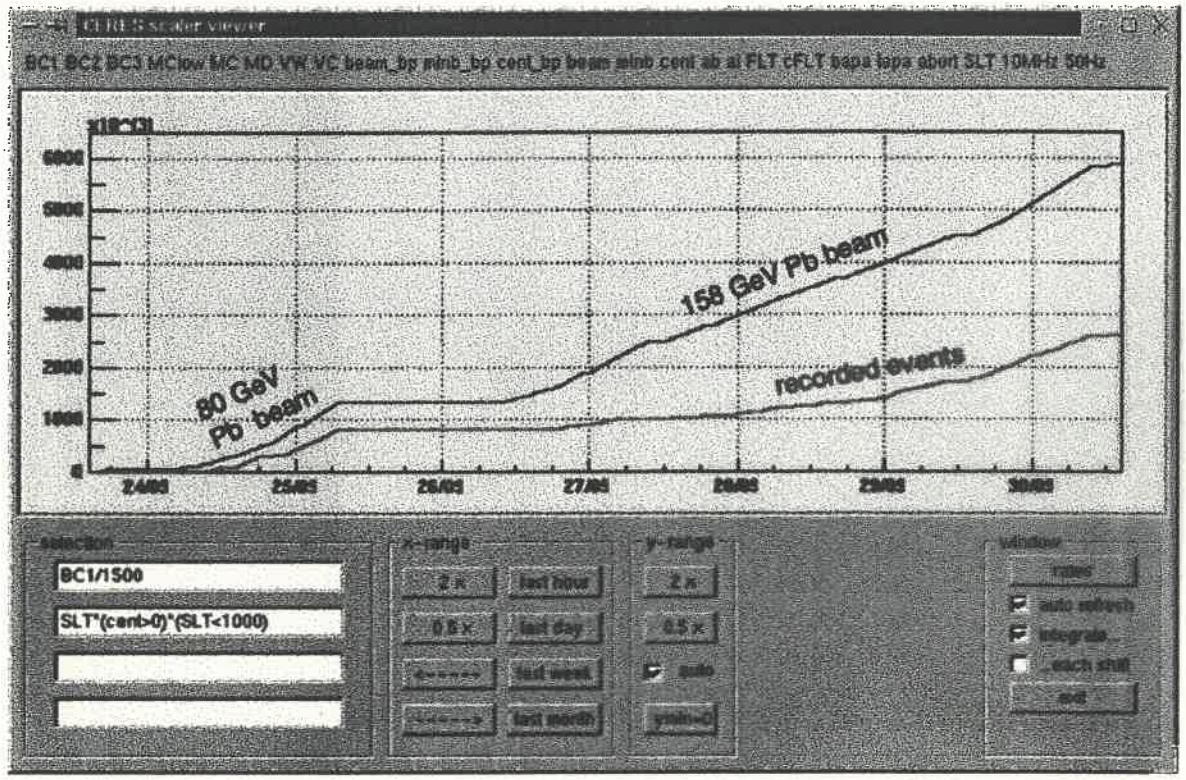


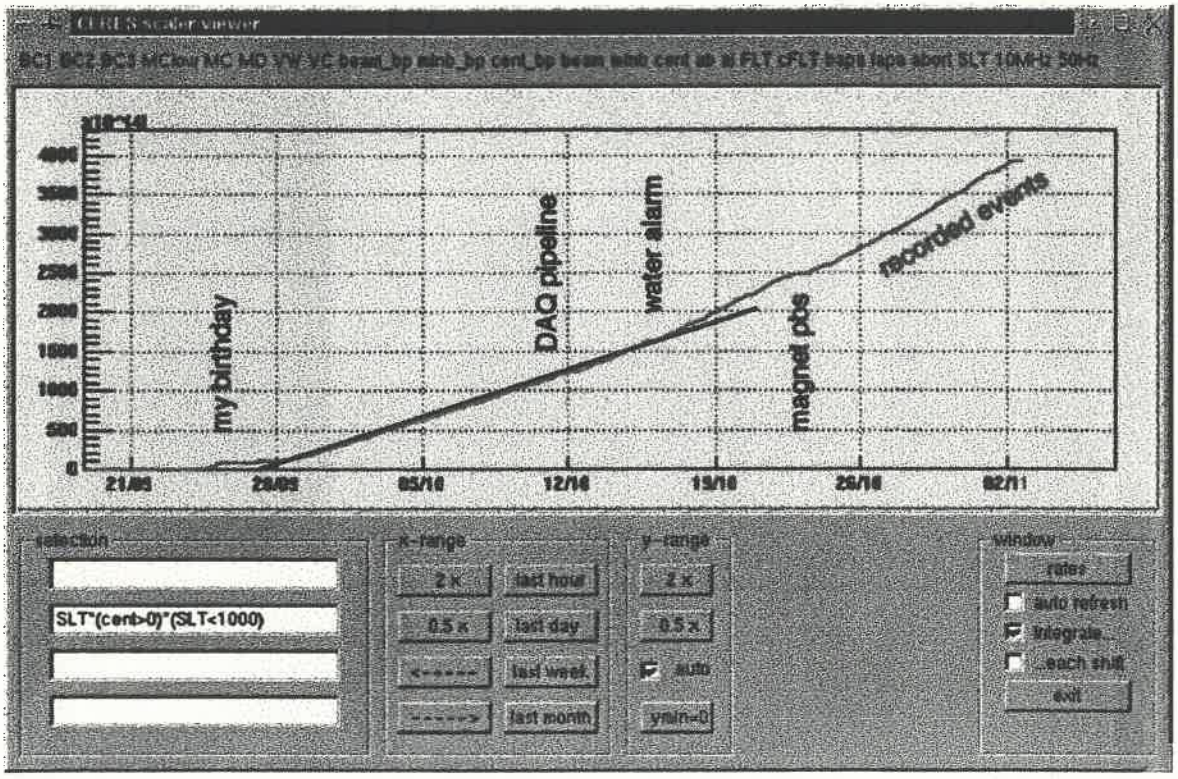


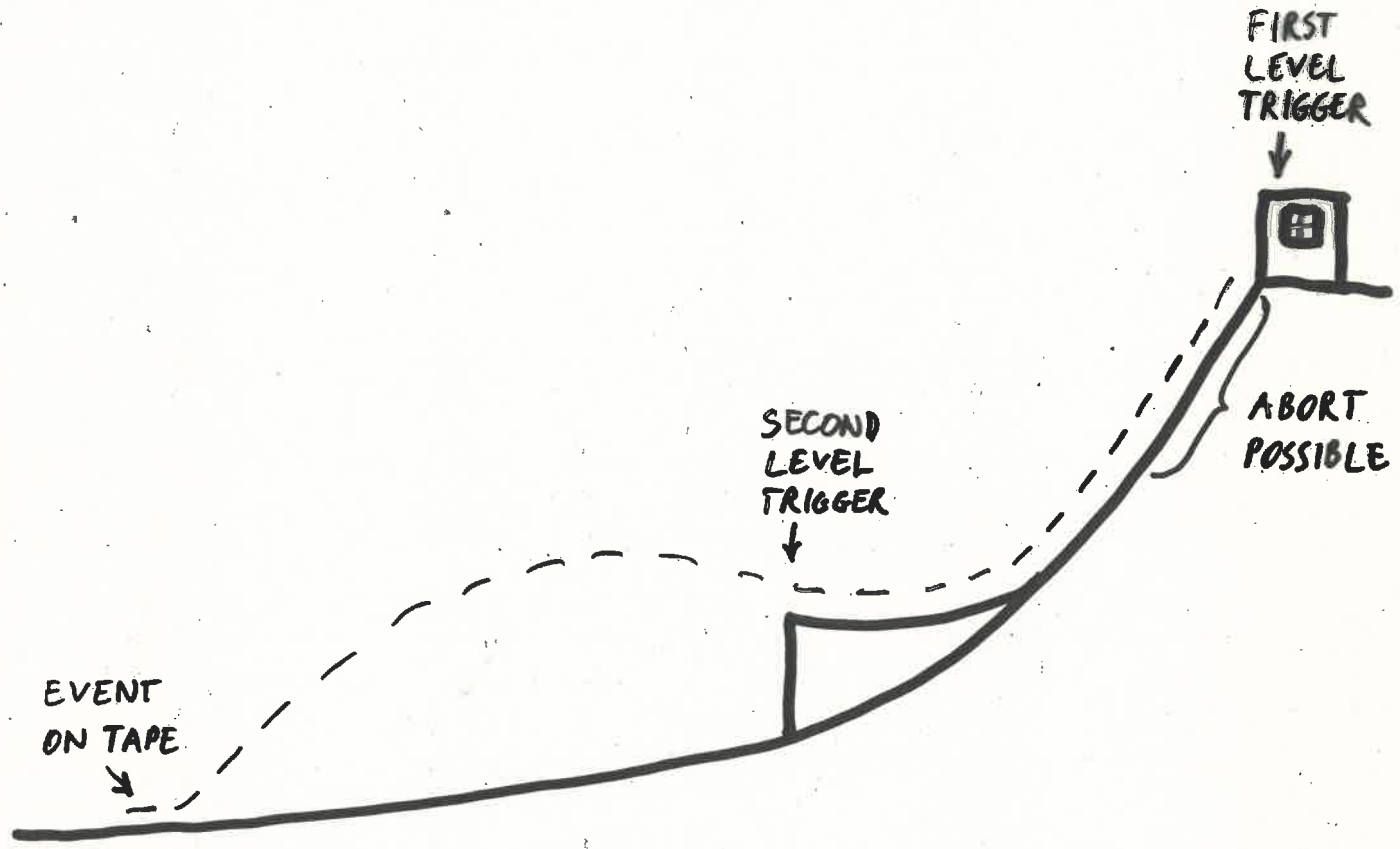
→ Λ and anti-Λ yields fit into the beam energy systematics

2000 run of CERES

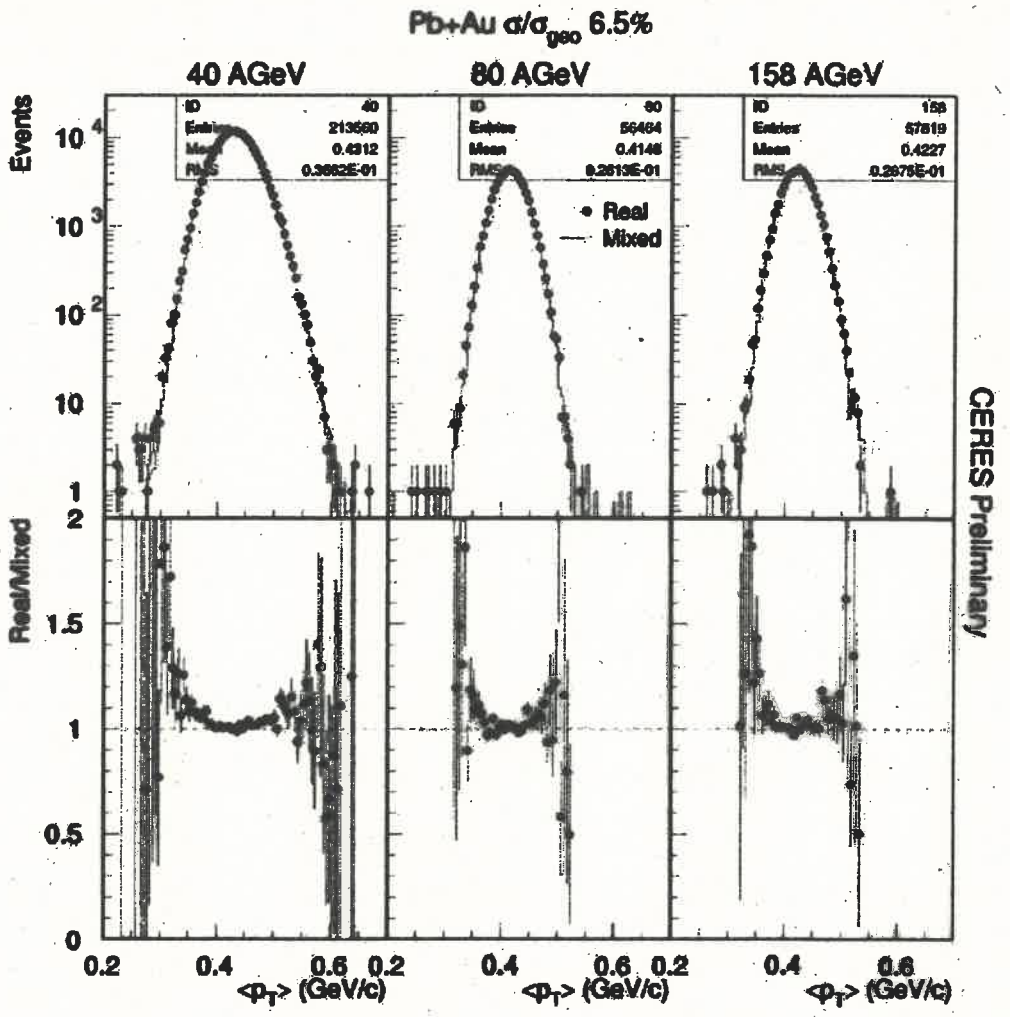
Total events vs time





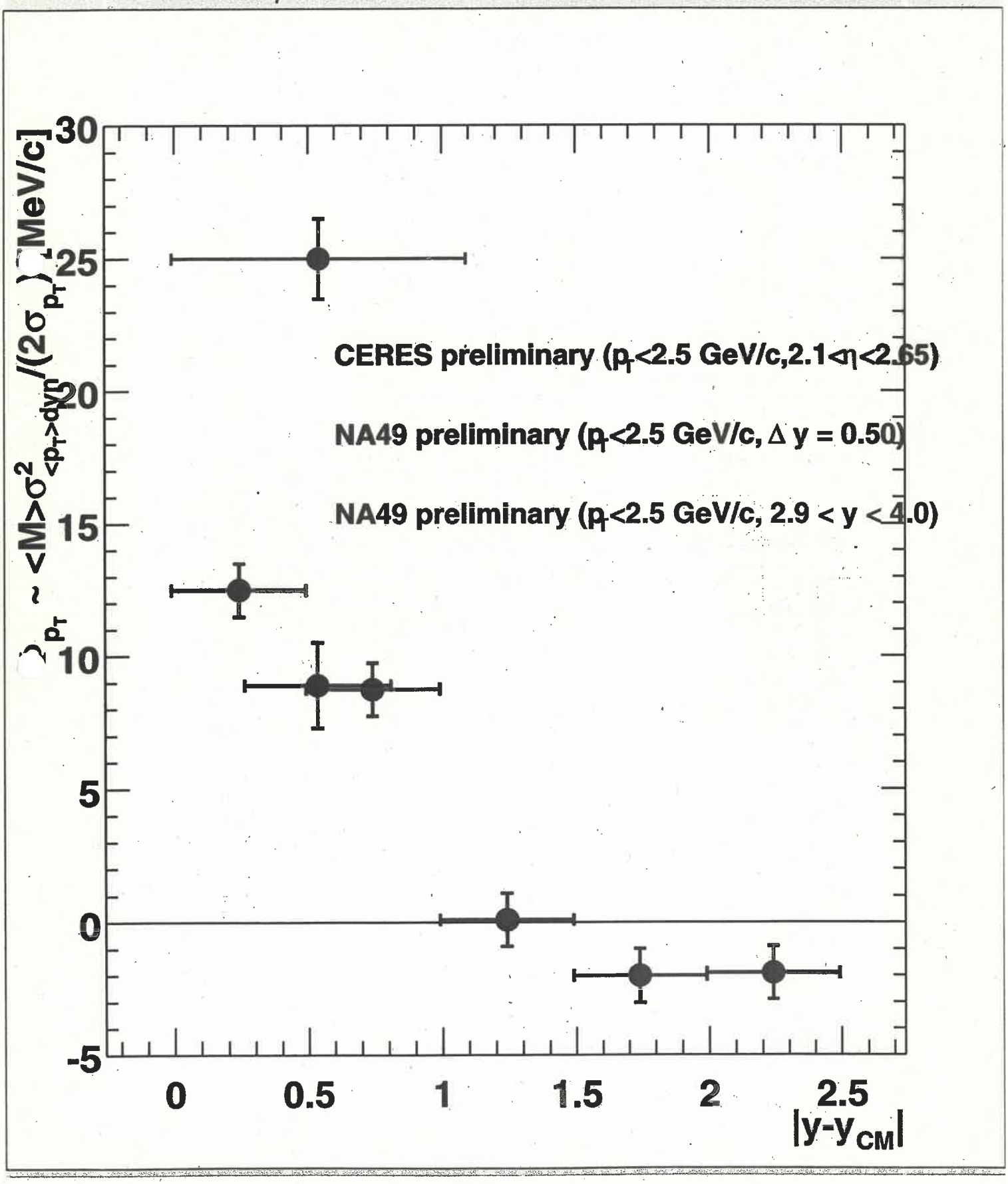

FIRST
LEVEL
TRIGGER
SECOND
LEVEL
TRIGGER
ABORT
POSSIBLE
EVENT
ON TAPE

Event by event mean pt



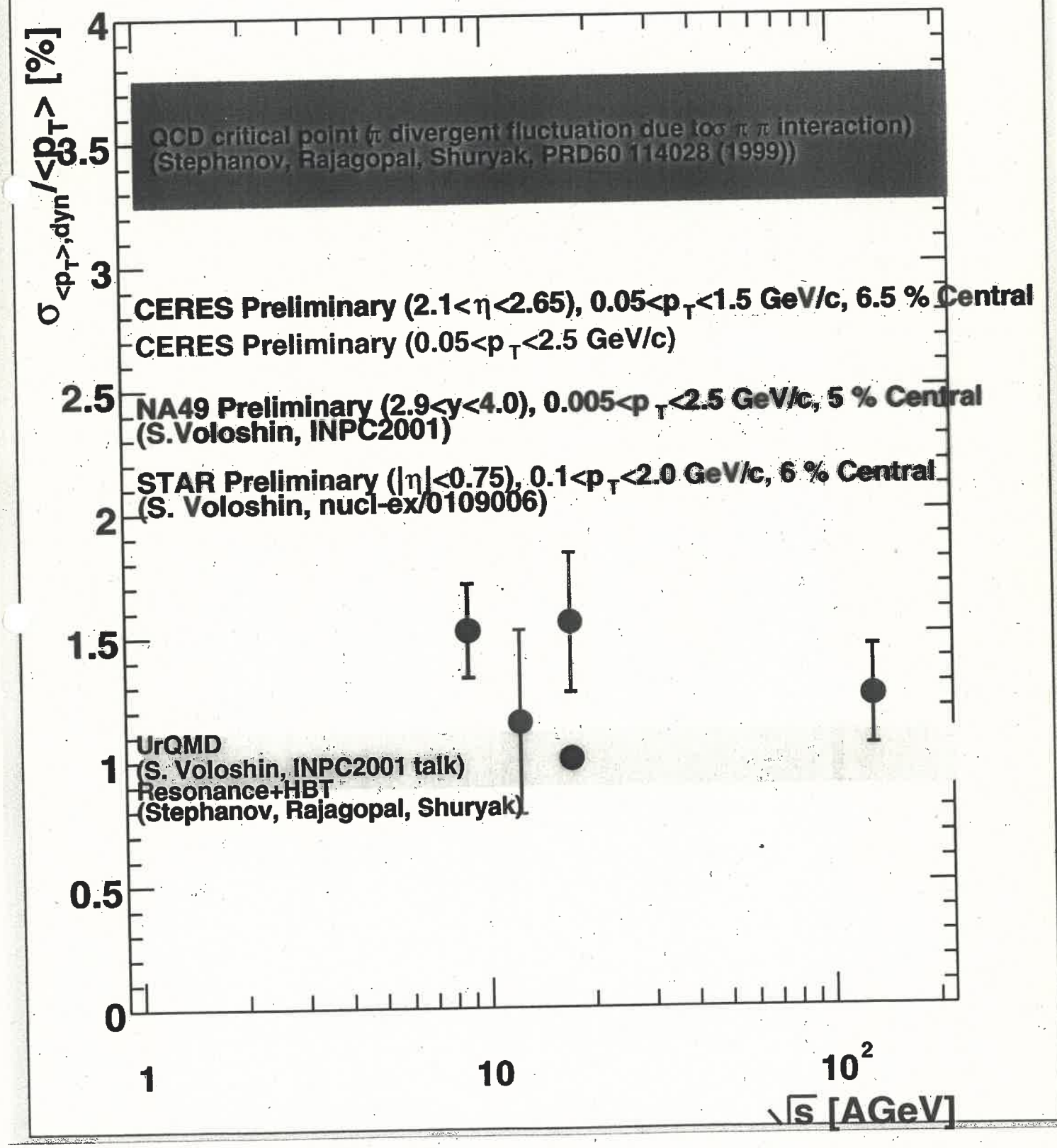
→ Non-zero event-by-event fluctuations

Φ_{p_T} Comparison (158 AGeV/c)



HIRO SAKO

$\sigma_{<p_T>,dyn}/<p_T>$ vs beam energy



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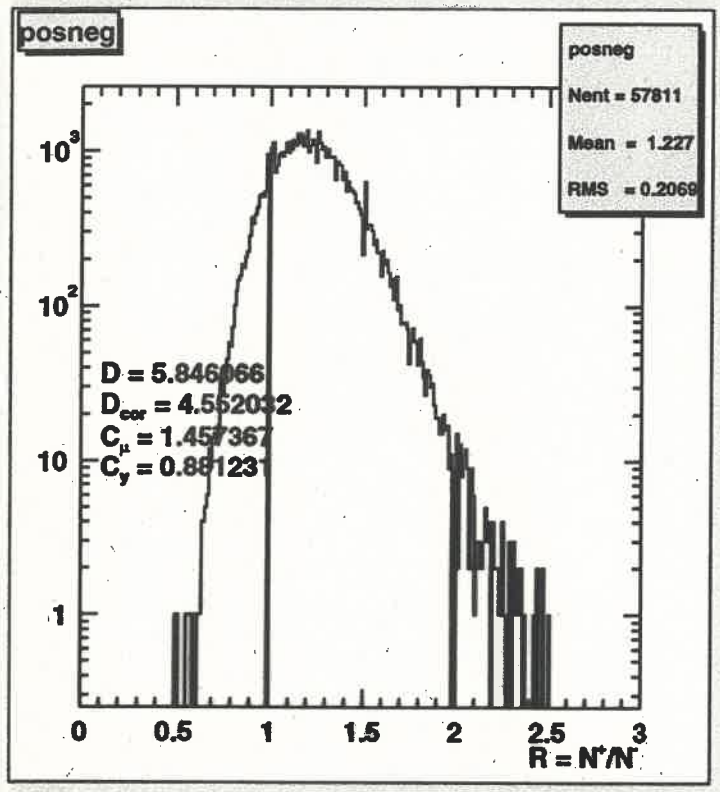
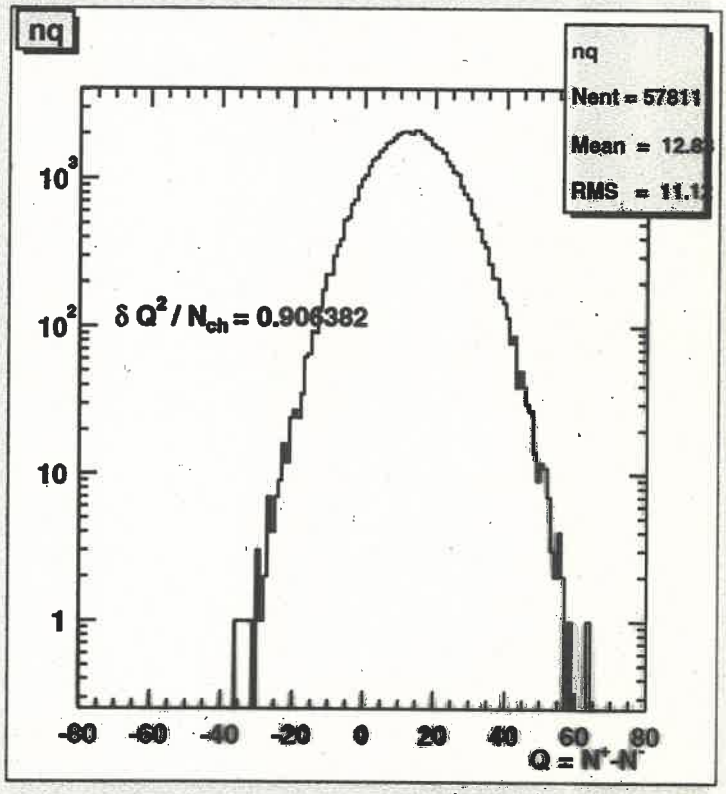
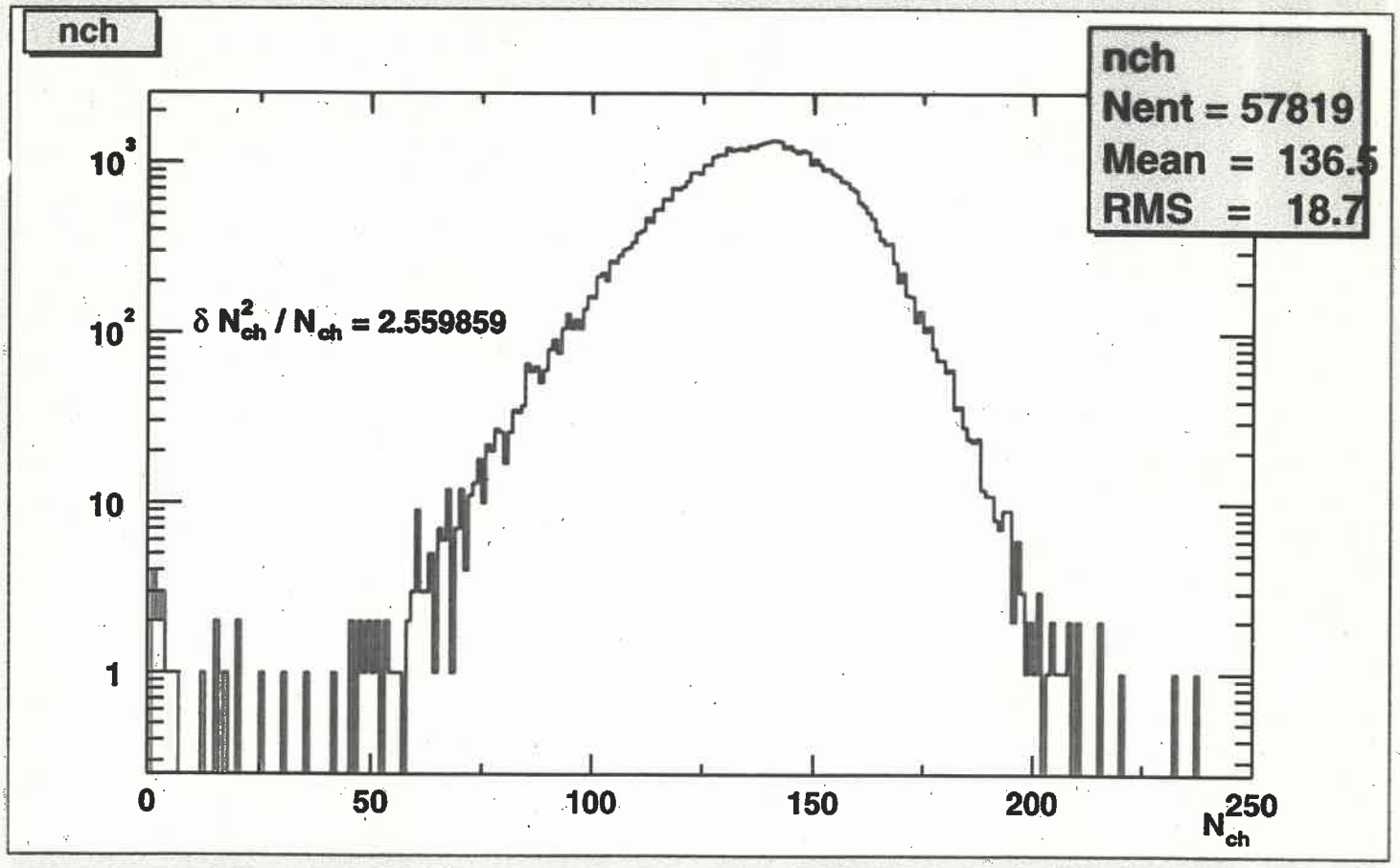
Preliminary CERES D (158 AGeV, 6.5% central)







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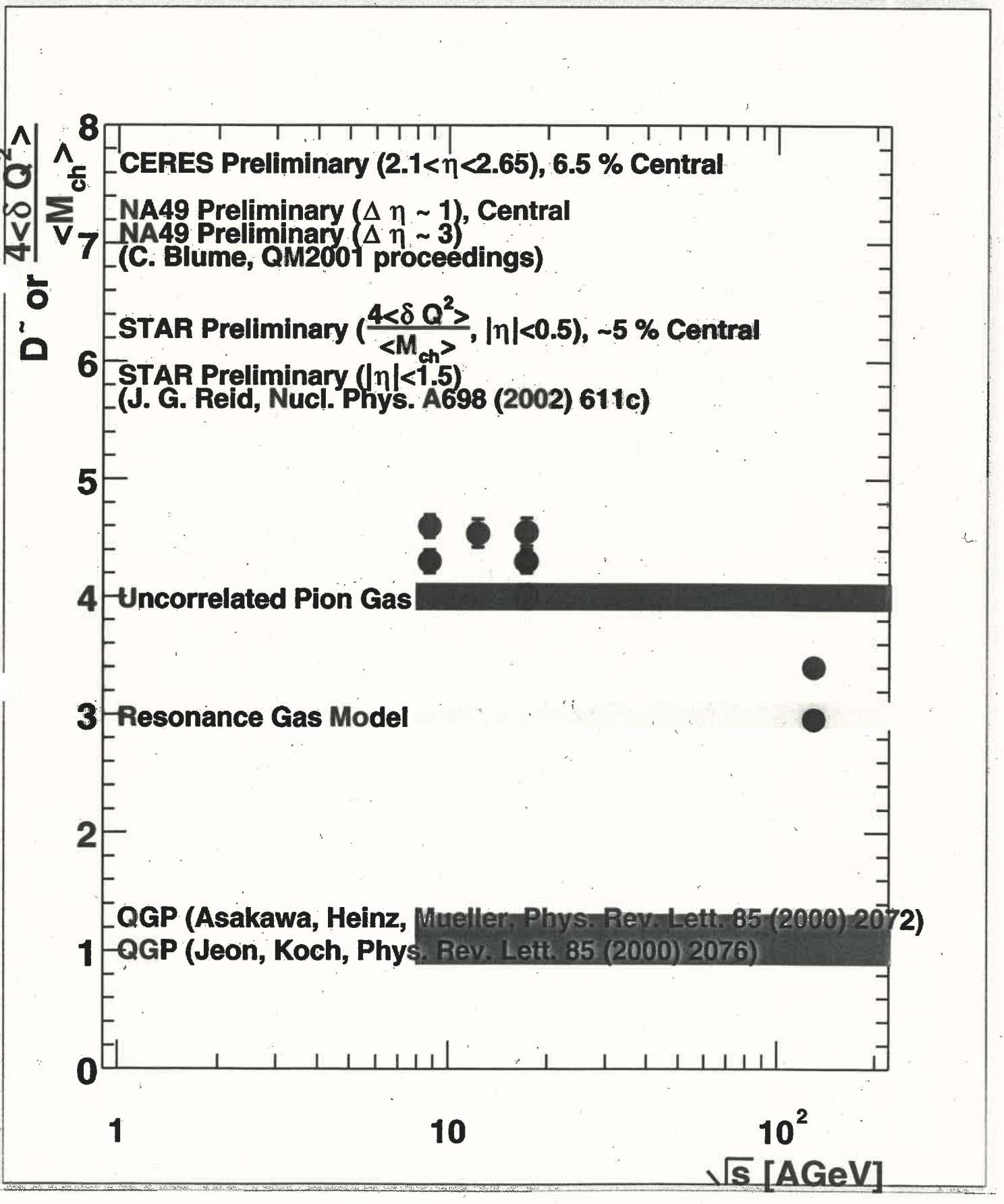
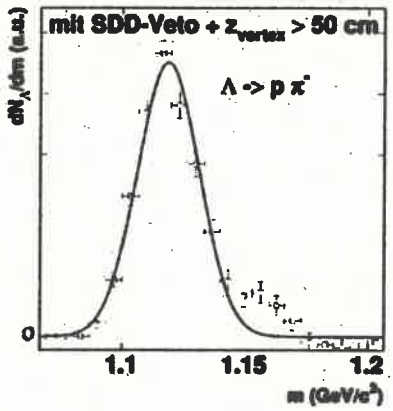
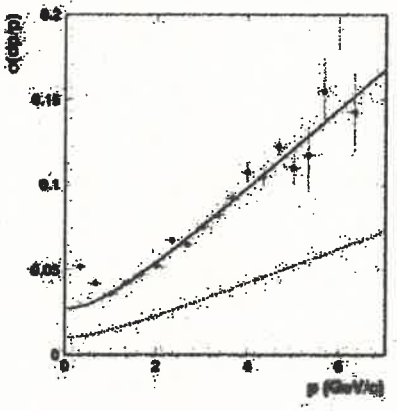
Charge ratio fluctuation vs beam energy



Current activities

λ at 40 GeV





λ peak too wide
→ Δp too high
→ better calibration needed

calibration of 2000 data

- TPC detailed calculation of E-field
- TPC detailed calculation of B-field
- TPC new hit finding algorithm
- TPC improved tracking algorithm
- RICH event by event monitoring
- SD careful drift velocity calibration
- new 3-d event display

Summary and outlook

- excess in low mass e+e- spectrum at 40 GeV
- no enhanced Lambda production at 40 GeV
- over-statistical pt fluctuations at 40-158 GeV
  but less than expected around critical point
- charge fluctuation like for pion gas

- High precision 158 GeV data under way
- 20/30 GeV in 2002 to be accepted