

New Results from CERES

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

Sources of e^+e^- pairs

- $qq \rightarrow \gamma^* \rightarrow e^+e^-$ Drell-Yan
- $qg \rightarrow q\gamma^* \rightarrow qe^+e^-$
- $q\bar{q} \rightarrow g\gamma^* \rightarrow ge^+e^-$

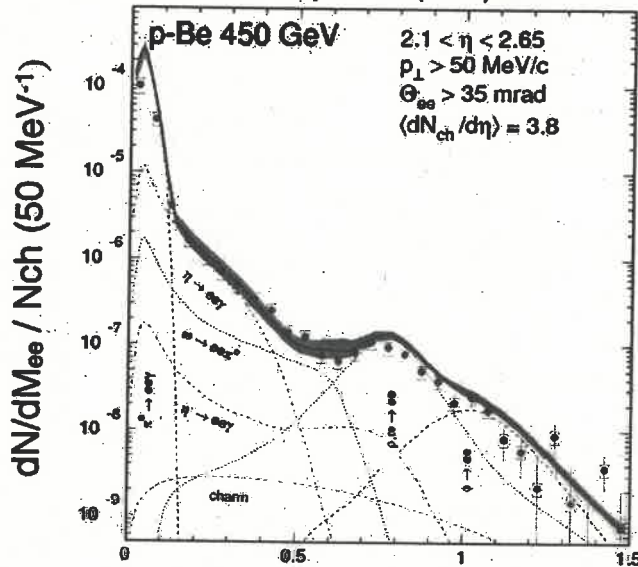
- $\rho, \omega, \phi, \psi, Y \rightarrow e^+e^-$ vector meson decay
- $\pi\pi \rightarrow e^+e^-$ pion annihilation
- $q\bar{q} \rightarrow \gamma^* \rightarrow e^+e^-$ QGP thermal radiation

- $\pi^0, \eta, \eta' \rightarrow e^+e^- \gamma$ Dalitz decay
- $\omega \rightarrow e^+e^- \pi^0$
- $D \rightarrow e^+ X$ open charm production
 $D\bar{q} \rightarrow e^- X$ and semileptonic decay

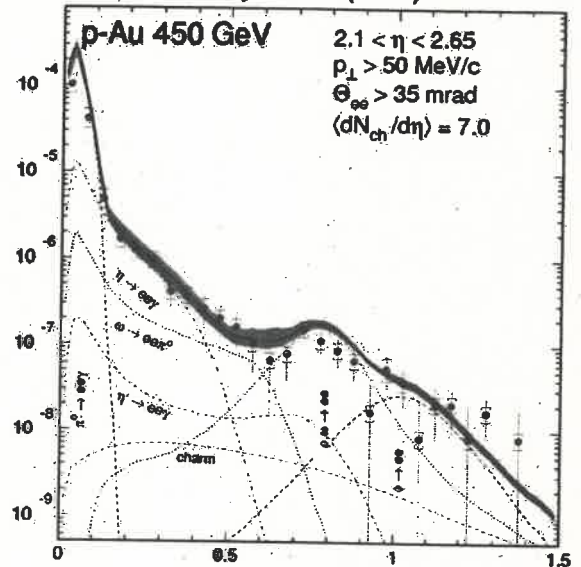
- $\gamma X \rightarrow e^+ e^- X$ pair conversion

CERES results 92-96

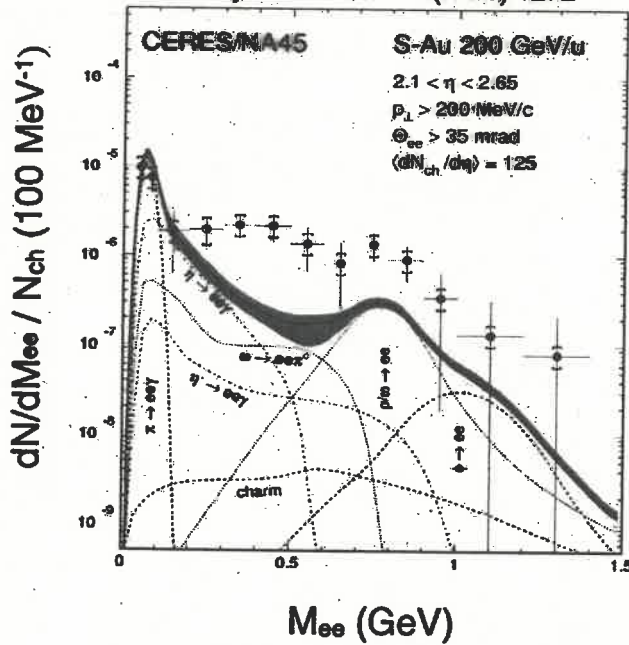
Eur. Phys. J C4 (1998) 231



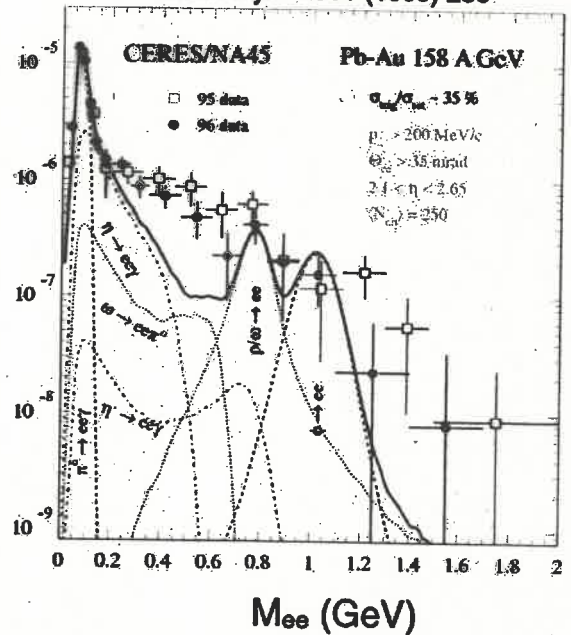
Eur. Phys. J C4 (1998) 231



Phys. Rev. Lett. 75 (1995) 1272



Nucl. Phys. A661 (1999) 23c

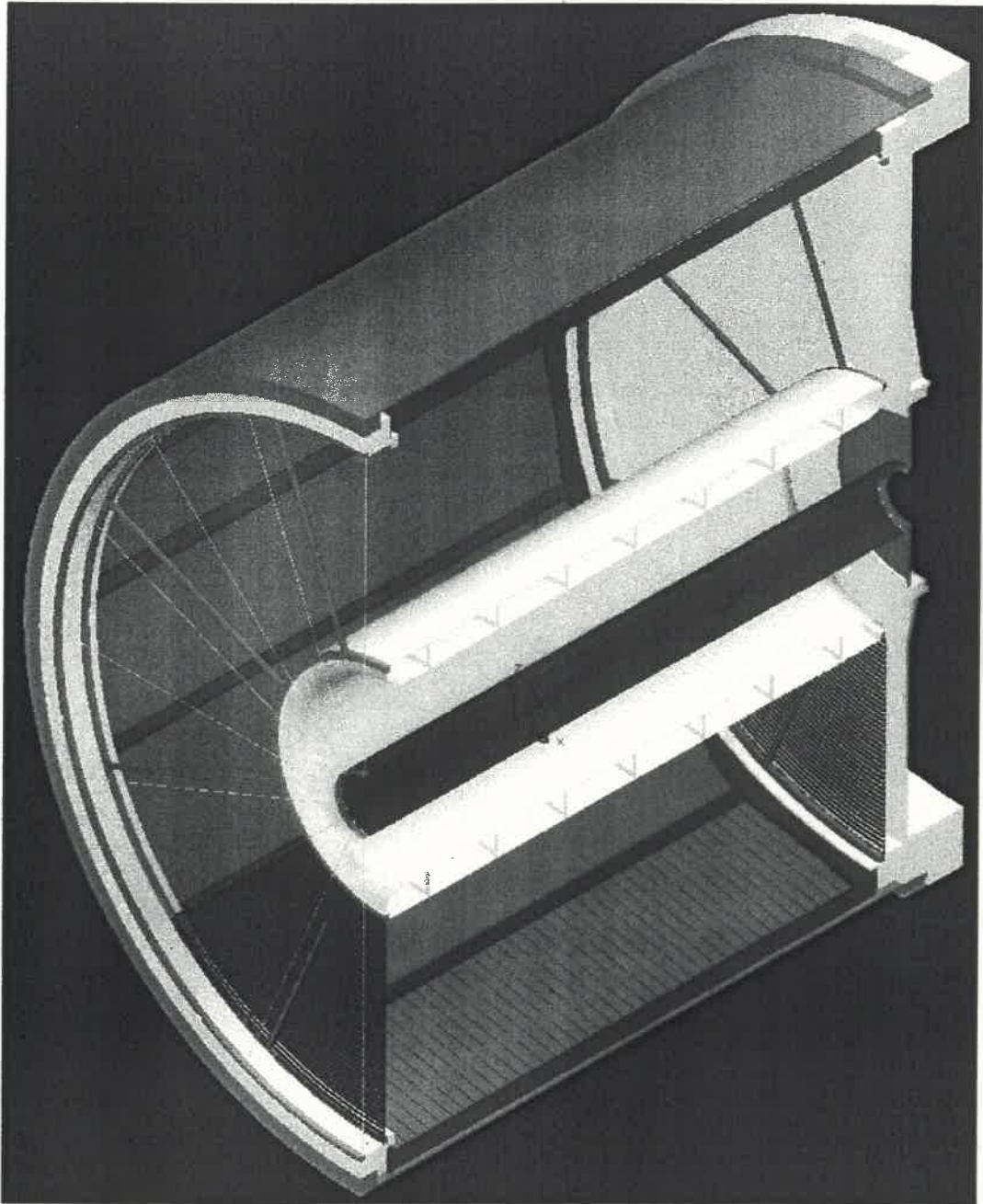


→ excess of e^+e^- pairs in heavy ion collisions

CERES run history

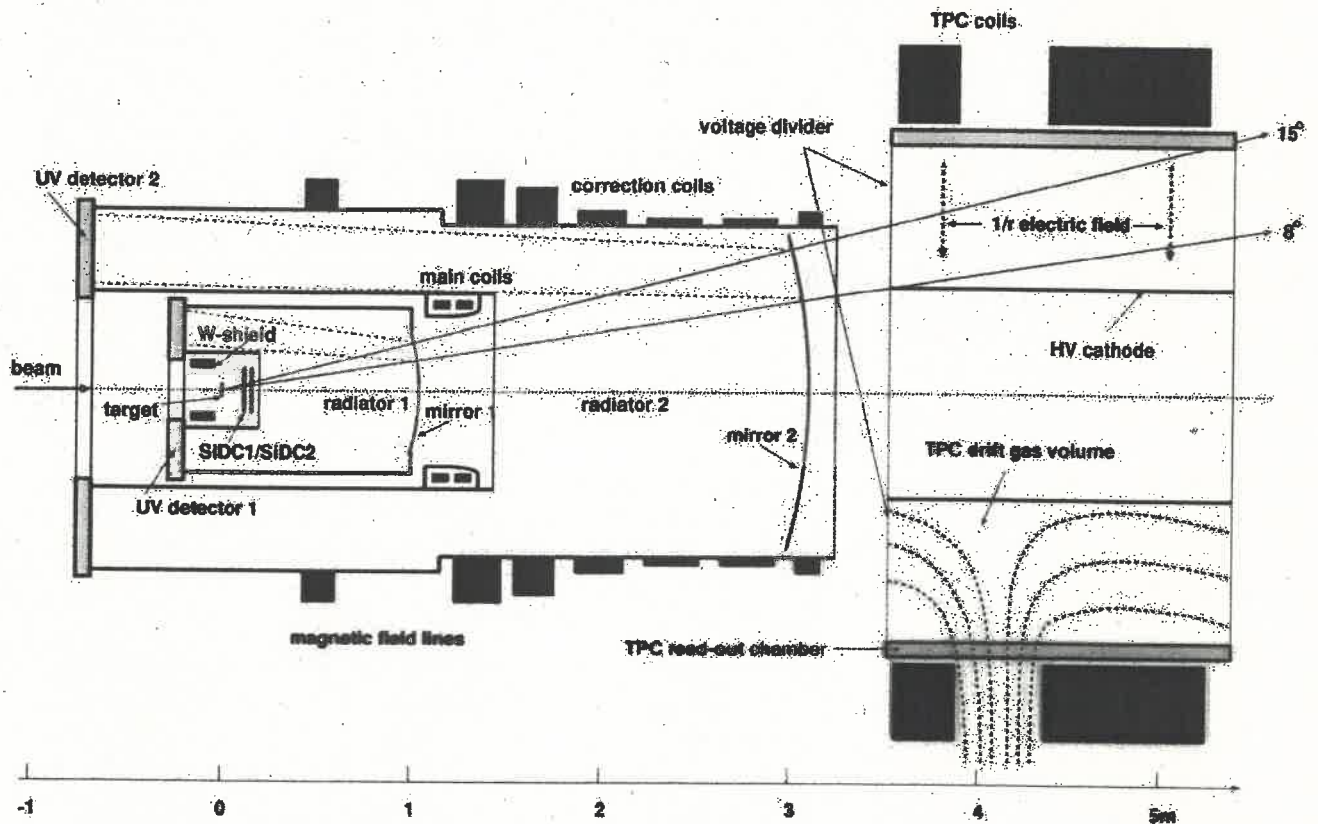
1990	installation	
1991	completed	
1992	200 GeV S+Au	4M central 3M pairs
1993	450 GeV p+Be 450 GeV p+Au	10M pairs 3M pairs
1995	160 GeV Pb+Au	10M central
1996	160 GeV Pb+Au	50M central
1997	TPC construction	
1998	TPC installation	
1999	40 GeV Pb+Au	10M central
2000	80 GeV Pb+Au 160 GeV Pb+Au	1M central 30M central

CERES TPC



- cylinder Φ 2.6 m x 2 m
- gas Ne:CO₂ (80:20)
- radial E-field $E_R \sim 1/r$ with $E=200-600$ V/cm
- radial drift with $v=0.7-2.4$ cm/ μ s

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

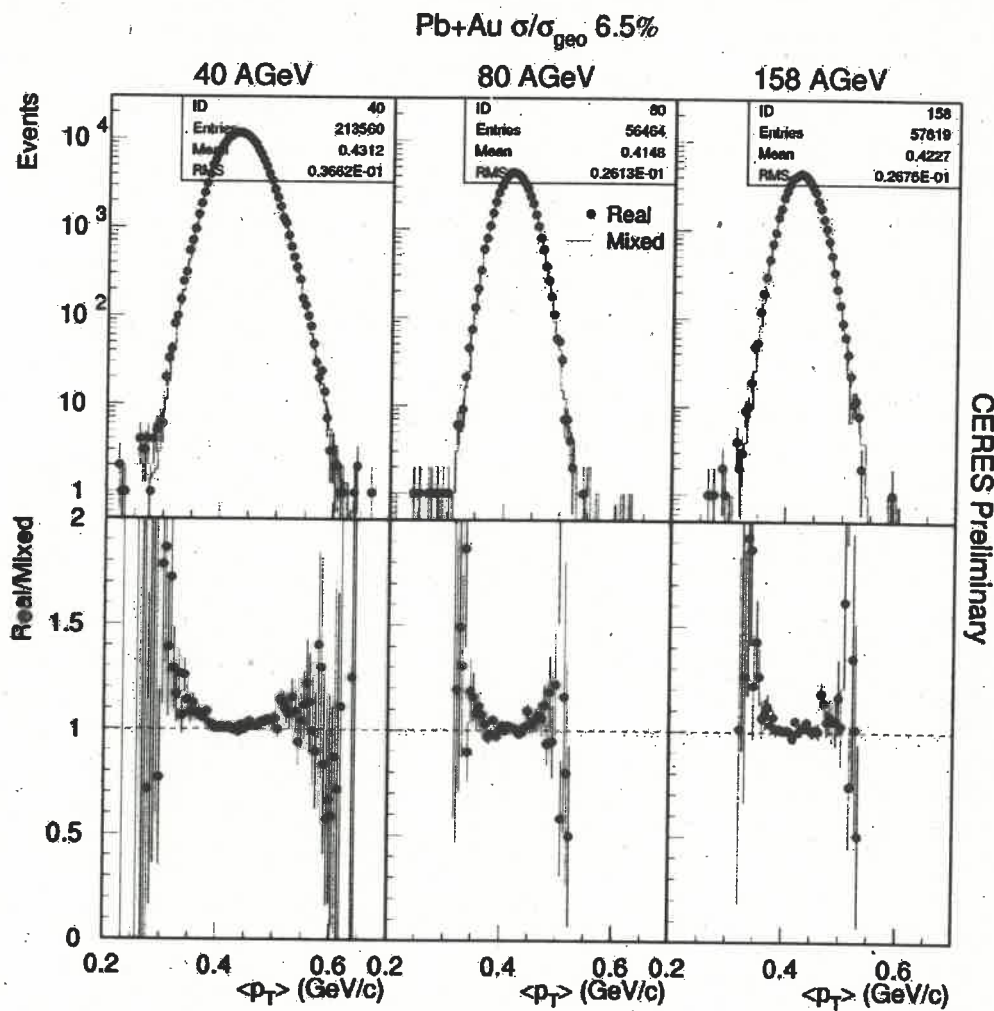
CERES 1999-2000

Pb+Au results

- 40 GeV e^+e^-
 - 40 GeV h^- spectra
 - 40 GeV $h^+ - h^-$ spectra
 - 40 GeV h^-h^- HBT
 - 40,80,160 GeV elliptic flow
 - 40,80,160 GeV pt fluctuations
 - 160 GeV high pt pion correlations
-
- 40 GeV λ
 - 80 GeV h^-h^- HBT

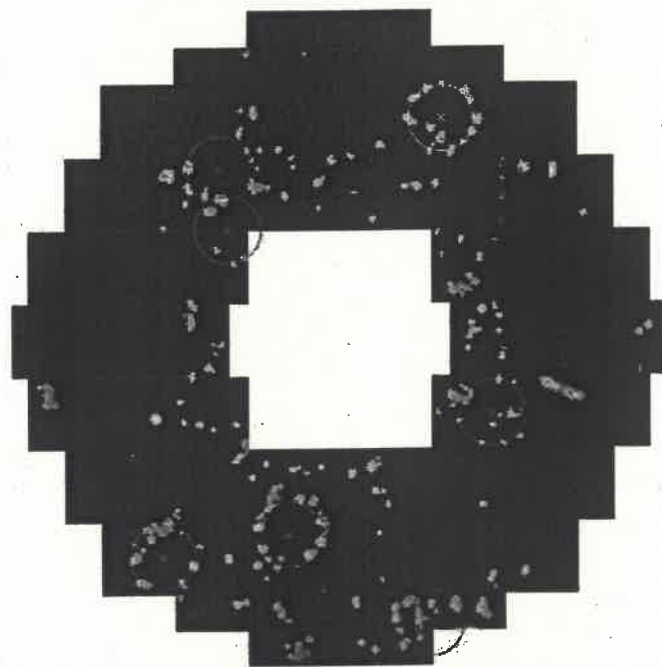
shown in
QM2001
by Harry
Appelshäuser

Event by event mean pt

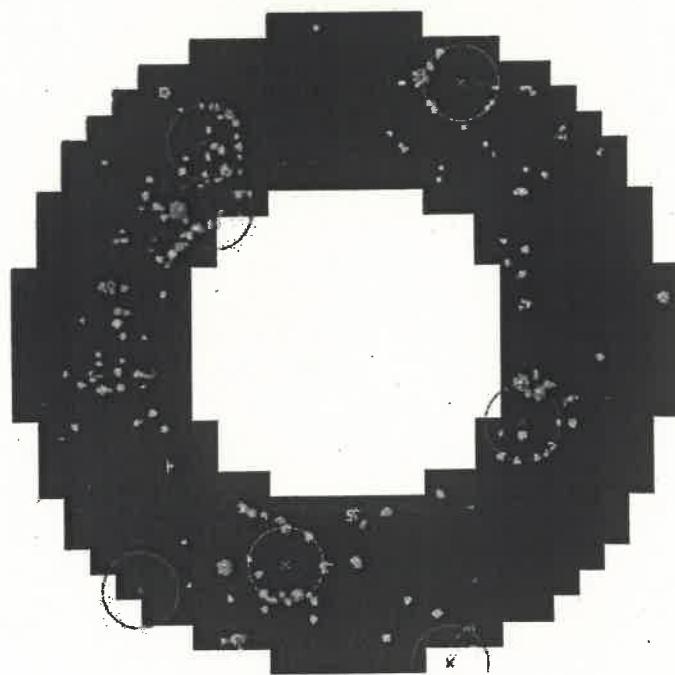


→ Non-zero event-by-event fluctuations

Event in RICH

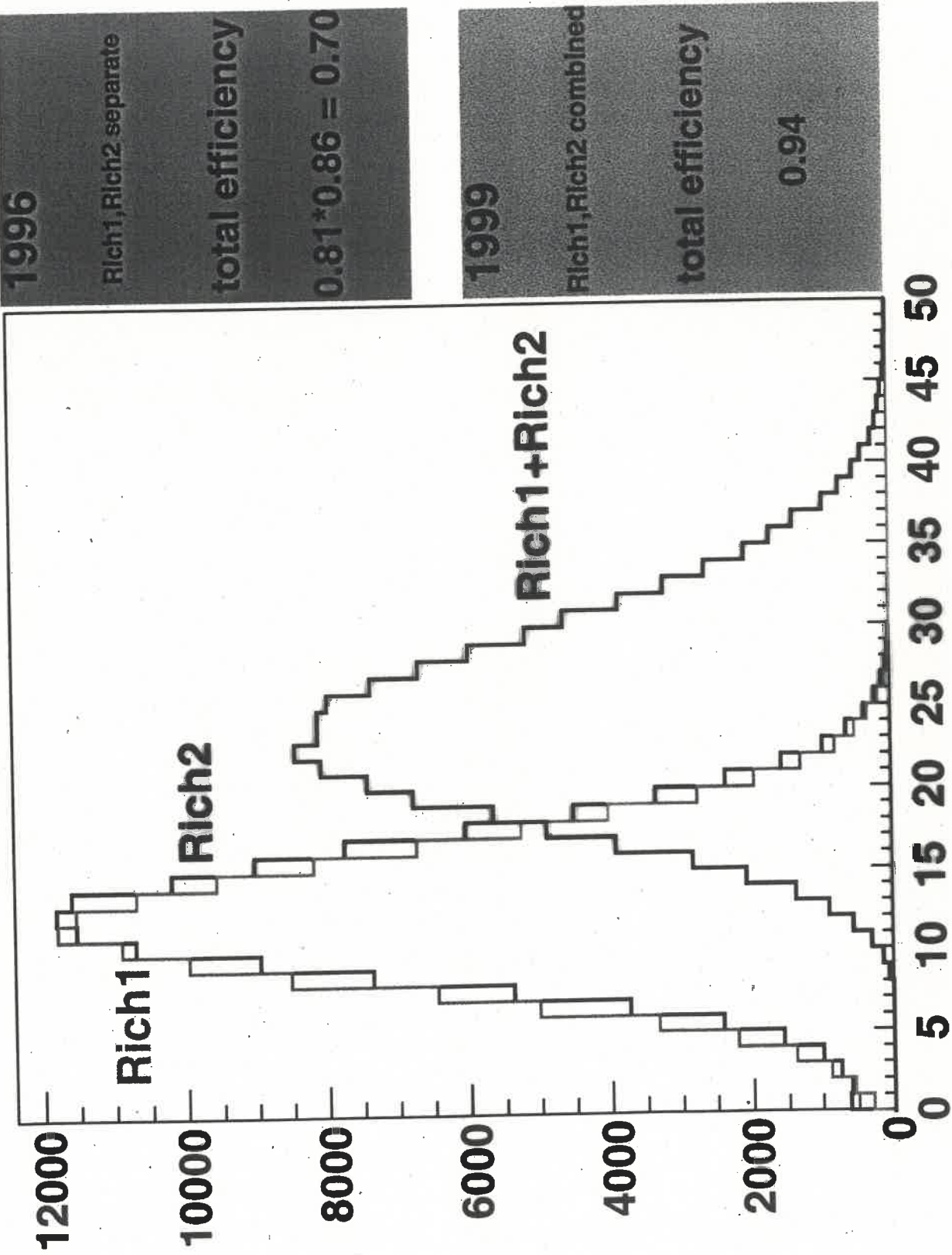


RICH 1



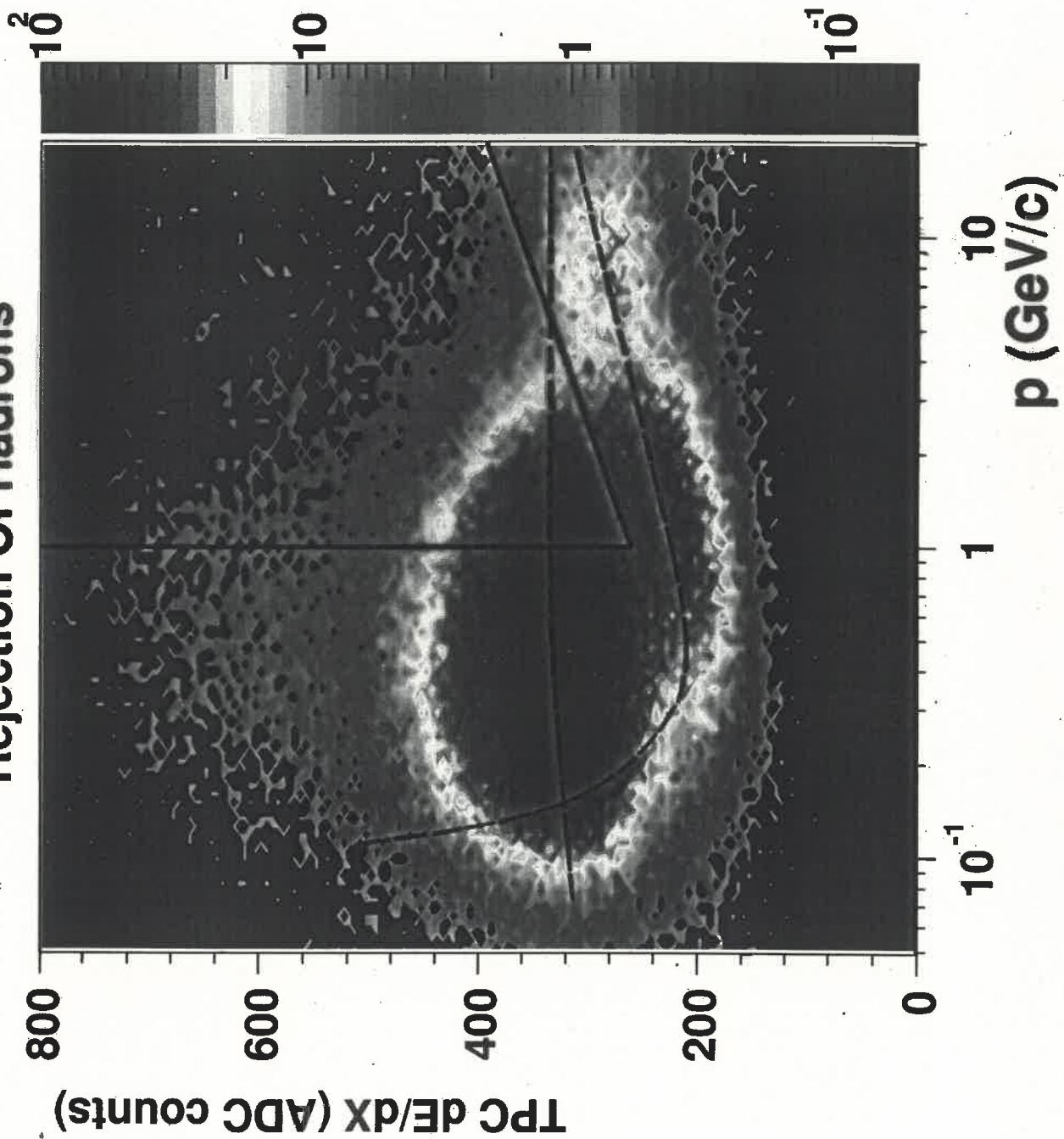
RICH 2

RICH Efficiency

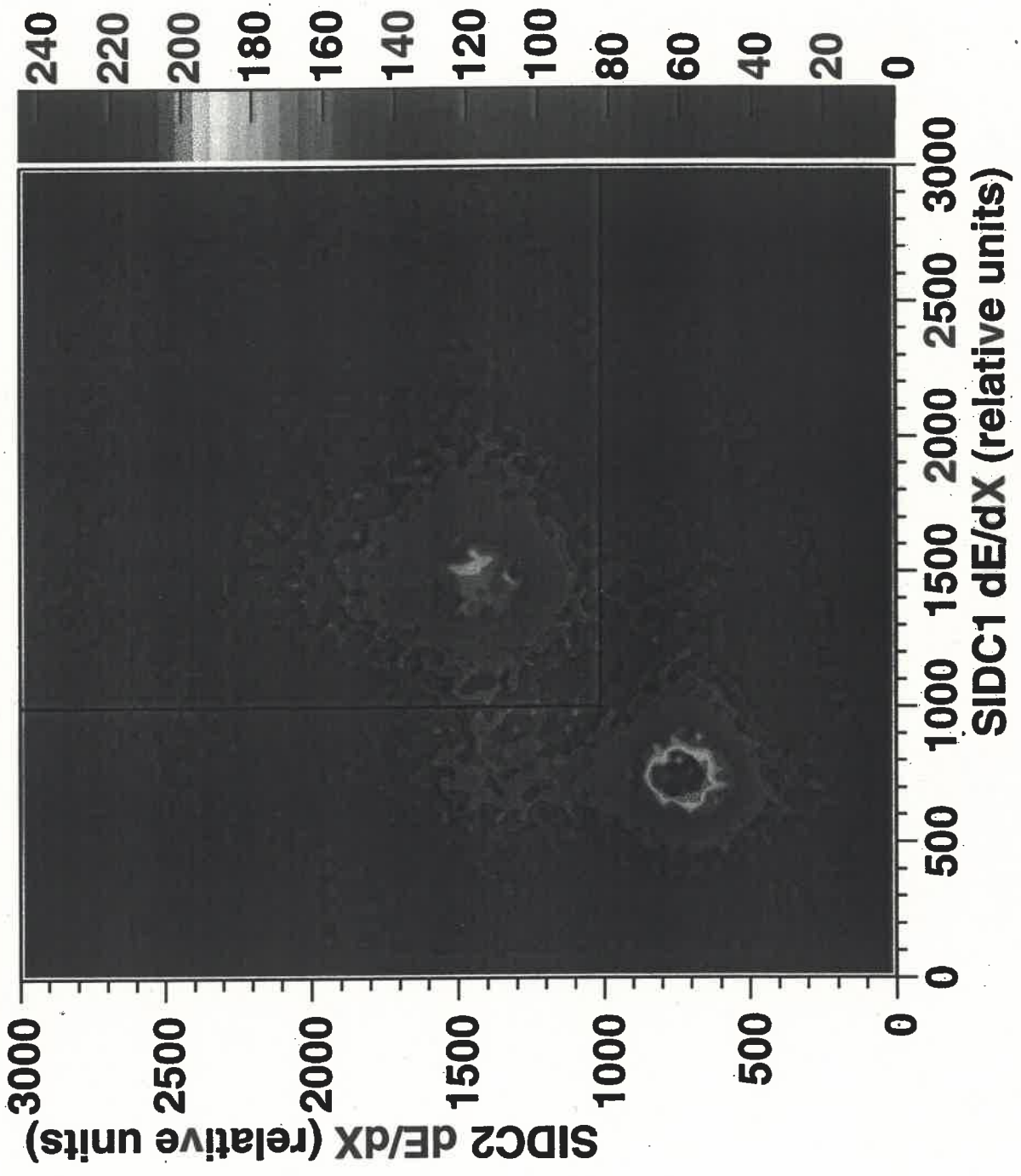


Number Of Hits On Ring

Rejection Of Hadrons

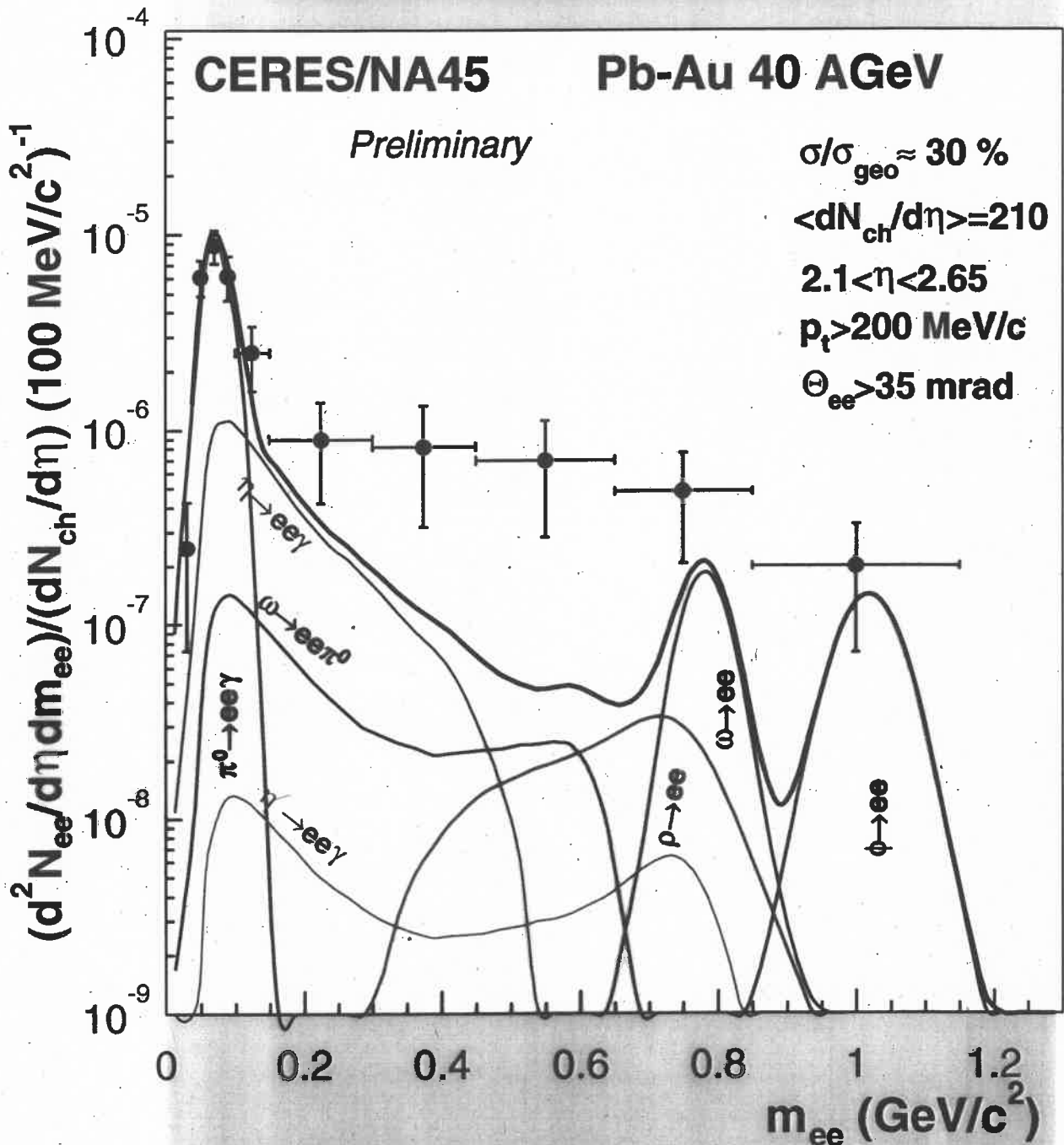


Rejection Of Close Conversion and Dalitz Pairs



S. DAMJANOVIĆ
K. FILIMONOV
H. SPECHT

e+e- mass spectrum



Number of pairs for $m > 0.2 \text{ GeV}/c^2$: 180 ± 48

Ratio Signal/Background: 1/6

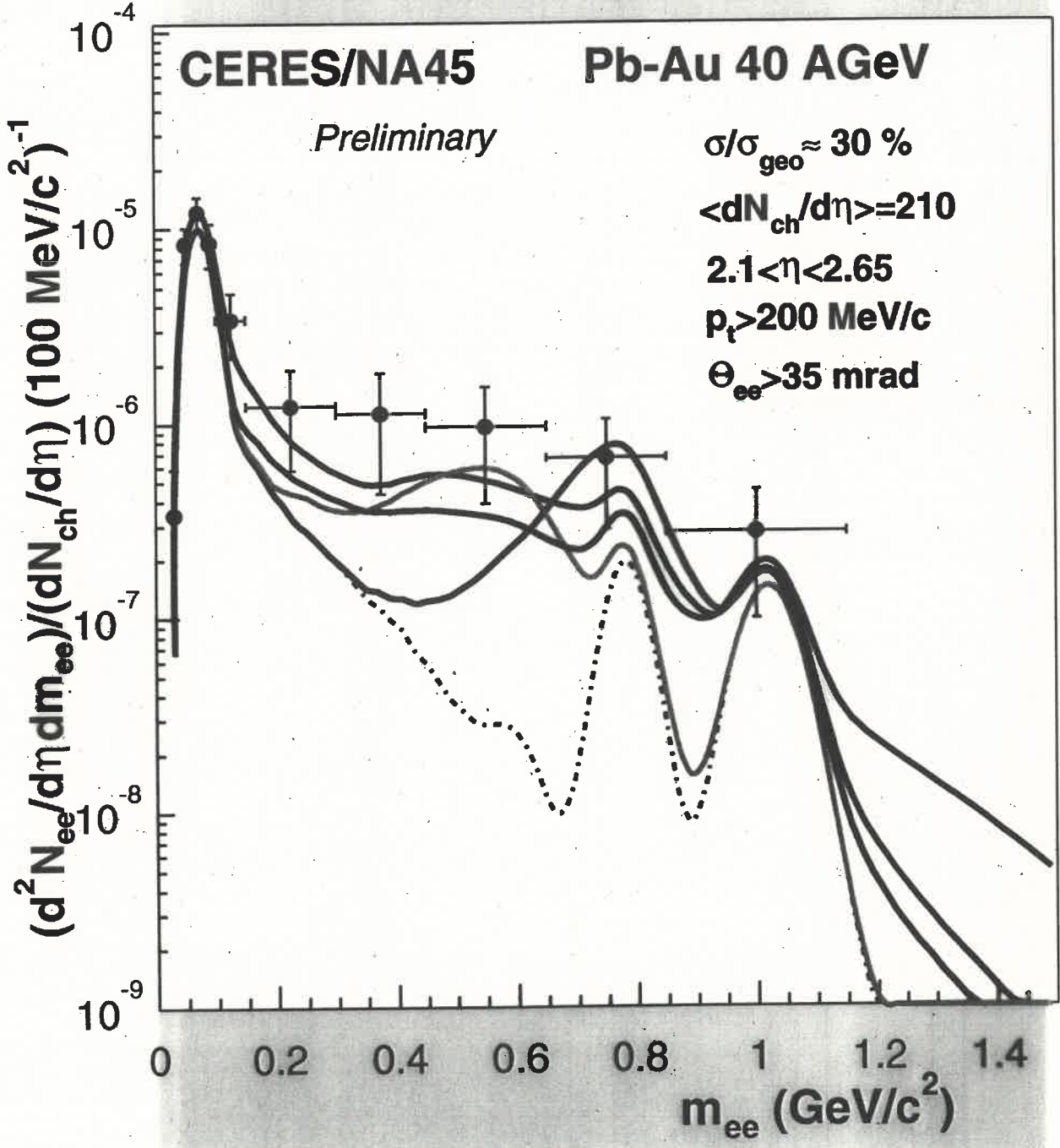
Hadronic decay cocktail:

- particle ratios taken from thermal model for Pb-Pb
- rapidity and p_t distributions from systematics in Pb-Pb

Enhancement: measured pairs/decay cocktail: 5.0 ± 1.5

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e+e- mass spectrum



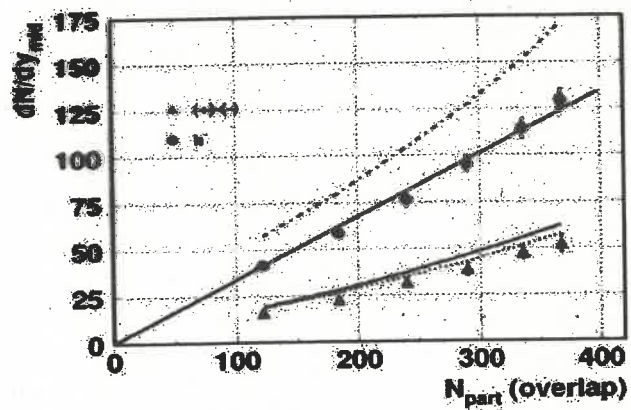
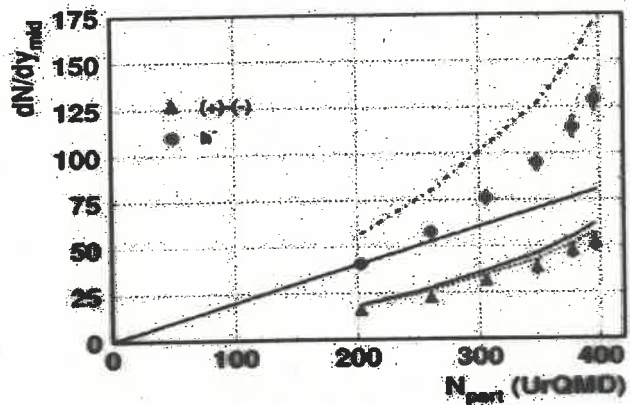
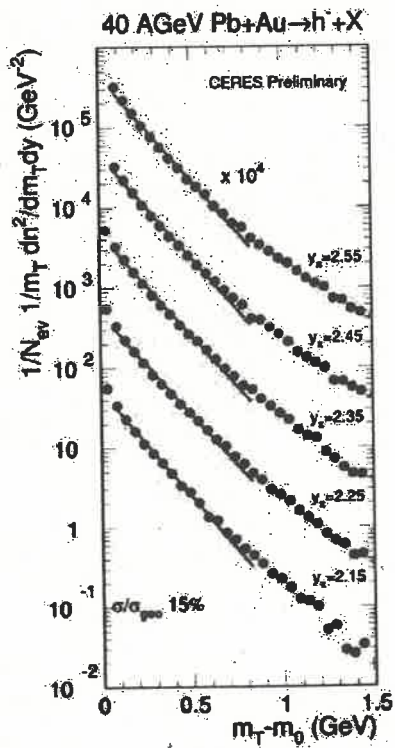
- Hadronic decay cocktail
- + Vacuum rho spectral function
- + Rho spectral function with dropping mass
- + In-medium rho spectral function
- + Lowest order pQCD rate

RALF
 RAPP
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NUCL-TM  
 10/4

# 40 GeV $h^-$ spectra

Harry Appelshäuser



VERY PRELIMINARY



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

# 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:  (mass number of the projectile nucleus)

B:  (mass number of the target nucleus)

Which density profile do you want?

sharp sphere

Woods-Saxon

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

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



A lead lead collision calculation takes typically 10 seconds per thousand trials.

Web interface by Jens Eigelt

## Average number of participants and collisions

from: b=  fm or  centrality

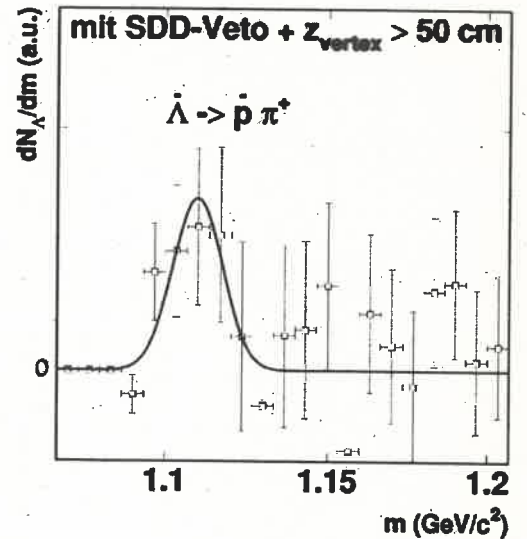
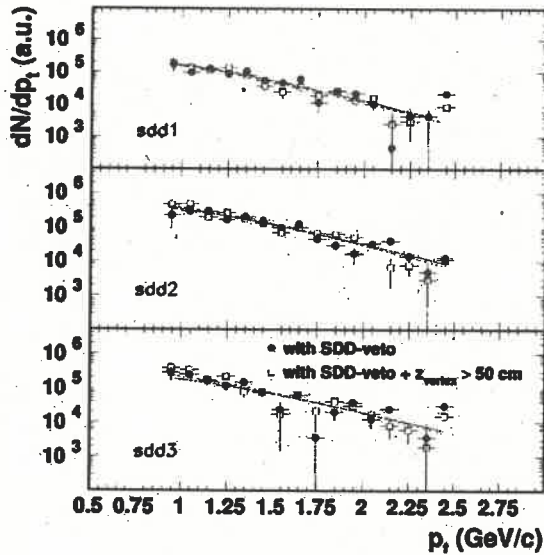
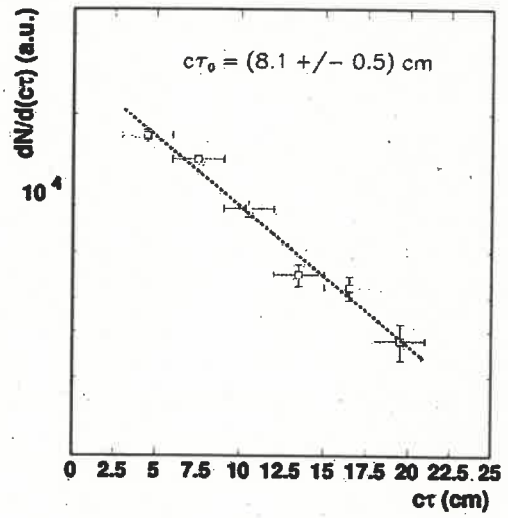
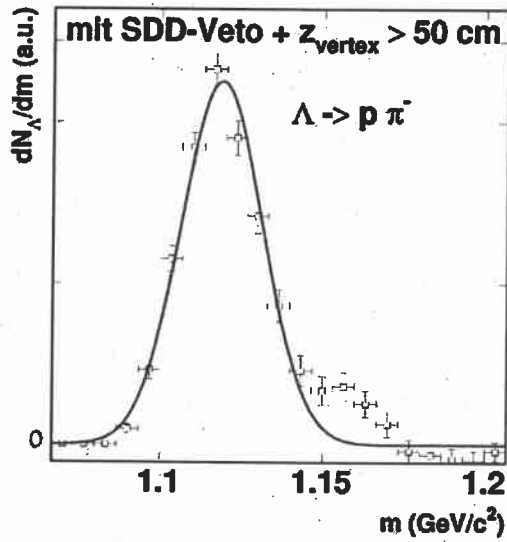
to: b=  fm or  centrality

Number of participants:

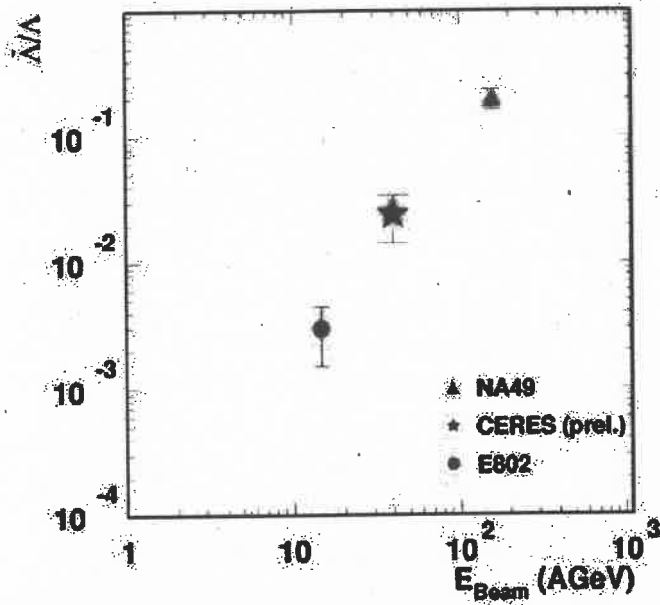
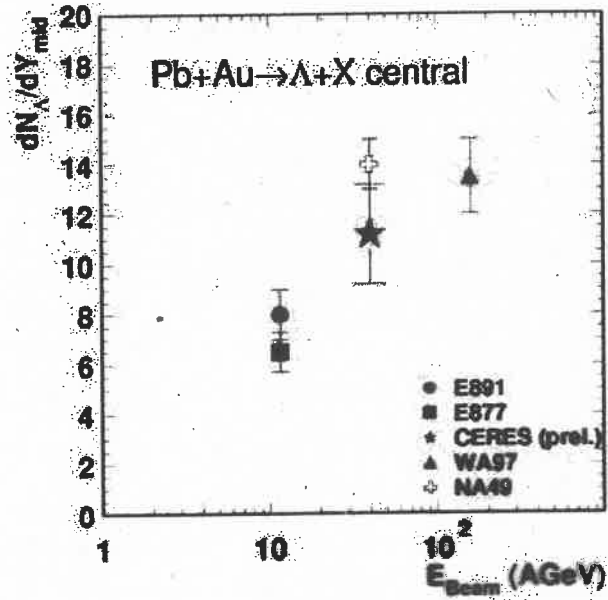
Number of collisions:



# $\Lambda$ Production at 40 GeV



# $\Lambda$ Production at 40 GeV



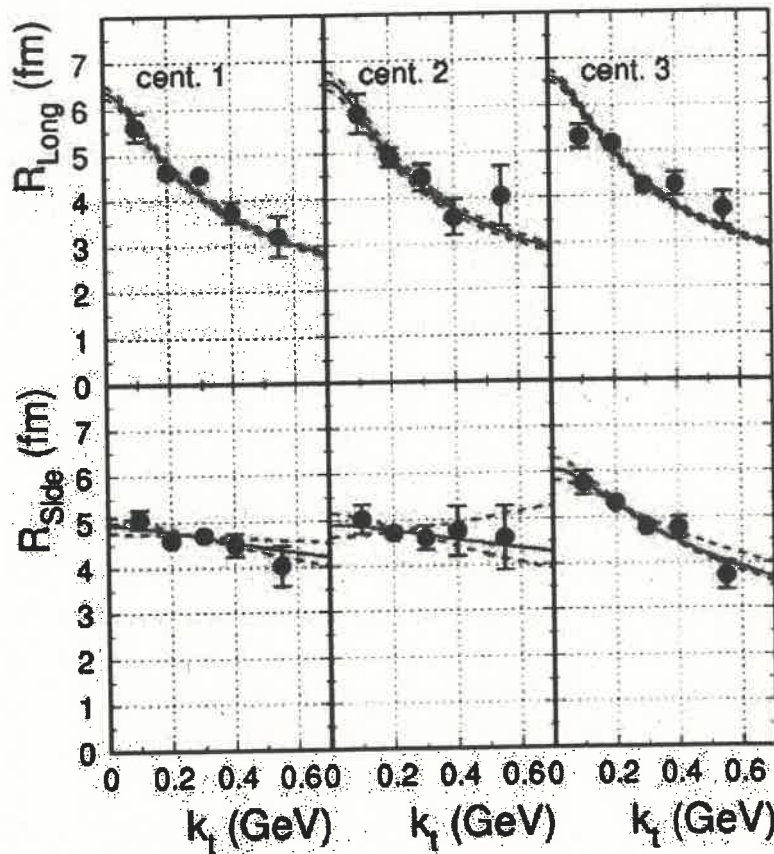
$\rightarrow$   $\Lambda$  and anti- $\Lambda$  yields fit into the beam energy systematics

# HBT in Pb+Au at 80 GeV

Harry Appelshäuser

VERY PRELIMINARY

80 AGeV Pb+Au  $\rightarrow$  h h $\bar{\otimes}$ h $^+$ h $^+$   $-0.5 < y_{\pi\pi} - y_{mid} < 0.0$



$$R_{Long}(k_T) = r_0 (T/m_t)^{1/2}$$

$$\rightarrow r_0 = 7 \text{ fm/c}$$

$$R_{Side}^2(k_T) = R_{geo}^2 / (1 + m_t \beta_T^2 / T)$$

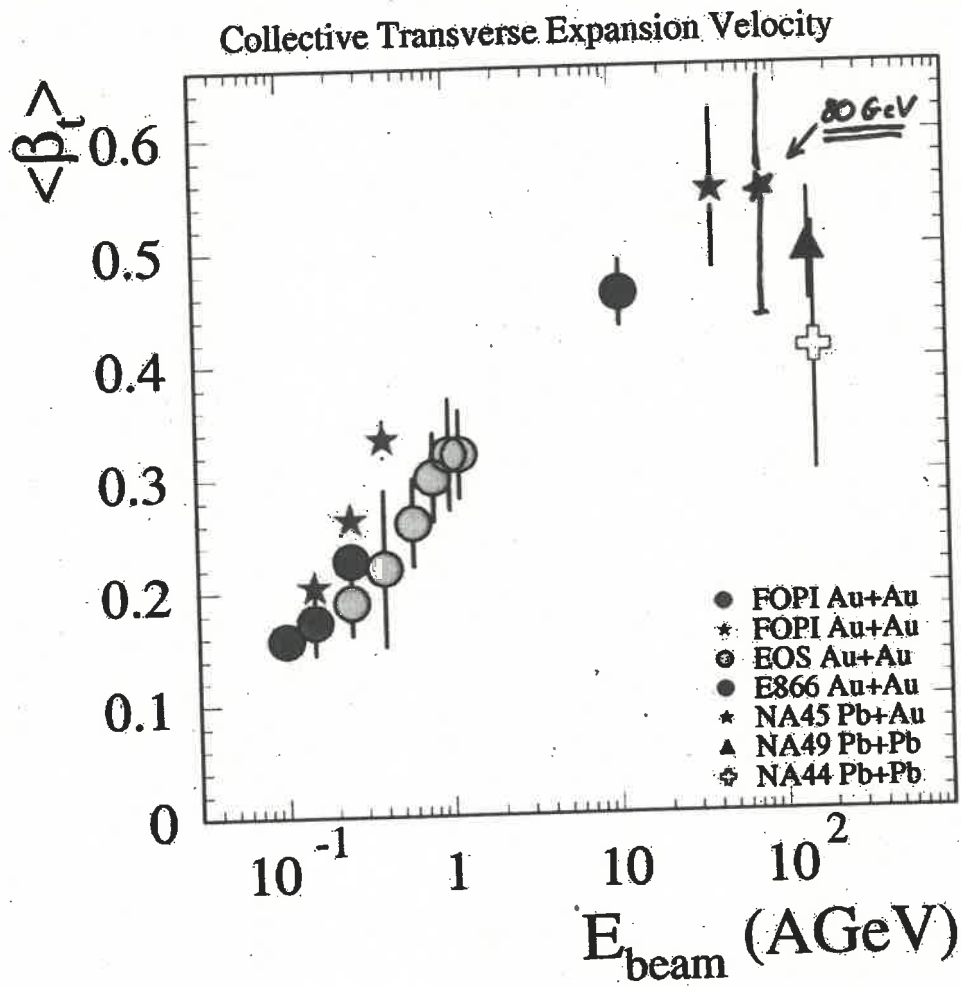
$$\rightarrow \beta_T = 0.22 - 0.55$$

$$\rightarrow R_{geo} = 5 - 8 \text{ fm}$$

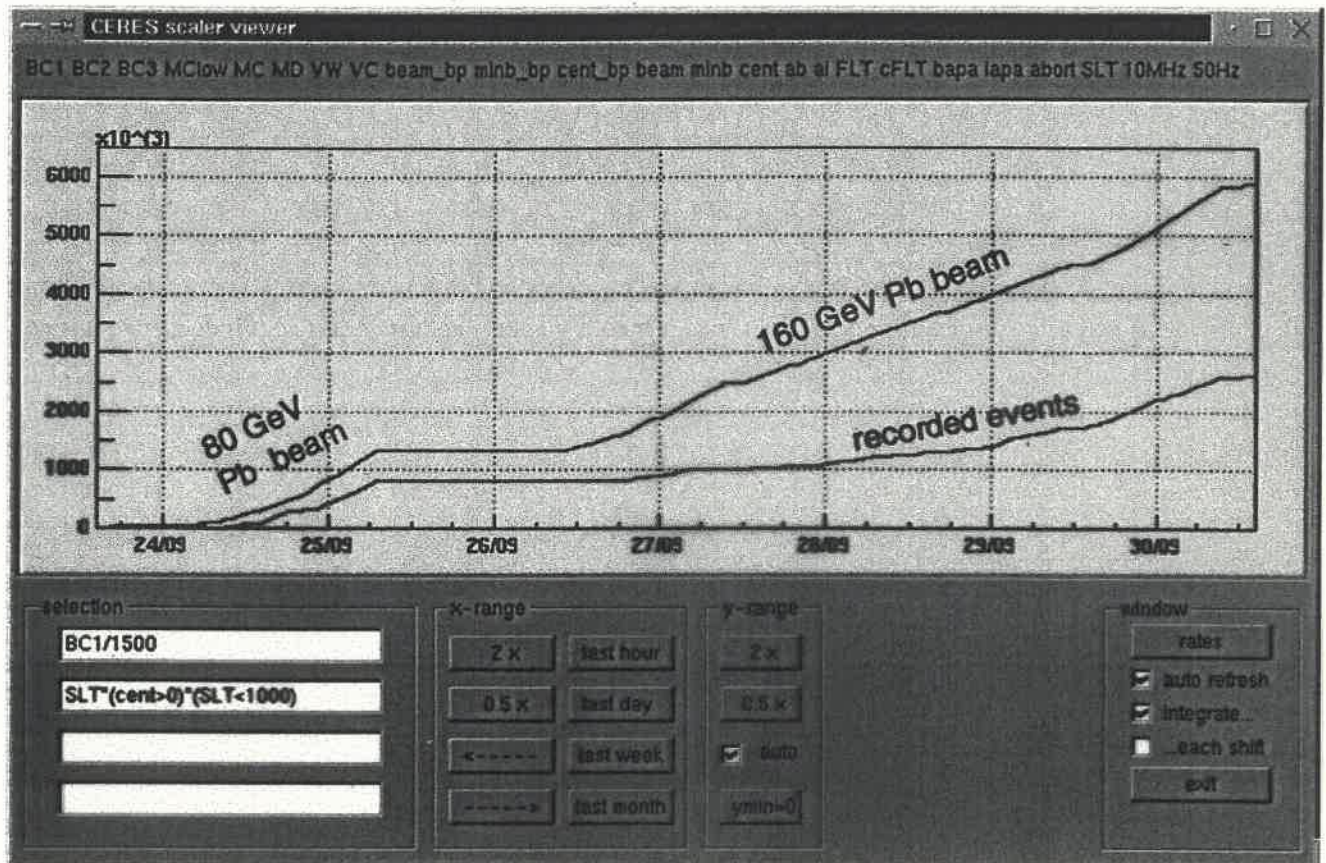
$\rightarrow$  similar to 40 GeV

# HBT in Pb+Au at 80 GeV

Harry Appelshäuser

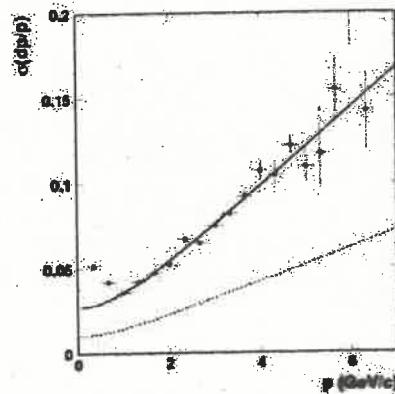
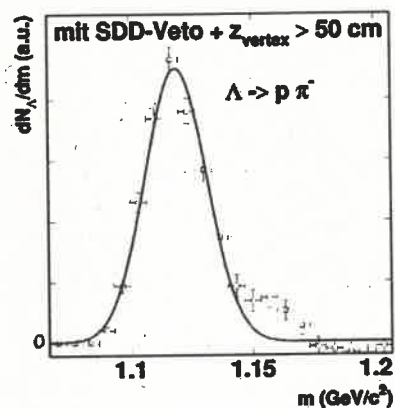


# 80 GeV/nucleon "run"



# Current activities

$\Lambda$  at 40 GeV



$\Lambda$  peak too wide  
→  $\Delta p$  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

- ❖ 40 GeV results close to final (dileptons, hadron spectra,  $\lambda$ )
- ❖ preliminary results for 80 GeV (hadrons)
  
- ❖ systematic calibration of the TPC to reach the design  $\Delta p$  in the 2000 data (160 GeV) results expected for QM2002
  
- ❖ 20,30 GeV run in 2002 under consideration