New results on

low-mass lepton pair production

in Pb-Au collisions at 40 AGeV

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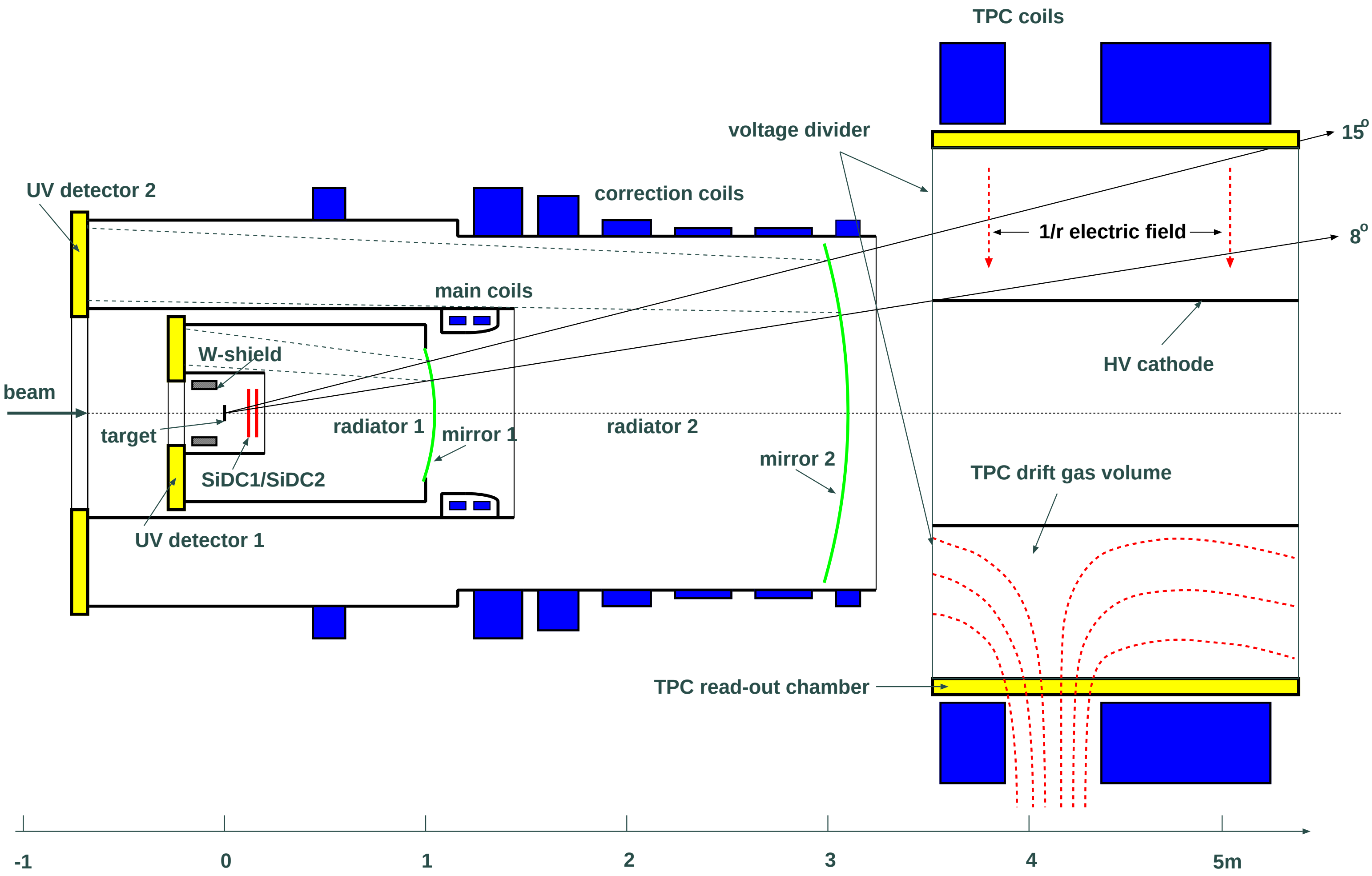
CERES/NA45

- The CERES - Experiment
- Analysis procedure
- Results ('99 data set)
- Comparison to theory

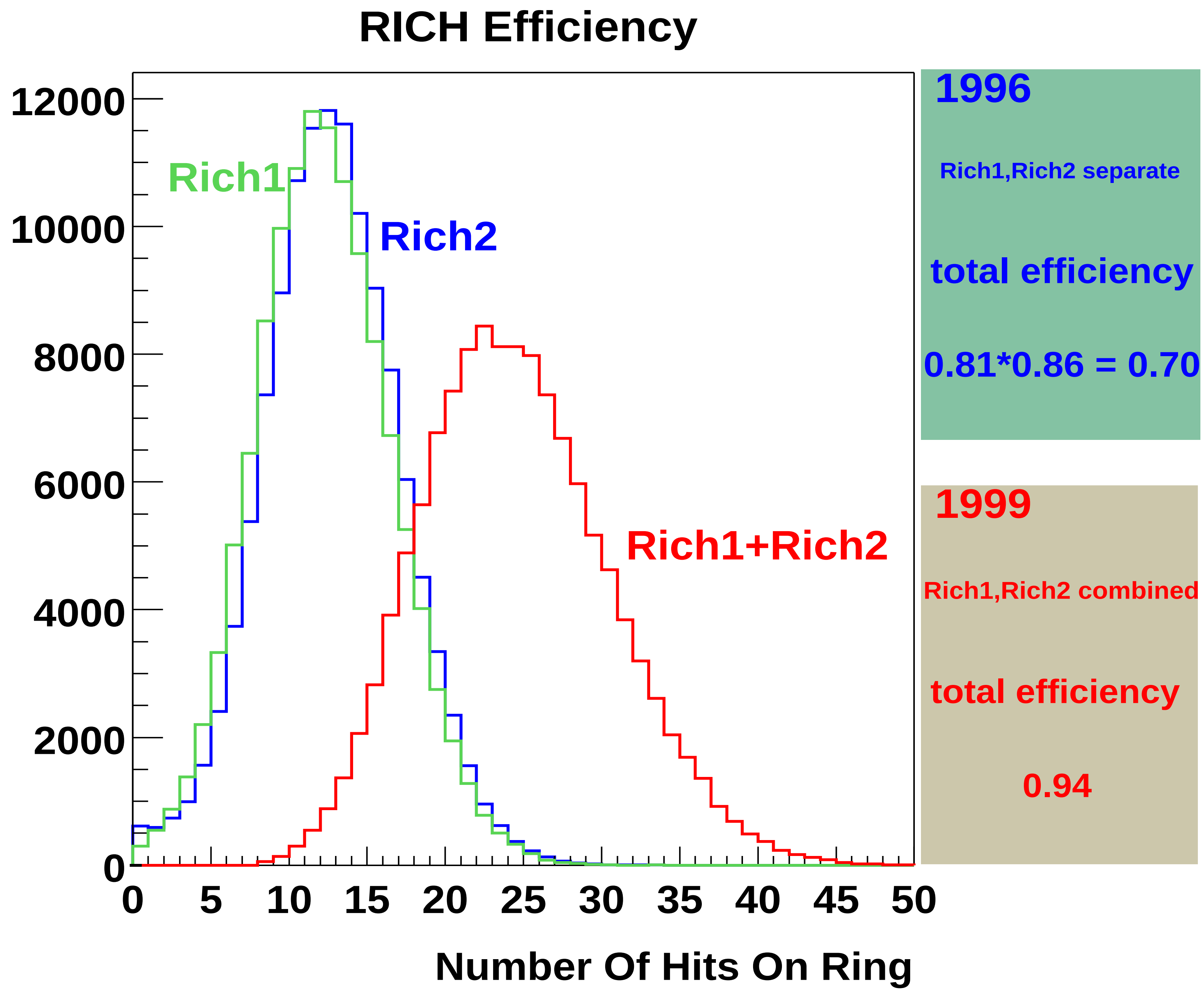
CERES/NA45 Experimental Setup



- SiDC1+2: Vertex reconstruction and angle measurement
- RICH1+2: Electron ID and angle measurement

- New cylindrical Time Projection Chamber with radial drift field, length 2 m, outer diameter 2.6 m
- New magnet system; azimuthal deflection inside TPC
- Not any more B-field between RICHES

Better mass resolution of spectrometar
Improved RICH efficiency from combined use of 1 and 2


RICH Efficiency
12000
10000
8000
6000
4000
2000
0
0
5
10
15
20
25
30
35
40
45
50
Number Of Hits On Ring
Rich1
Rich2
Rich1+Rich2
1996
Rich1,Rich2 separate
total efficiency
0.81*0.86 = 0.70
1999
Rich1,Rich2 combined
total efficiency
0.94

vhspace -1 cm

Main Experimental Problems

in the CERES Experiment

- $N_{e^+e^-}/N_{ch} \sim 10^{-5}$
  - solved by using Ring Imaging Cherenkov detectors with high threshhold $\gamma_{th} \sim 31$
  - 95 % of all charged hadrons do not produce any signal

- $N_{e^+e^-}/N_{\gamma} \sim 10^{-5}$

  solved by minimizing the radiation length within the detector acceptance

  $X/X_0 < 1\% \rightarrow N_{e^+e^-}/N_{\gamma \rightarrow e^+e^-} \sim 10^{-3}$

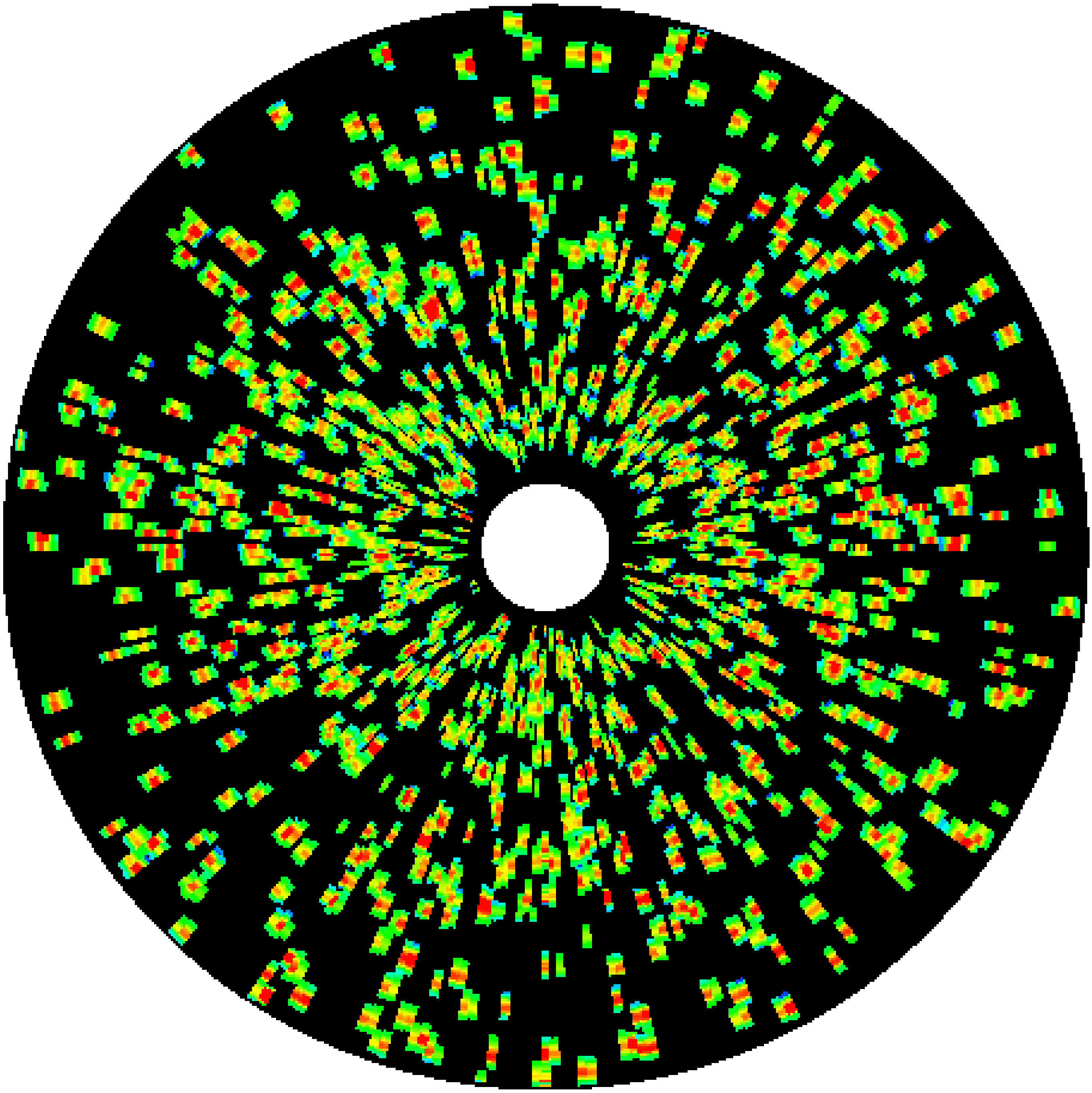
$\rightarrow$ **still large combinatorial background**

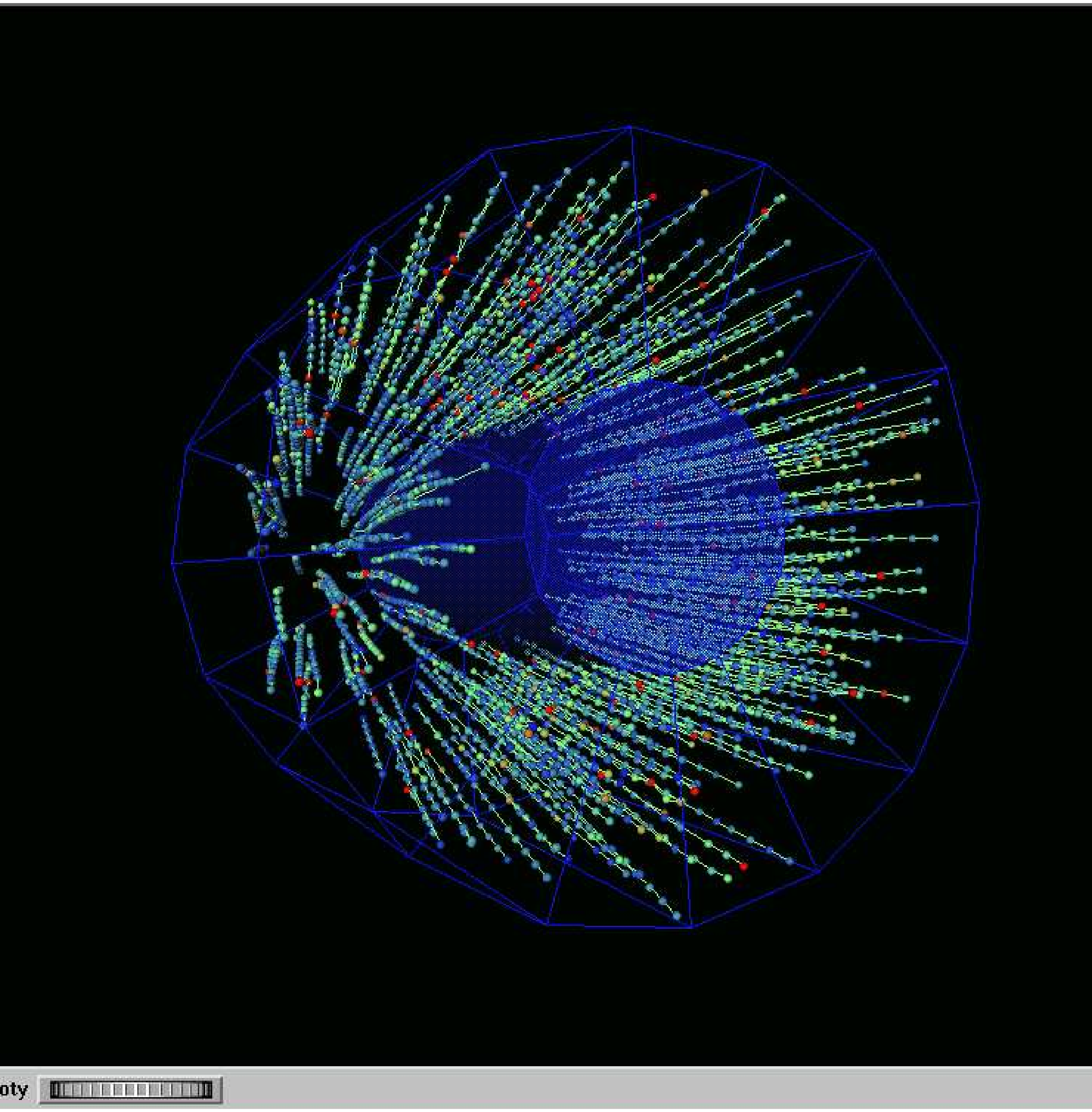
$\gamma \rightarrow e^+e^-$

$\pi^0 \rightarrow e^+e^-\gamma$

pair background $\propto (dN_{ch}/dy)^2$

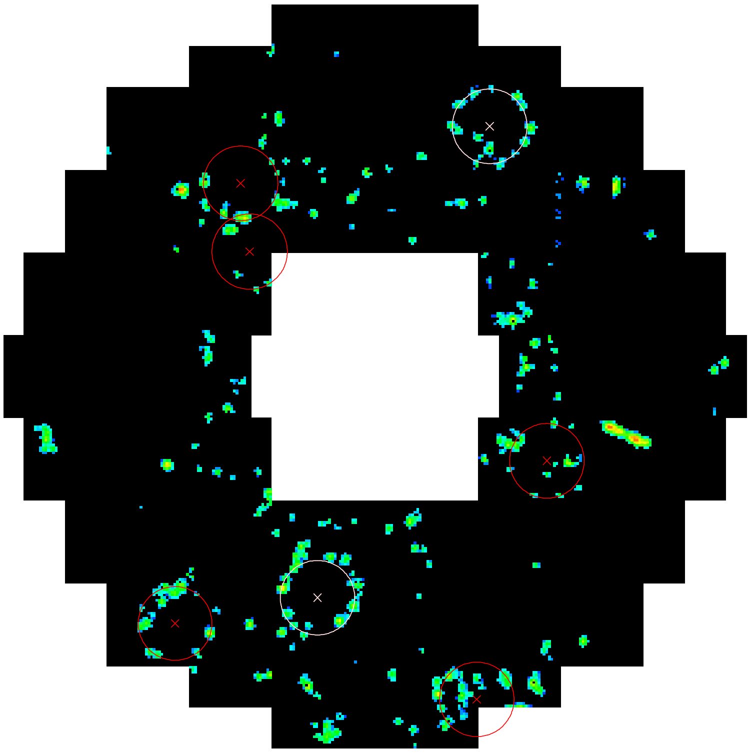
SiDD Event Display



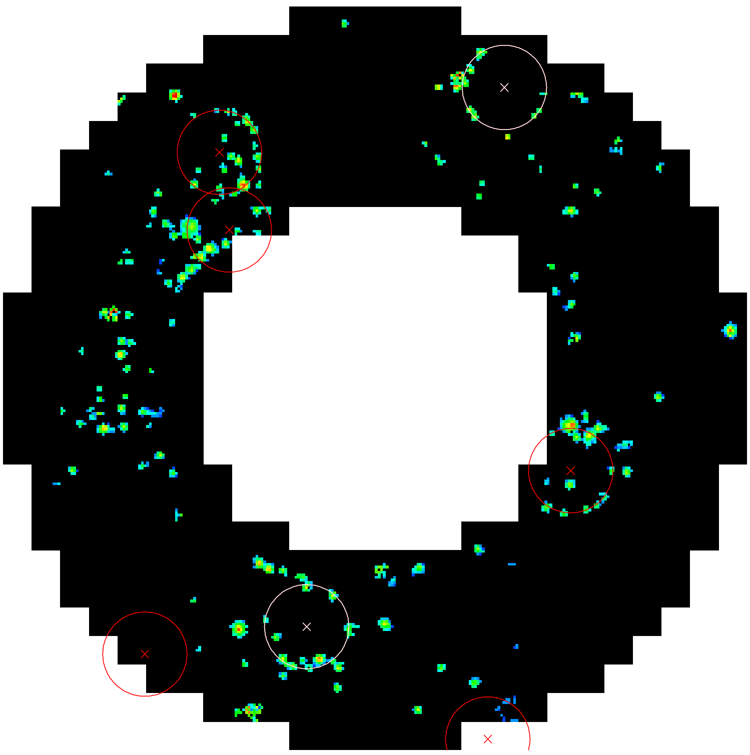


RICH Event Display

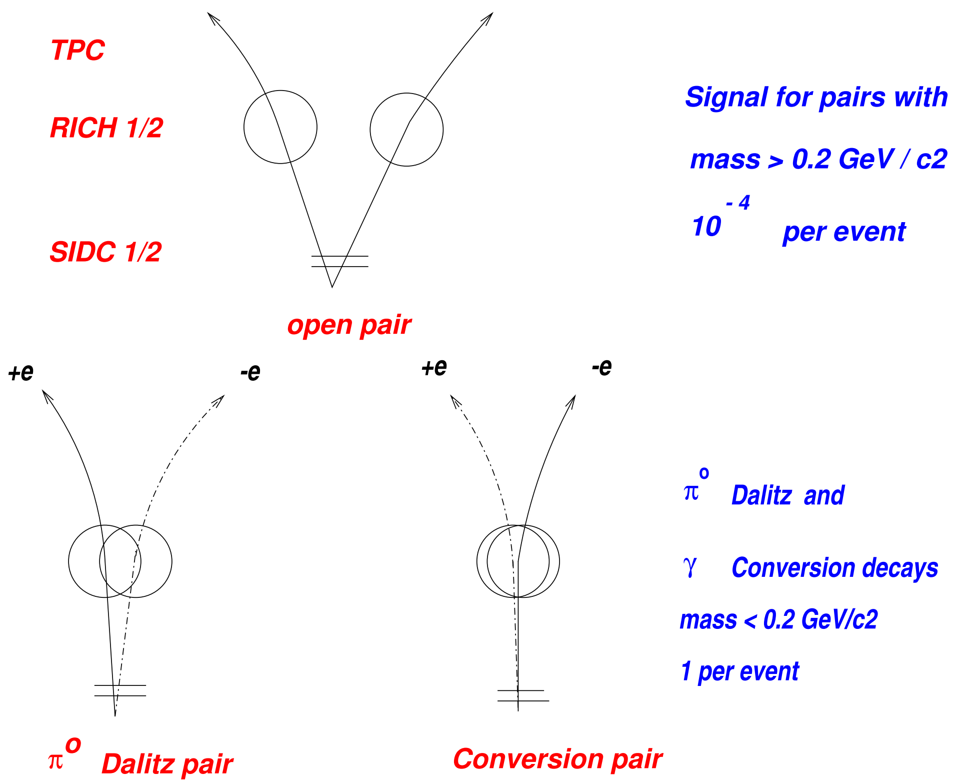
RICH 1:



RICH 2:

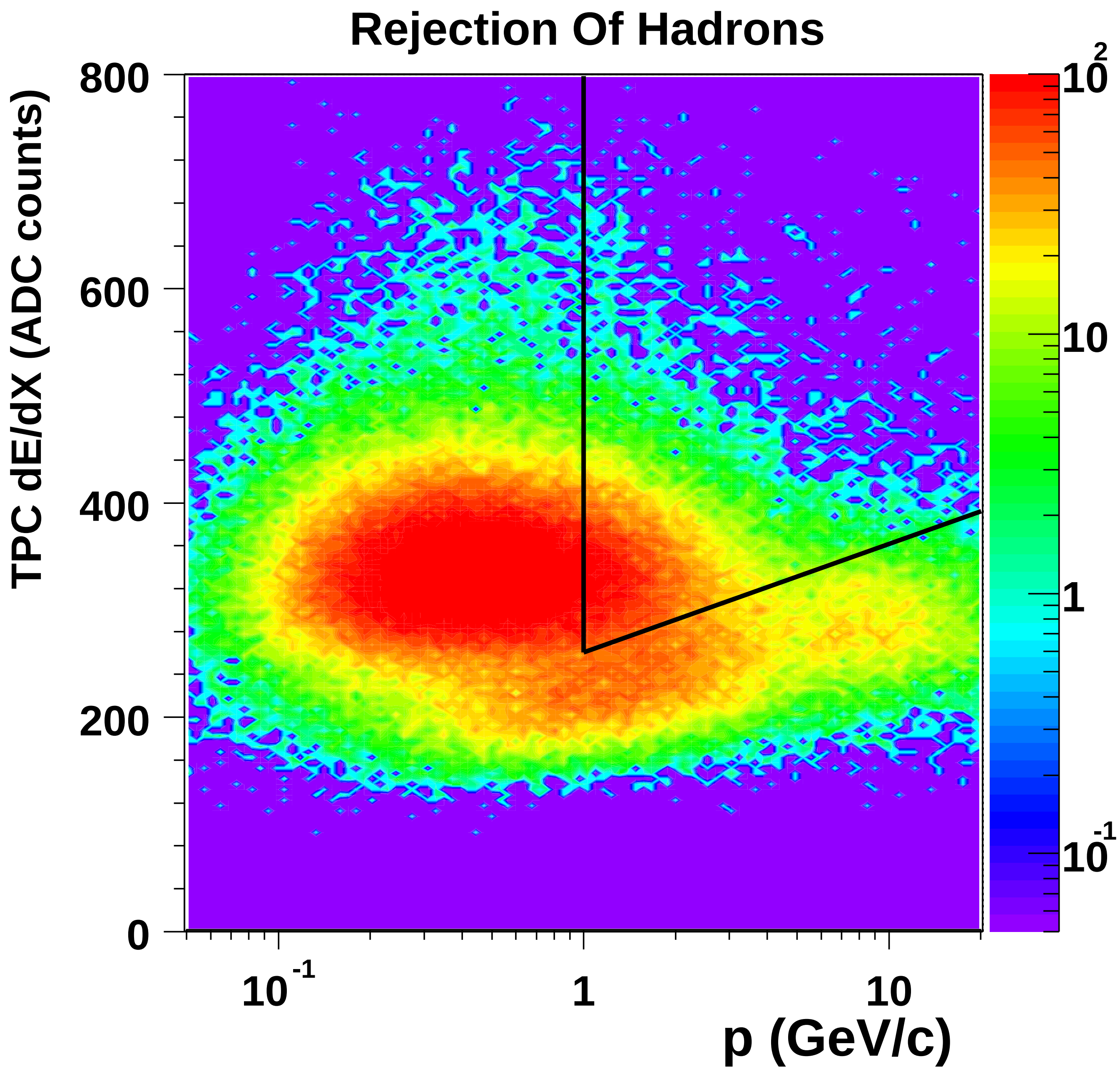


Combinatorial background

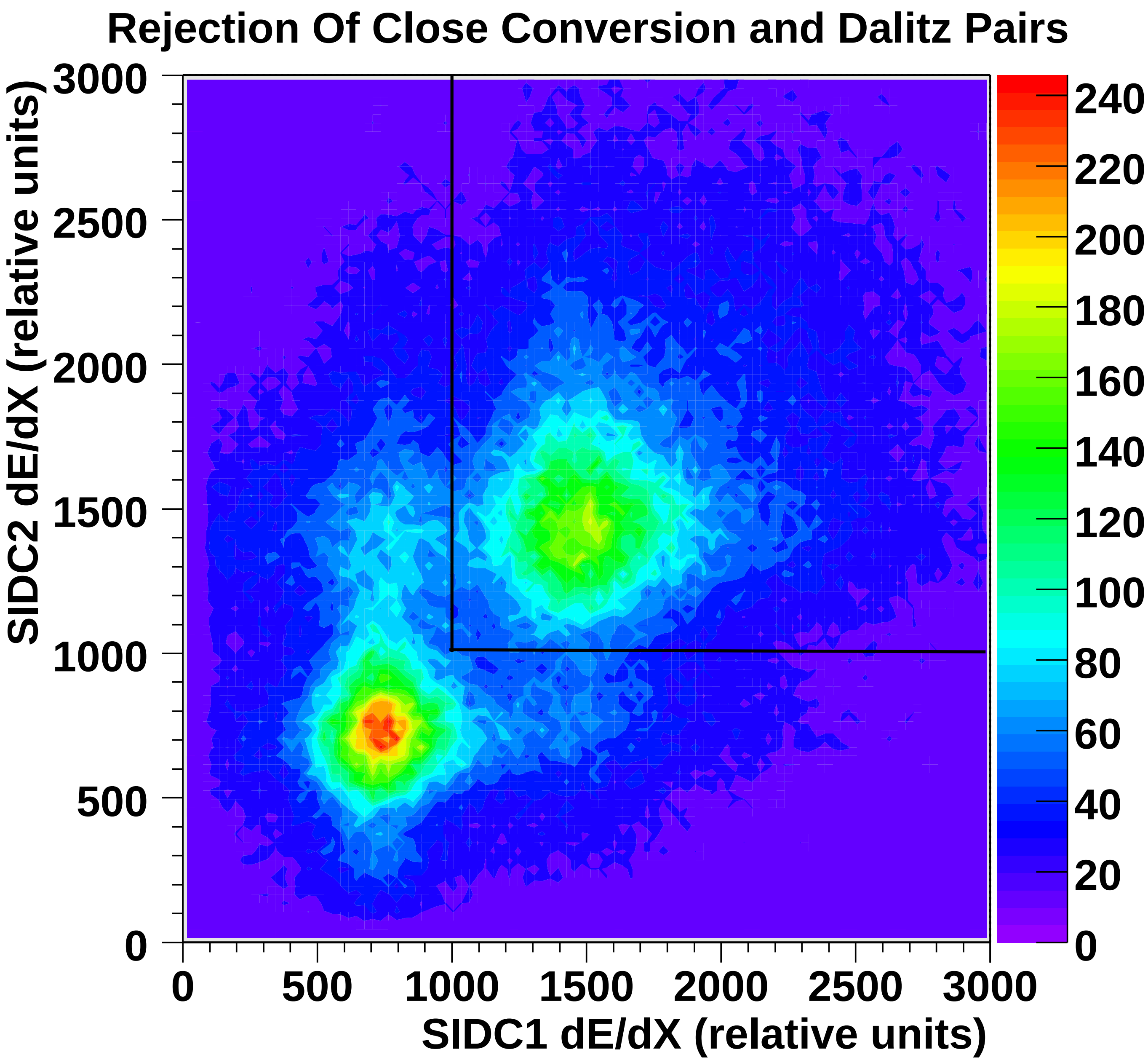


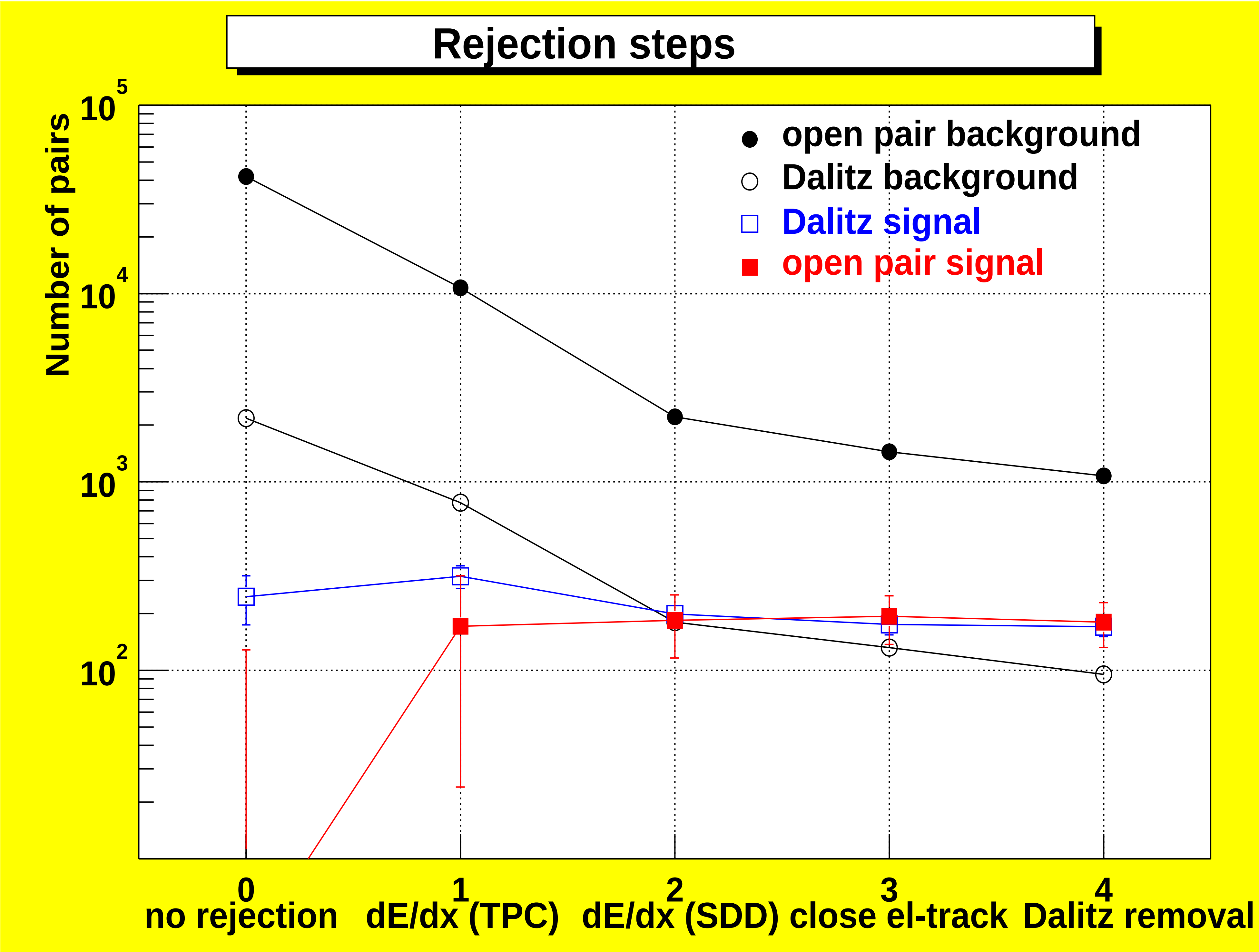
Two partialy recognized
low mass pairs produce combinatorial background with high mass

Require efficient identification and thereby rejection of low mass pairs in SIDC1/2, RICH1/2 and, to some extent, TPC

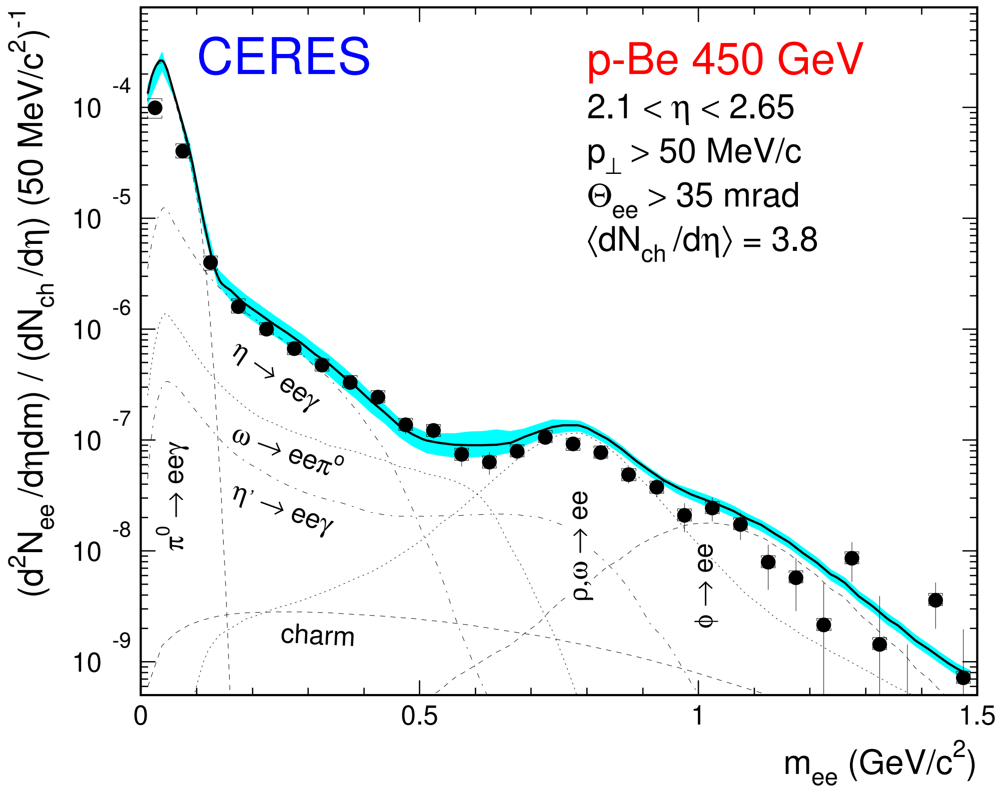


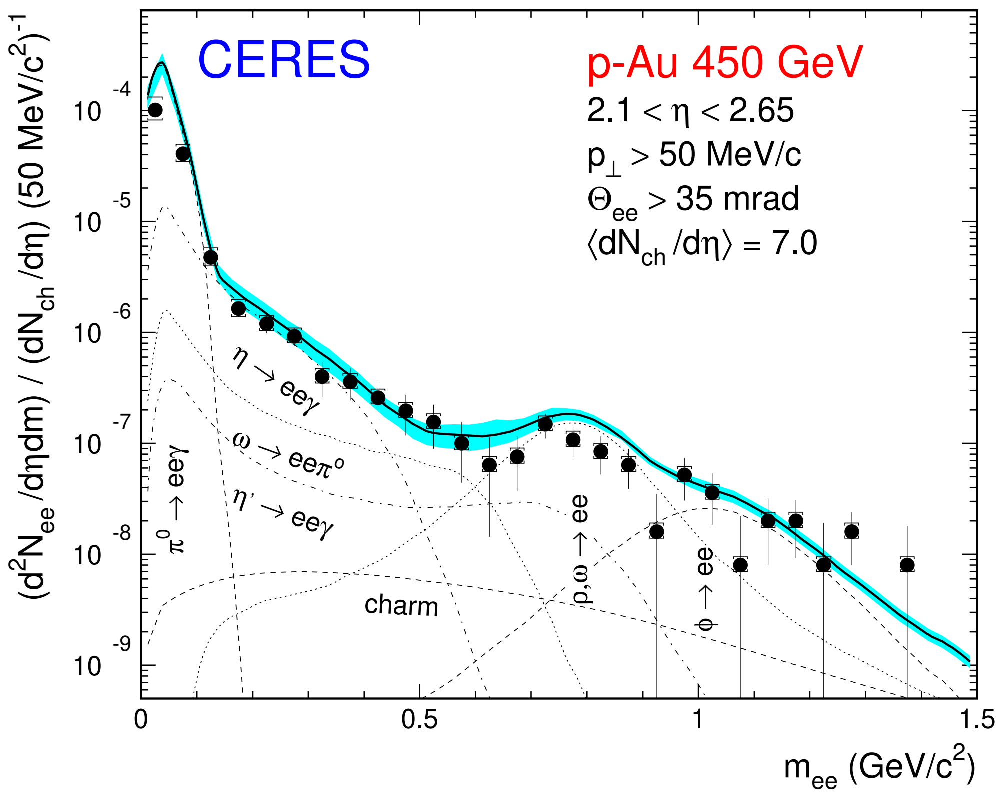
Rejection Of Hadrons
TPC dE/dX (ADC counts)
800
600
400
200
0
10^{-1}
1
10
p (GeV/c)
10^{2}
10
1
10^{-1}


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

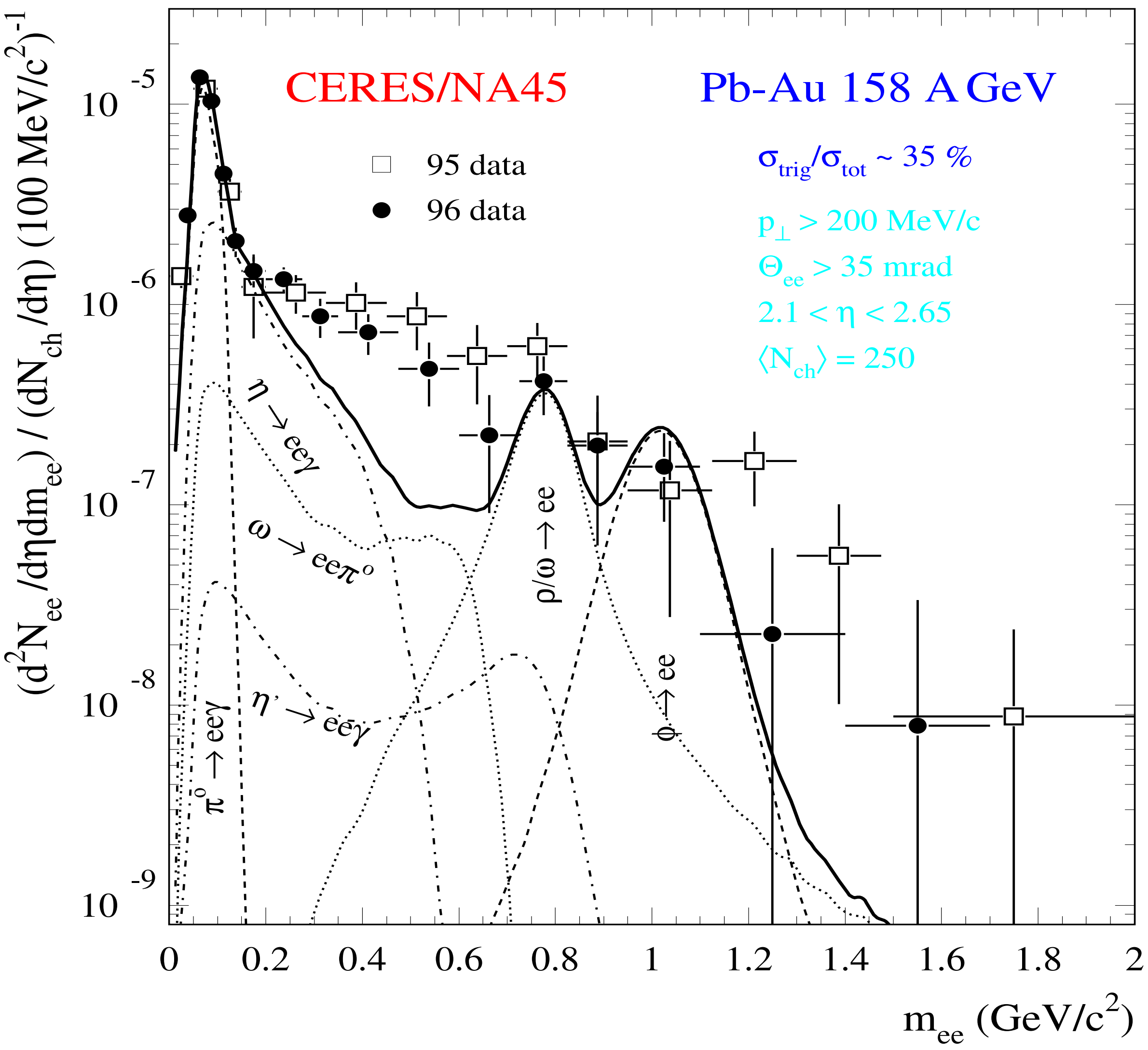

Rejection steps
Number of pairs
10^5
10^4
10^3
10^2
open pair background
Dalitz background
Dalitz signal
open pair signal
0
no rejection
1
dE/dx (TPC)
2
dE/dx (SDD)
3
close el-track
4
Dalitz removal

Previous CERES Results



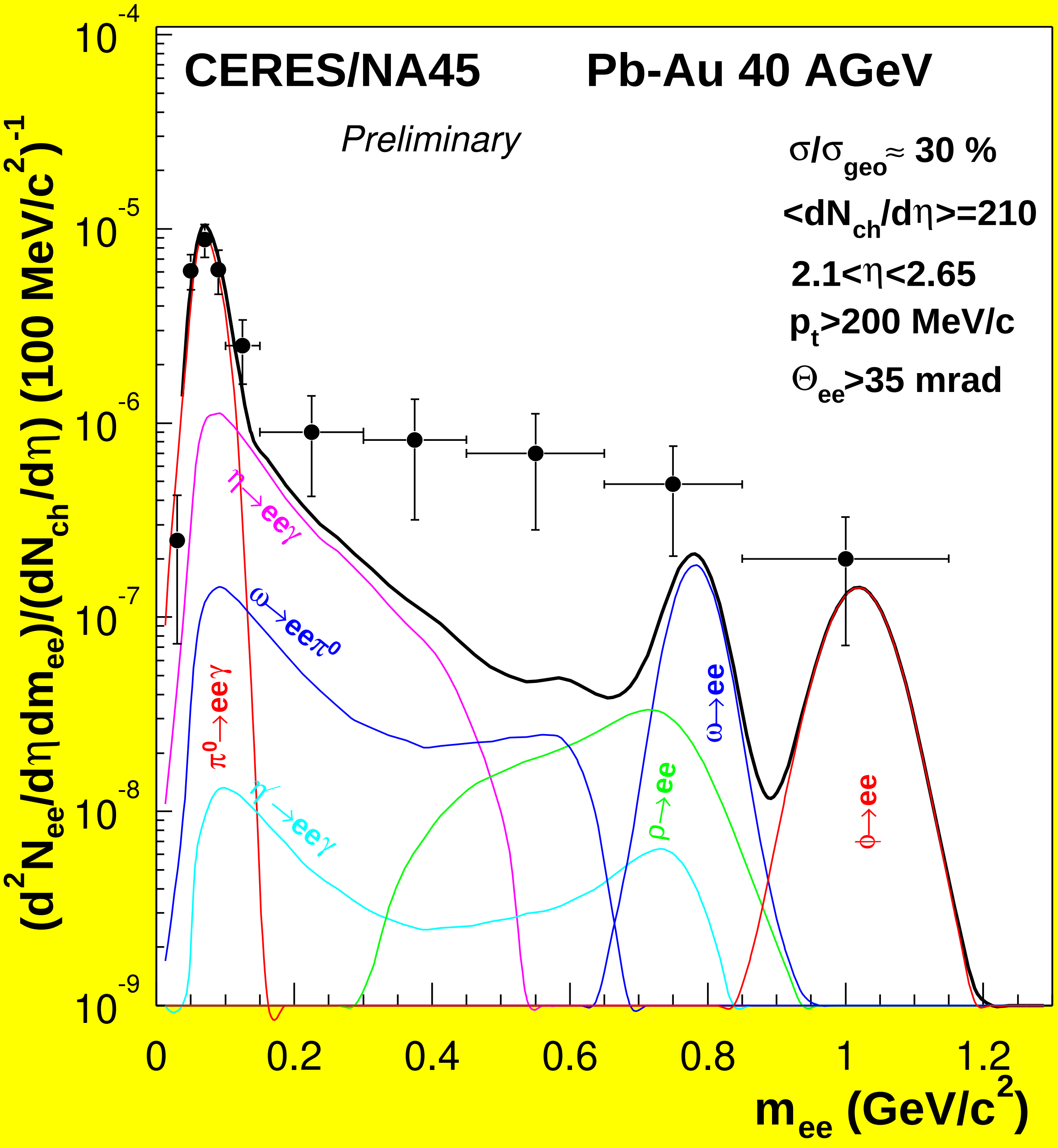


e^+e^- pair mass spectrum



- particle ratios taken from a thermal model fitted to measured ratios in Pb-Pb ($\boldsymbol{T = 175 MeV, \mu_B = 270 MeV}$)
- rapidity and pt distributions following measured systematics in Pb-Pb
- enhancement ($0.25 < m_{ee} < 0.7$ GeV/c²) :
  $\boldsymbol{2.6 \pm 0.5(stat.) \pm 0.6(syst.)}$ (96' data set)
  $\boldsymbol{3.9 \pm 0.9(stat.) \pm 0.9(syst.)}$ (95' data set)

e+e- mass spectrum



Number of pairs for m>0.2 GeV/c2: 180+-48

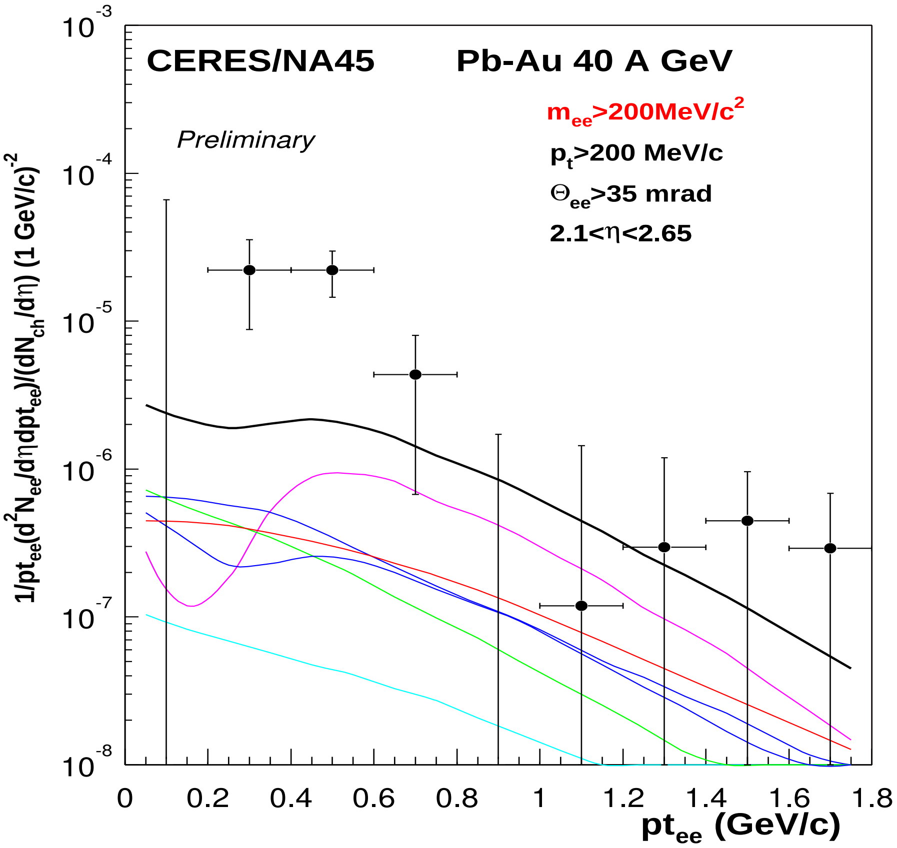
Ratio Signal/Background: 1/6

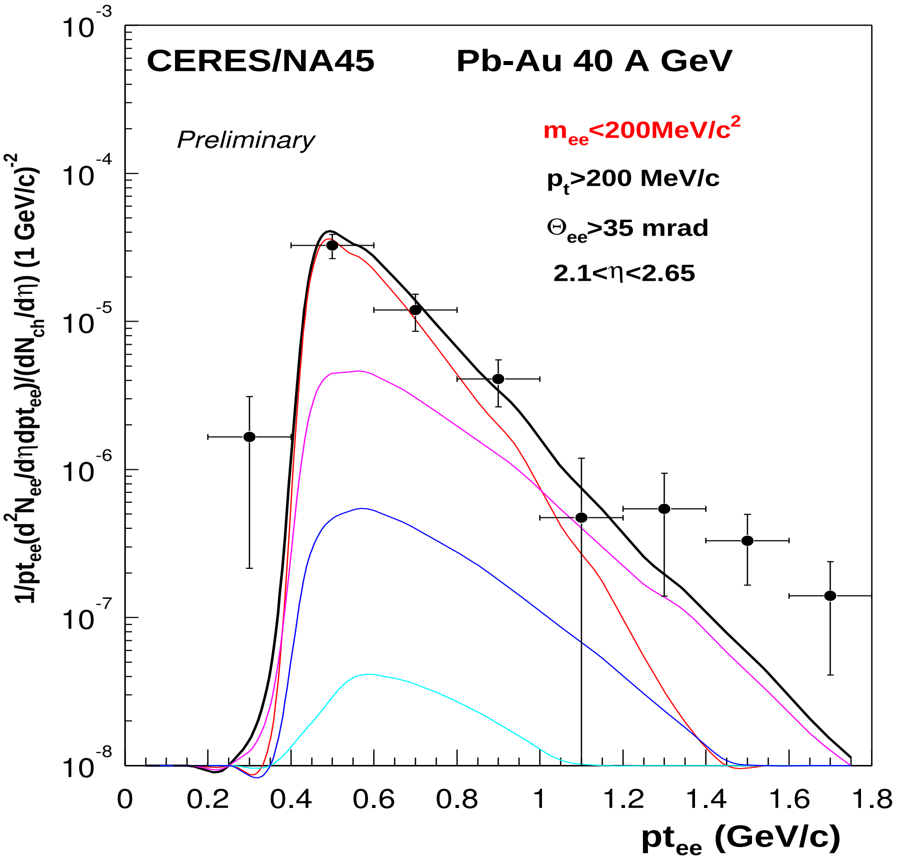
Hadronic decay cocktail:

- 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 +- 1.5


CERES/NA45
Pb-Au 40 A GeV
Preliminary
m_{ee}>200MeV/c^2
p_t>200 MeV/c
Θ_{ee}>35 mrad
2.1<η<2.65
$1/pt_{ee}(d^2N_{ee}/d\eta dpt_{ee})/(dN_{ch}/d\eta)$ (1 GeV/c)$^{-2}$
pt_{ee} (GeV/c)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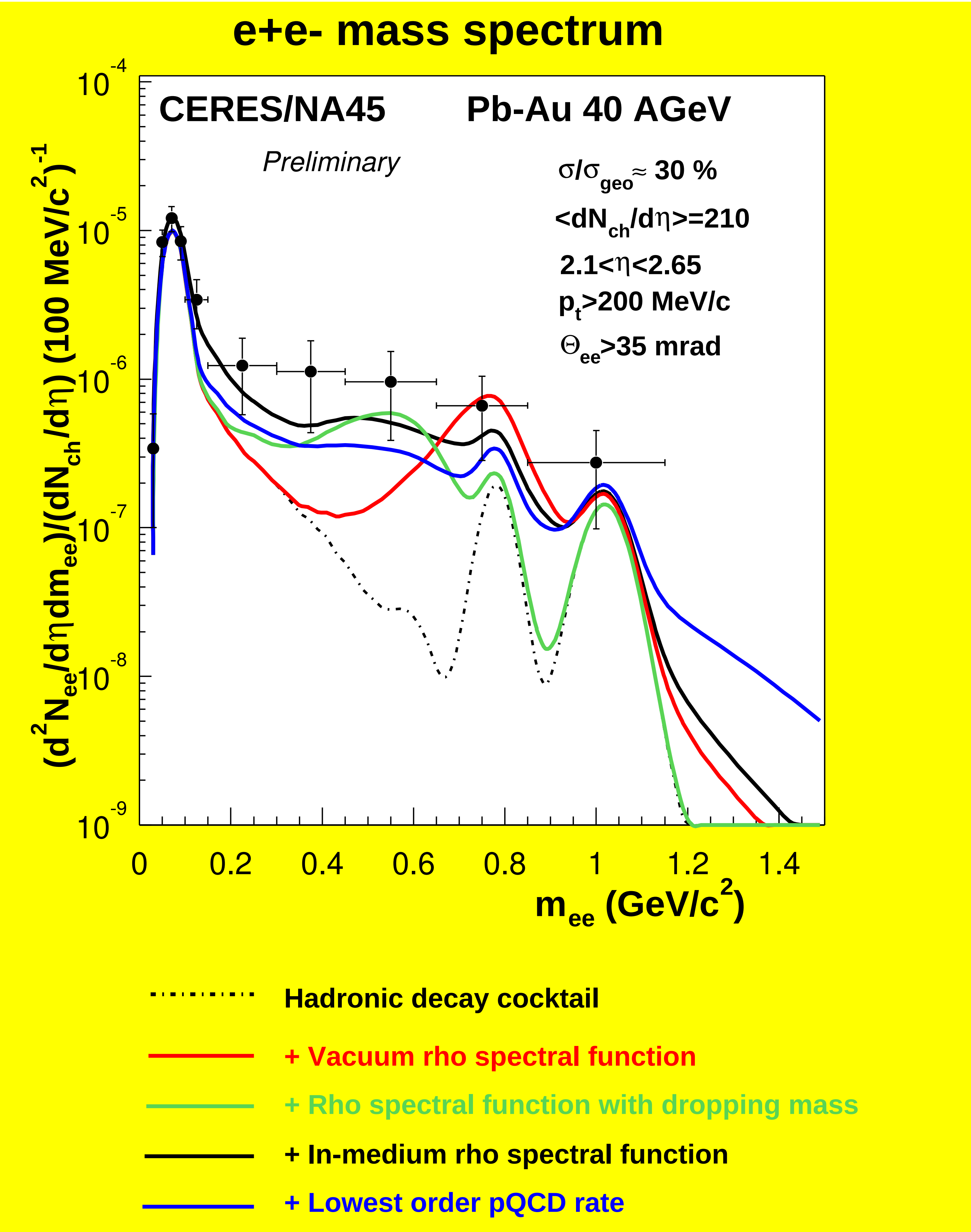

e+e- mass spectrum
CERES/NA45
Pb-Au 40 AGeV
Preliminary
σ/σ_geo ≈ 30 %
<dN_ch/dη>=210
2.1<η<2.65
p_t>200 MeV/c
Θ_ee>35 mrad
(d²N_ee/dηdm_ee)/(dN_ch/dη) (100 MeV/c²)⁻¹
m_ee (GeV/c²)
Hadronic decay cocktail
+ Vacuum rho spectral function
+ Rho spectral function with dropping mass
+ In-medium rho spectral function
+ Lowest order pQCD rate

Summary

- Within errors the 40 GeV e-pair data show a similar enhancement compared to the hadronic decay cocktail as the 160 GeV data. Both agree with present theoretical descriptions.

- CERES has also taken data in 2000 at 160 GeV. These have better statistics than any CERES run before, and it is hoped that this together with better mass resolution will help to distinguish within different theoretical approaches.

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