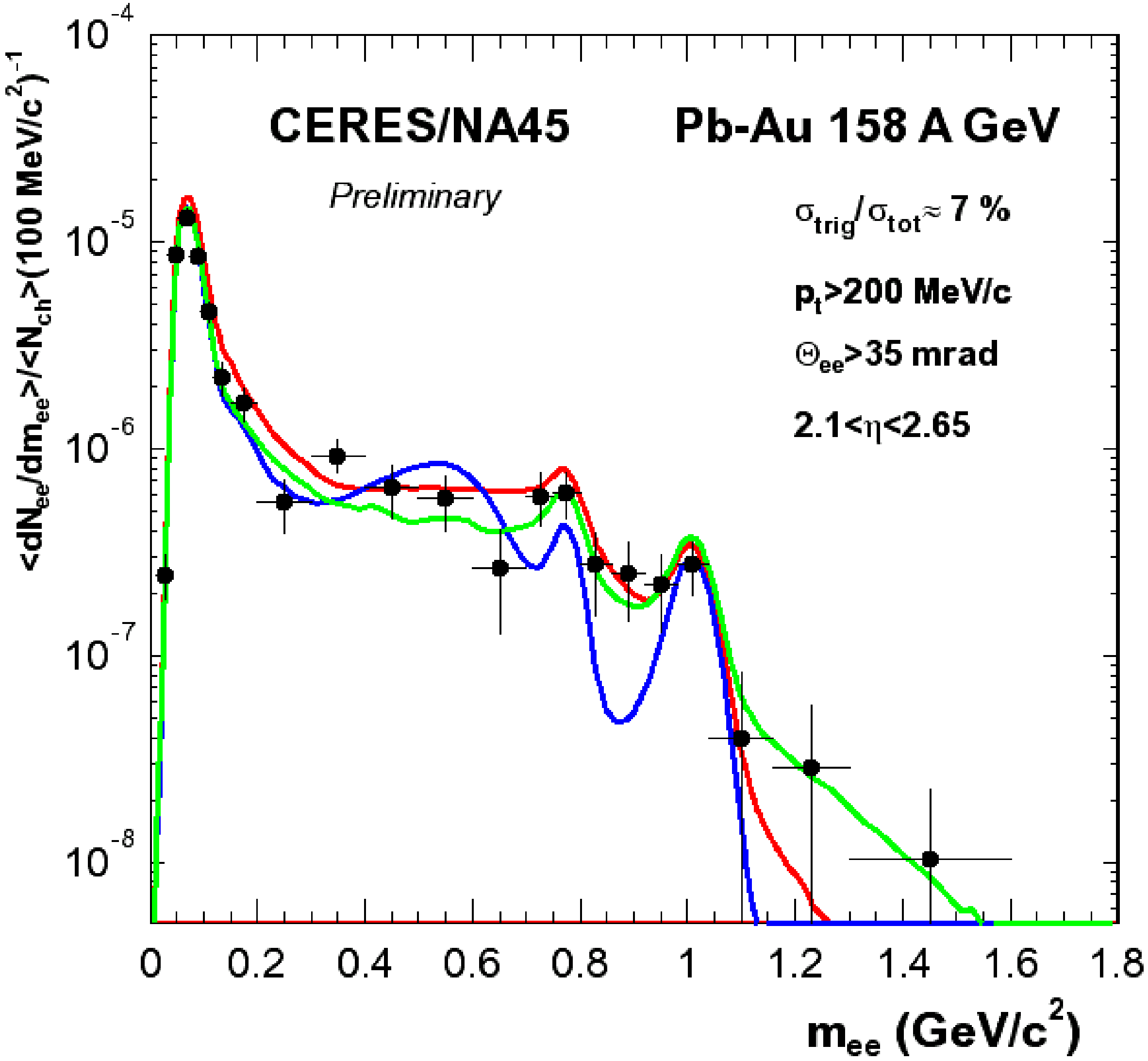
Charged particle multiplicity analysis
- experience from CERES

- **dileptons traditionally normalized to $dN_{ch}/d\eta$**
- **rather than repeating the standard analysis, for the 2000 data set new approach:**

data driven N_{ch} analysis (no Monte Carlo!)

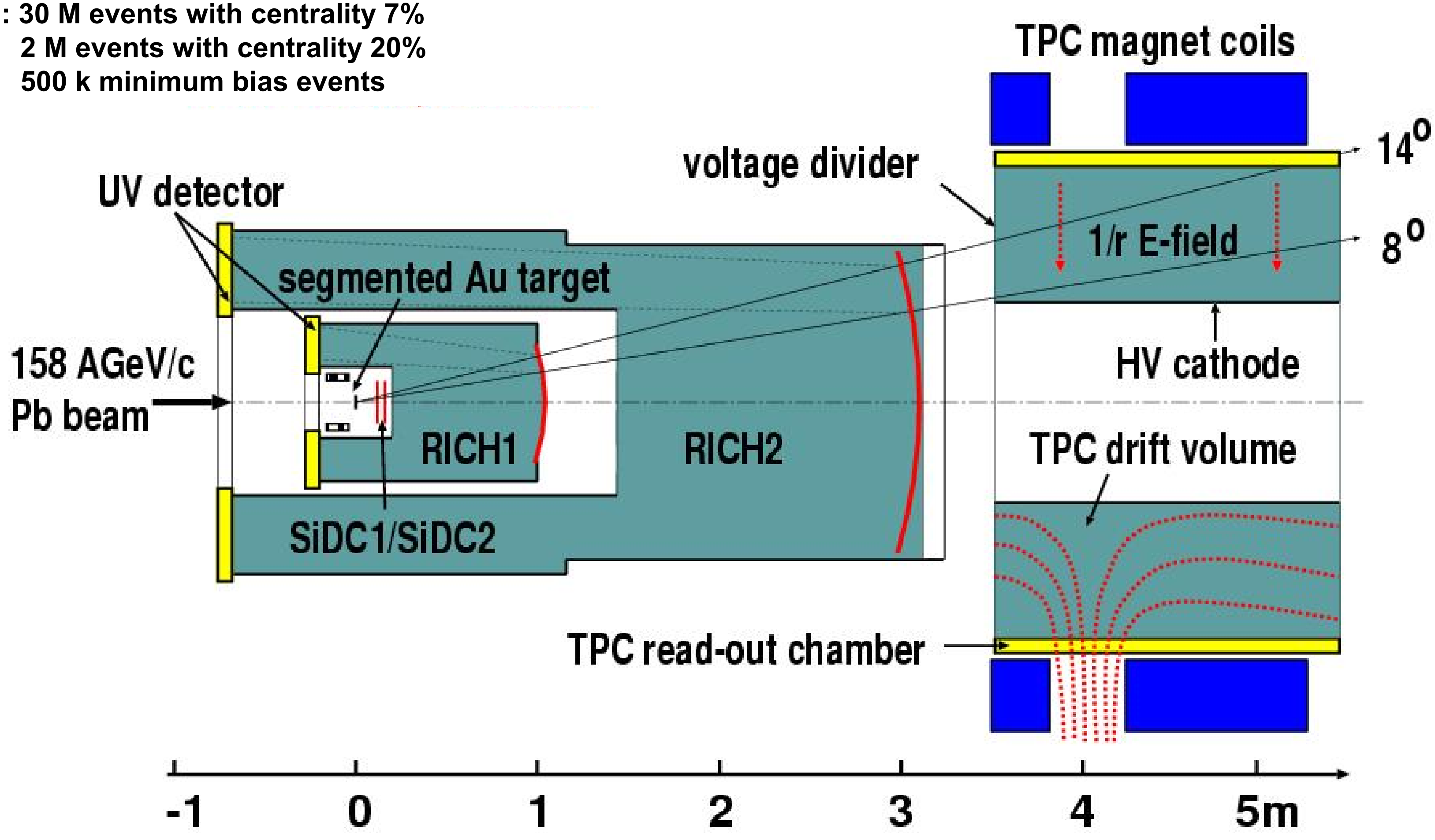
CERES e+e- mass spectrum: traditionally normalized to N_{ch}

N_{ch} in $2.1<\eta<2.65$

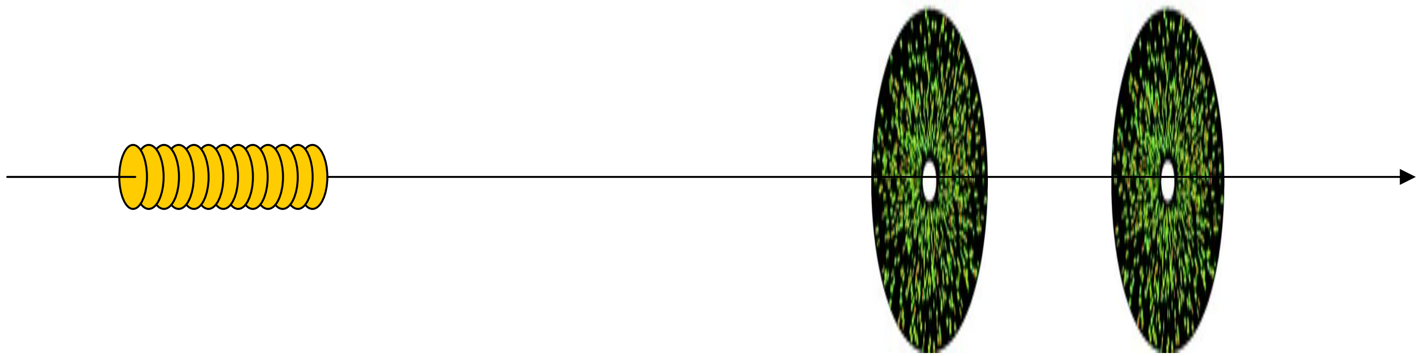


CERES setup in 2000

run 2000: 30 M events with centrality 7%
2 M events with centrality 20%
500 k minimum bias events



…the parts relevant for this talk



segmented Au target
13 disks 25 µm thick
diameter 0.6 mm
disk-to-disk 2 mm

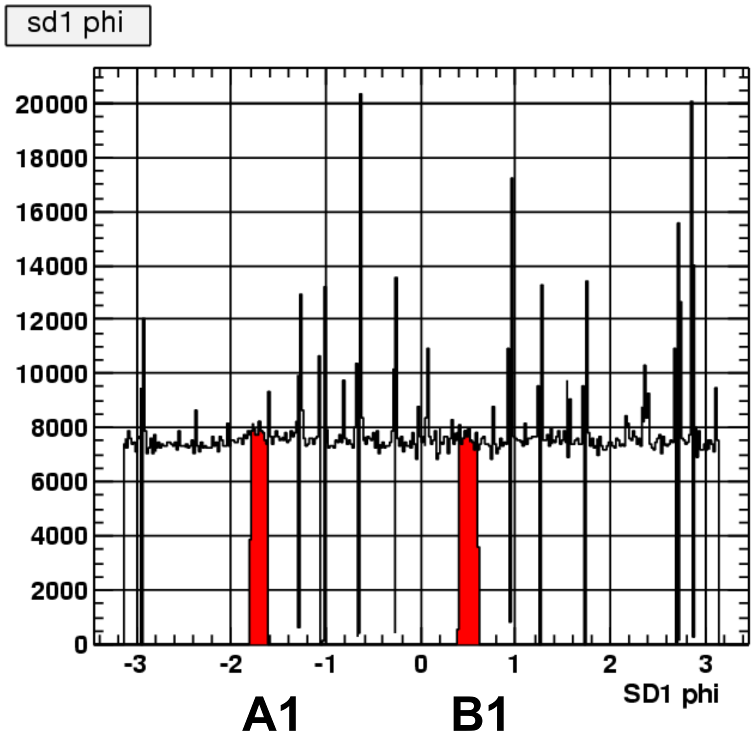
two silicon drift detectors
360 anodes in phi
(hit makes signal on 2-3 anodes)
radius via drift time

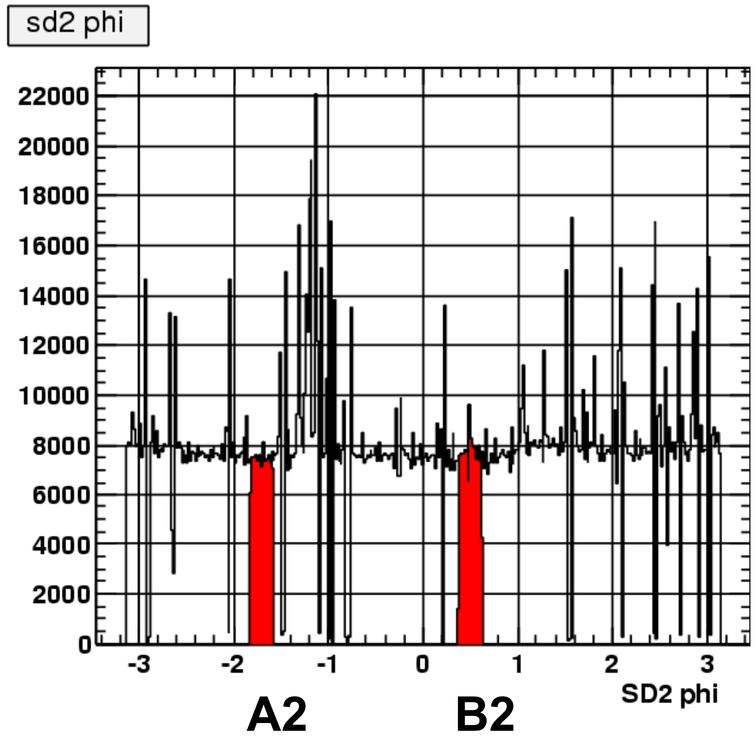
Absolute multiplicity of charged particles

in principle can be determined by counting tracks,
track := matching hits in SD1 and SD2. But…

- **single track efficiency**
- **fake tracks**
- **two-track resolution**
- **delta electrons**

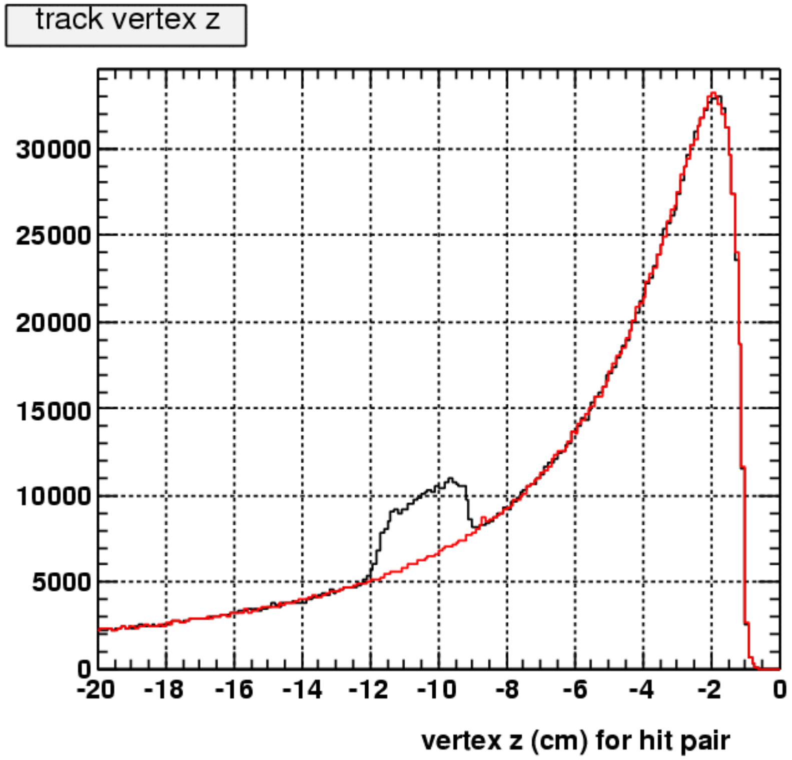
Single track efficiency

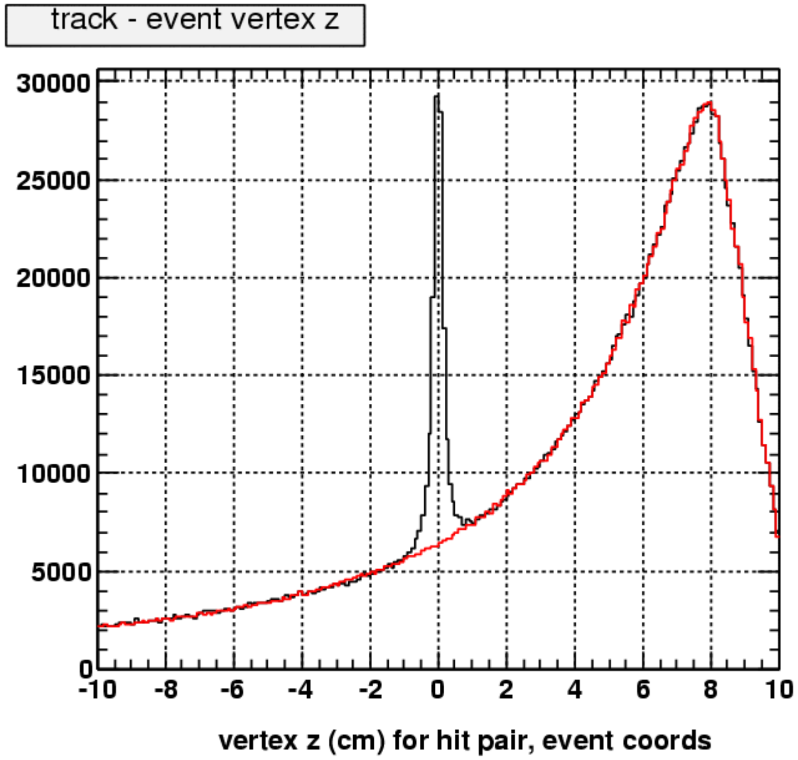




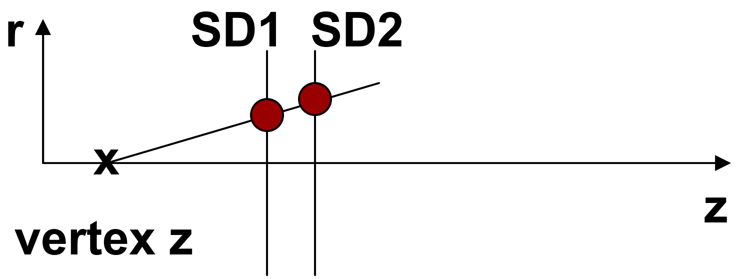
- pick two regions of phi without dead anodes
- acceptance determined by SD1 (narrower windows)

Fake track subtraction





abscissa:

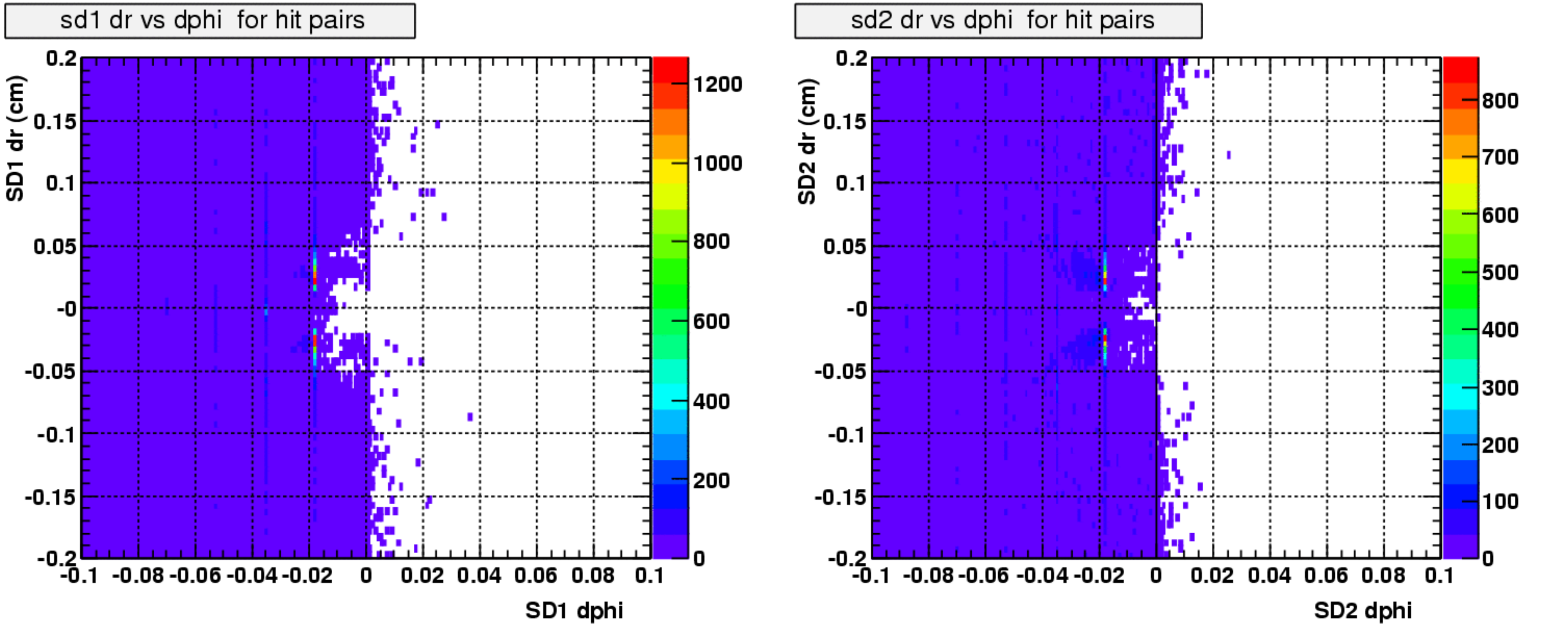


ordinate:

- aligned A1*A2 + B1*B2

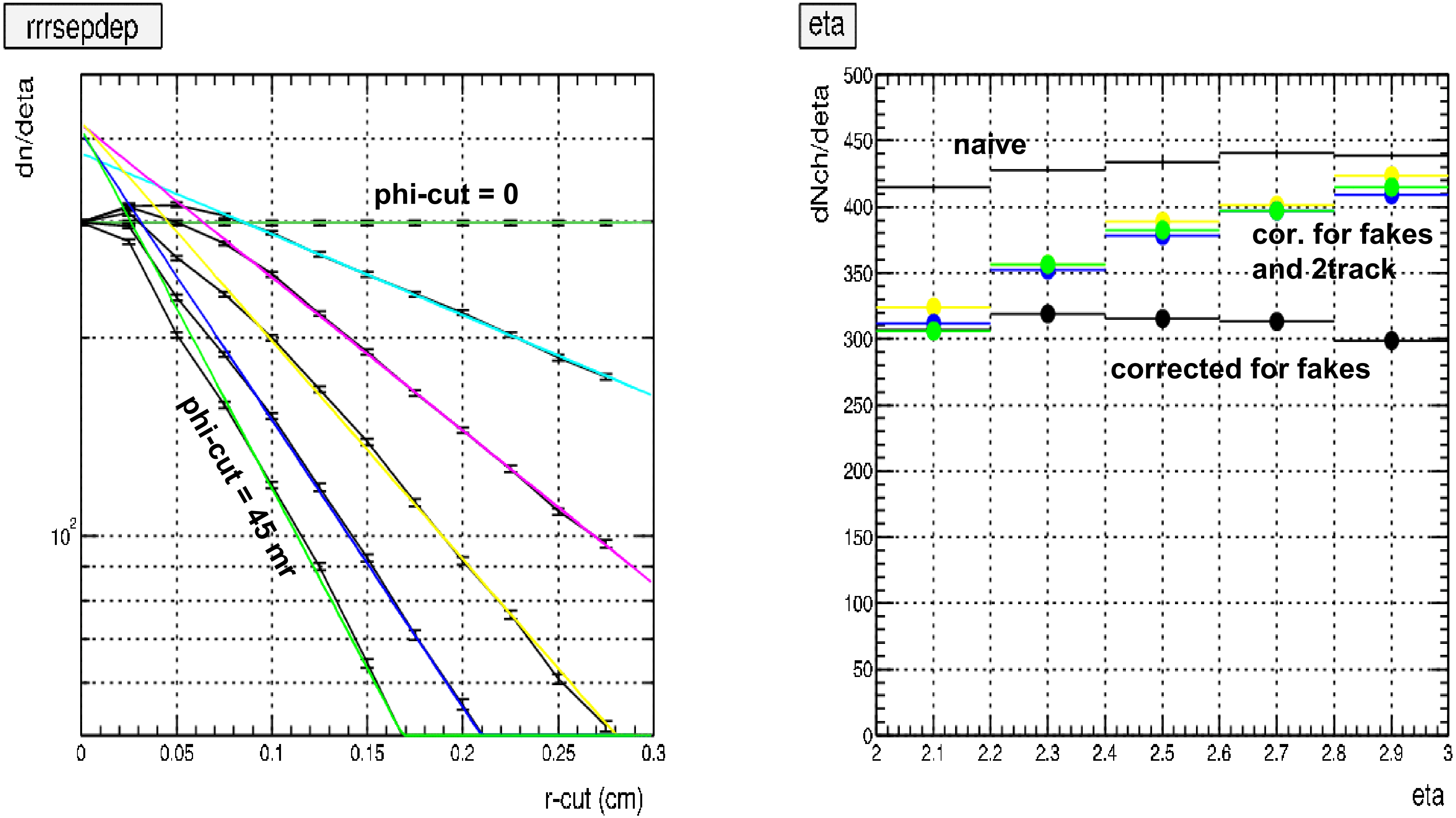
- rotated A1*B2 + B1*A2

Two-track resolution



- inefficiency for pairs of close tracks
- make it worse by applying cuts, study the influence on the result

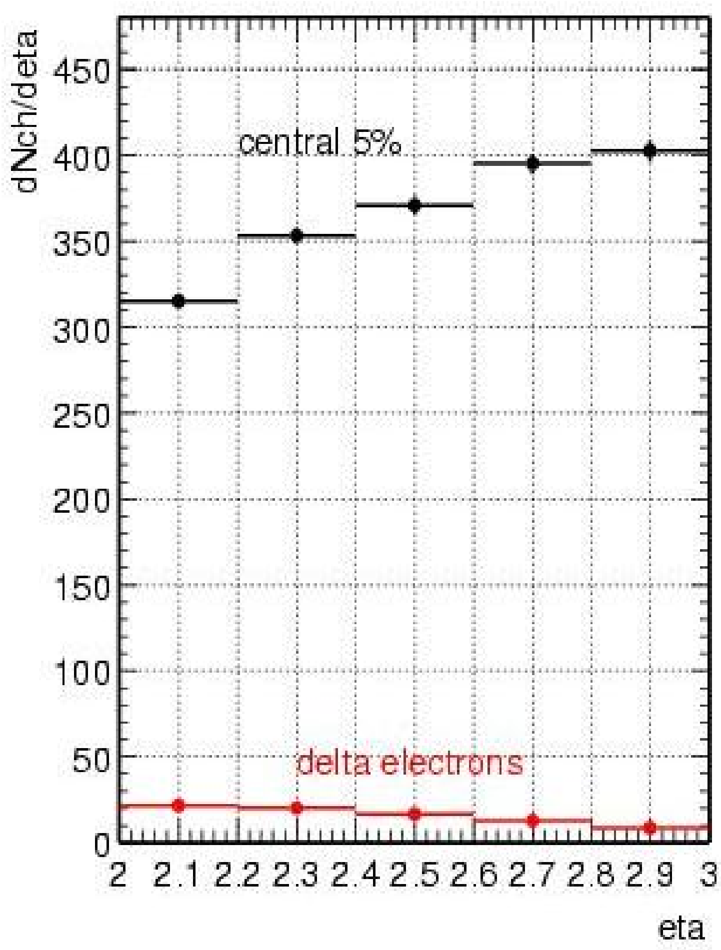
Two-track cuts, extrapolated to zero



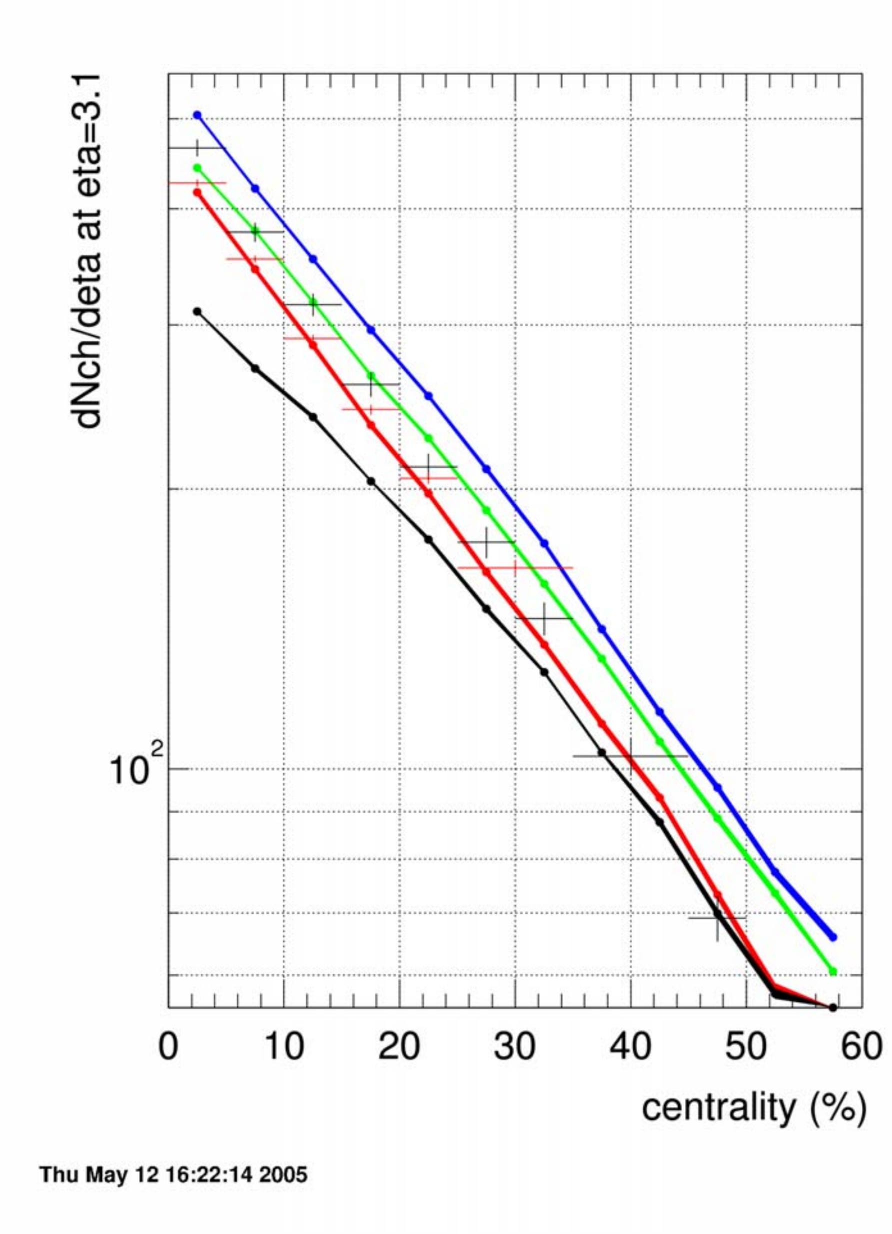
delta electrons

determined in the same way but using data taken with the beam trigger

1/2 of the obtained delta electron multiplicity subtracted (on average, beam passes through half of the target thickness before making an interaction)



$dN_{ch}/d\eta$ vs centrality



raw
corrected for fakes
…and for 2-track resolution
seen by TPC (not discussed here)

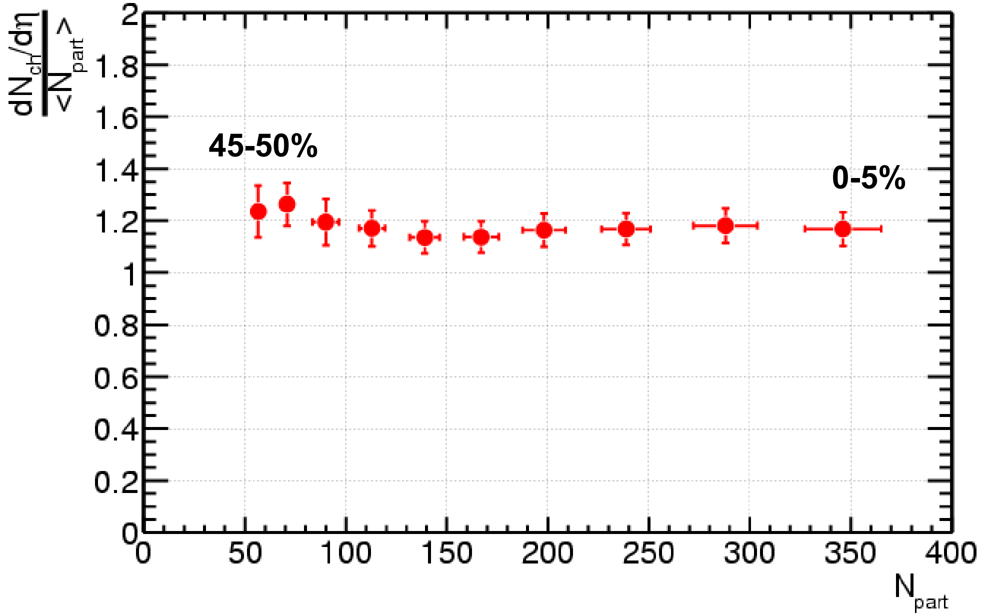
NA57

NA50

corrections are significant

corrected results agree with NA57 and NA50

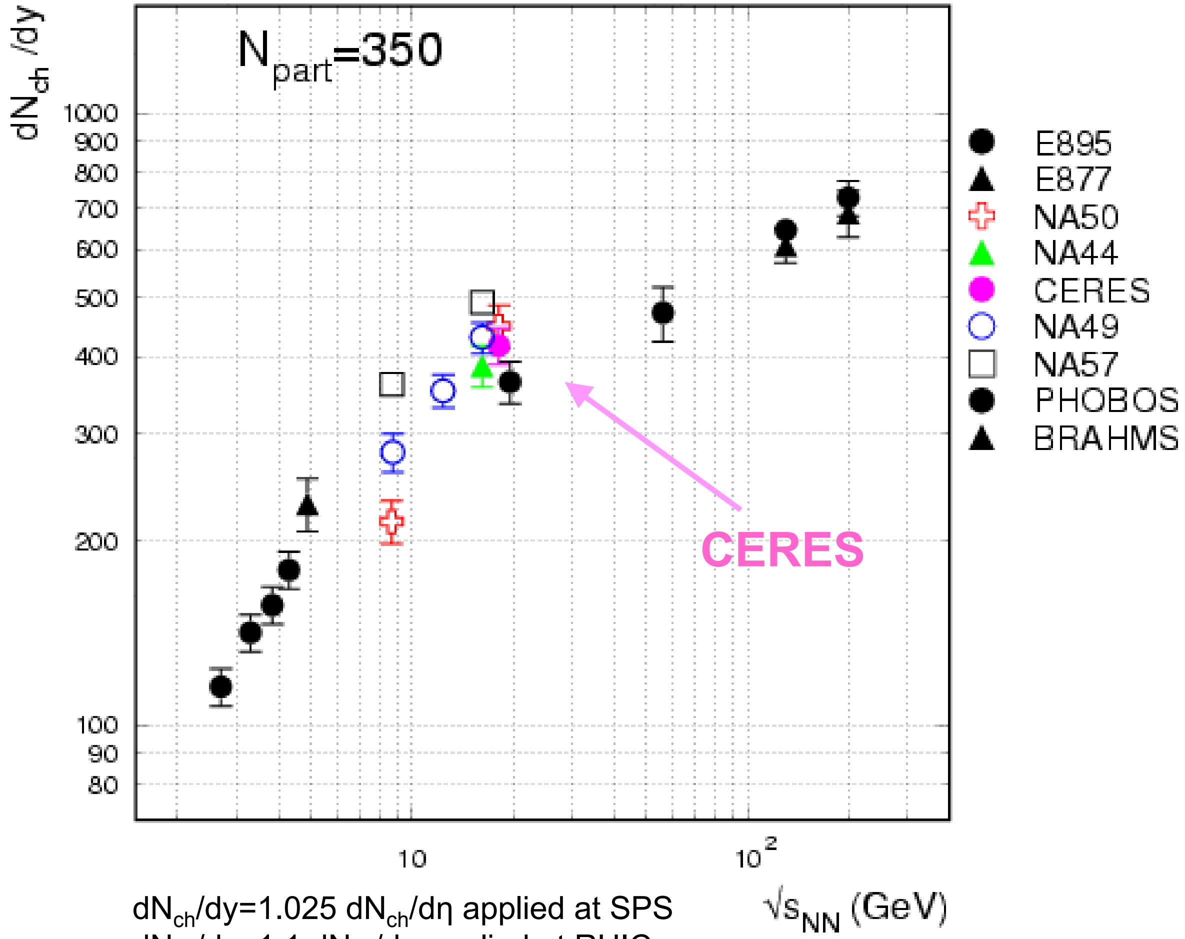
$dN_{ch}/d\eta$ vs centrality



flat N_{ch} per participant

dN_{ch}/dy vs sqrt(s)

dN_{ch}/dy in central collisions of Au or Pb
compilation by Anton Andronic



$dN_{ch}/dy=1.025\ dN_{ch}/d\eta$ applied at SPS
$dN_{ch}/dy=1.1\ dN_{ch}/d\eta$ applied at RHIC

good agreement with NA49, NA50, and NA44

Summary: problems and solutions

- **single track efficiency**
  use the best performing parts of detectors
- **fake tracks**
  subtract event mixing
- **two-track resolution**
  apply separation cuts and extrapolate to zero
- **delta electrons**
  measure and subtract

- **absolute multiplicities without Monte Carlo**
- **result very reasonable**
- **systematic error estimate 12% max**

Backup transparencies

centrality determination

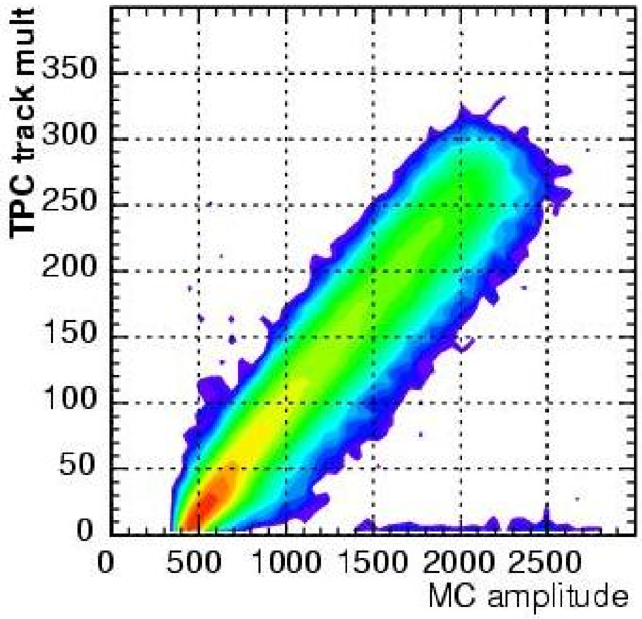
Pb+Au at 158 GeV per nucleon

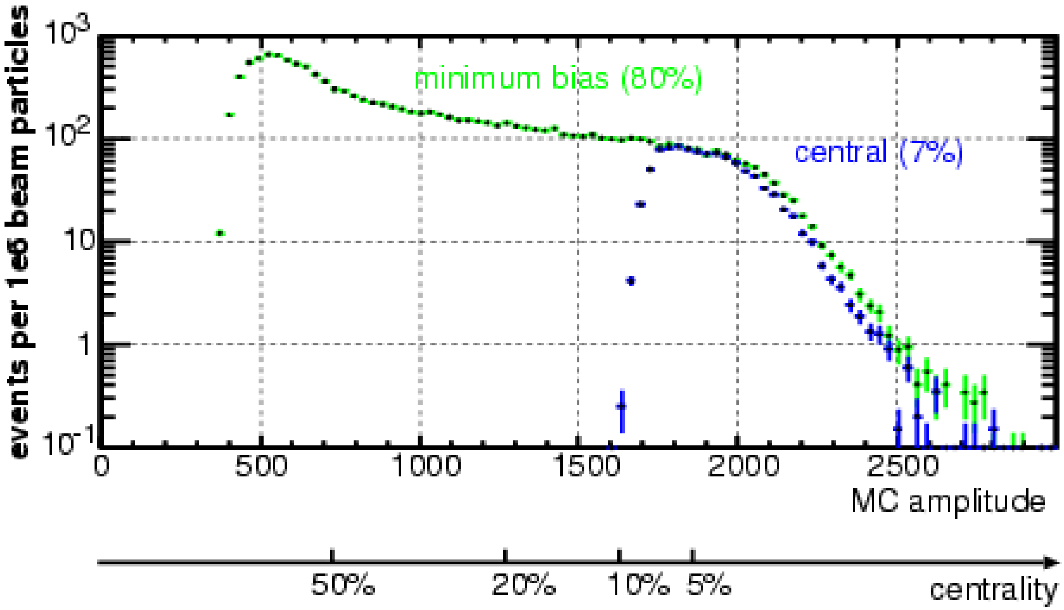
centrality deduced from the multiplicity of charged particles around mid-rapidity

MC scintillator amplitude $2.95 < \eta < 4.05$

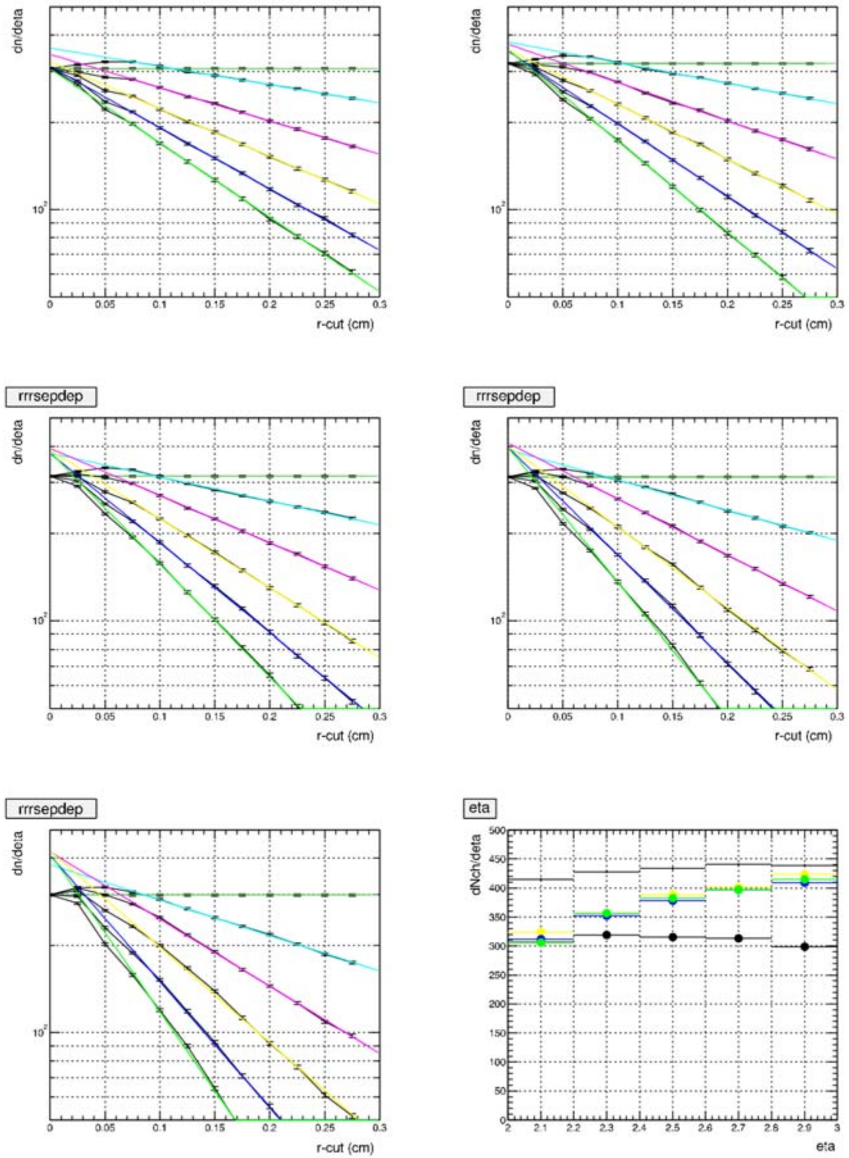
TPC track multiplicity $2.10 < \eta < 2.80$

mid-rapidity $y = 2.91$

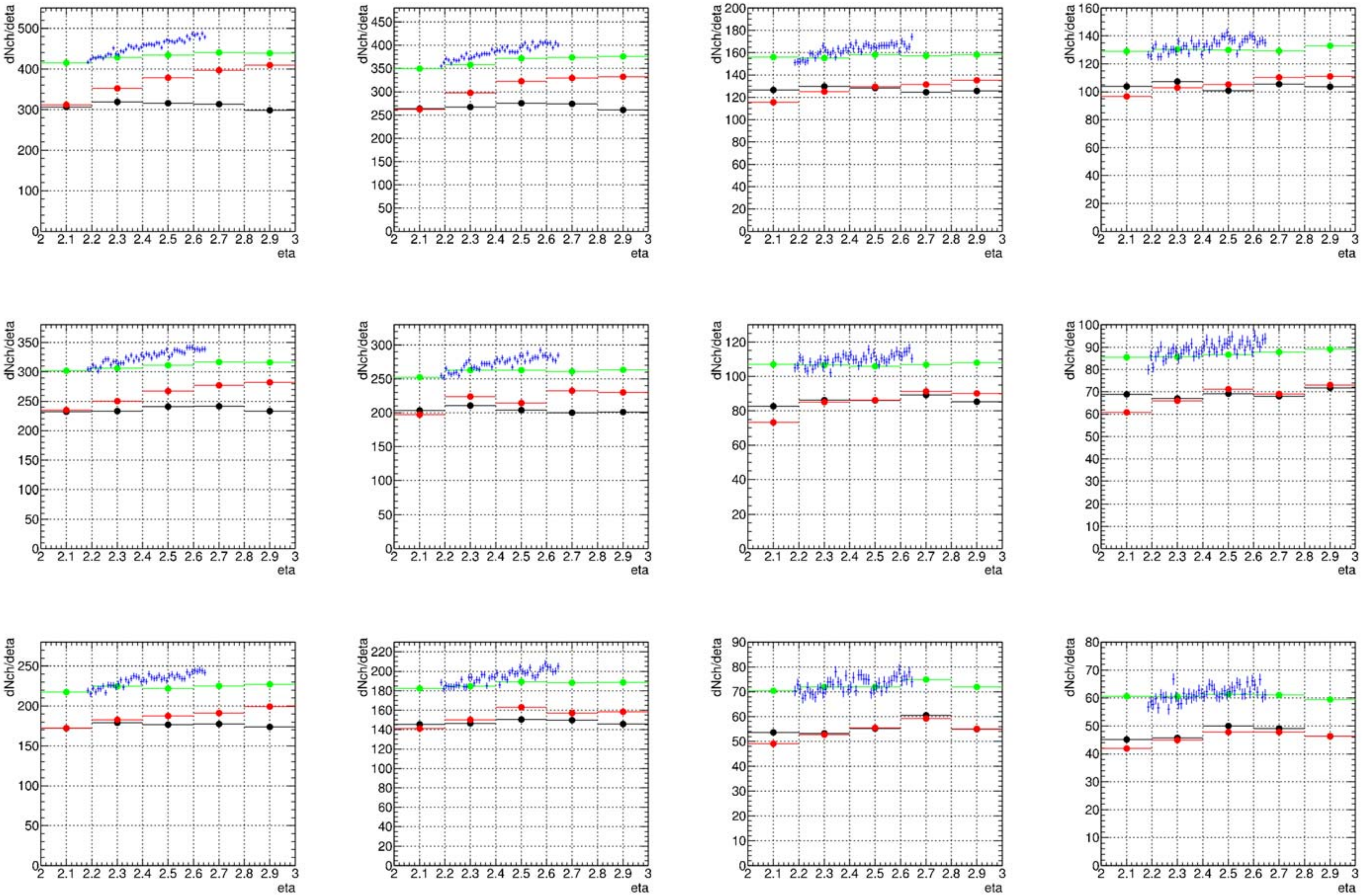




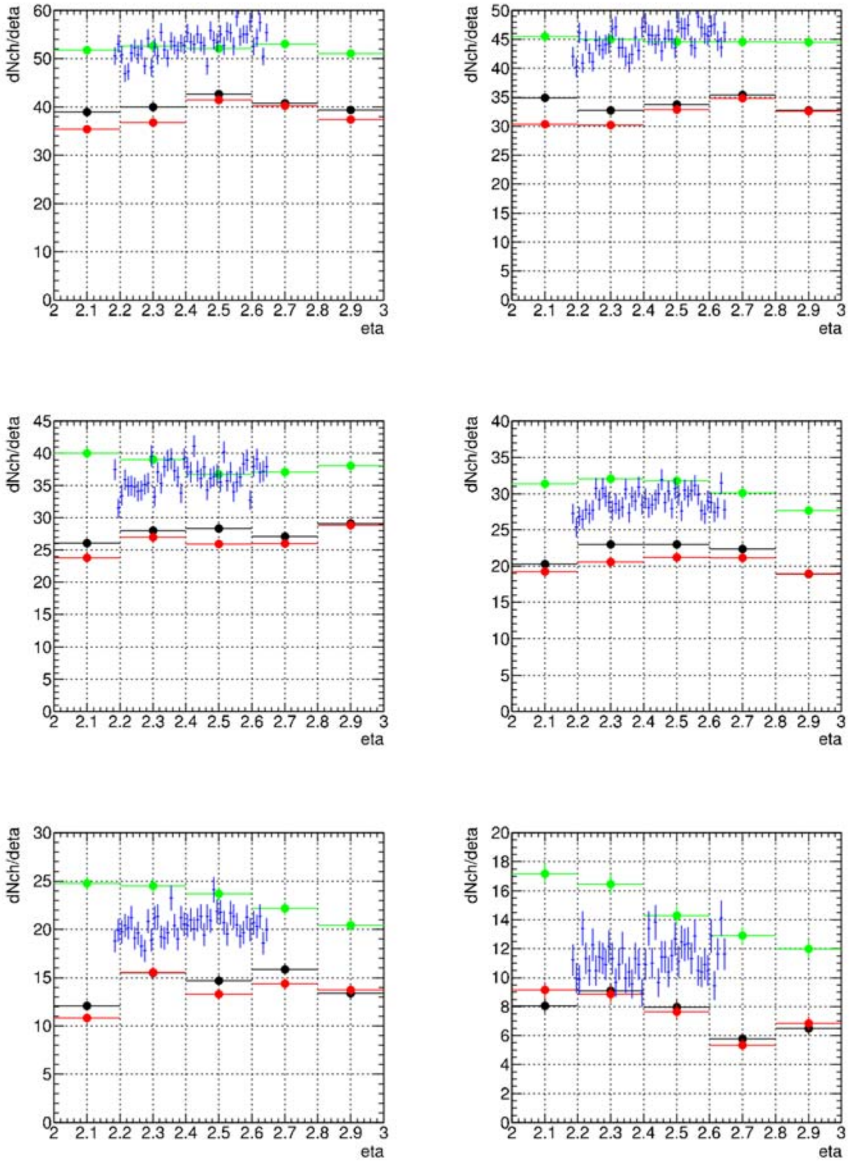
two-track cut extrapolation - centrality 0-5



$dN_{ch}/d\eta$ for centralities 0-60%

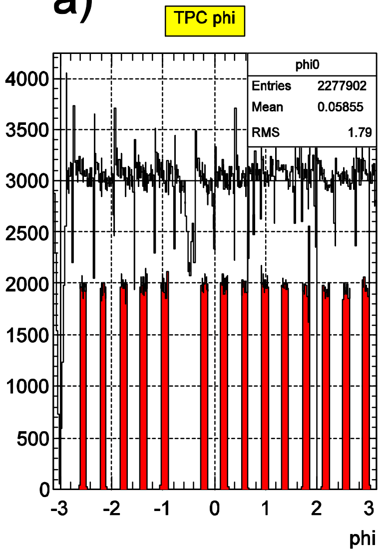


$dN_{ch}/d\eta$ for centralities 60-90%

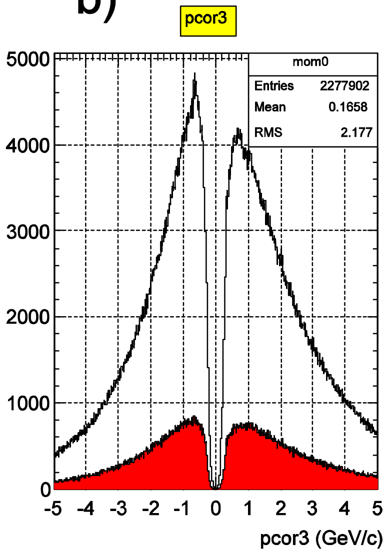


Track multiplicity in the TPC

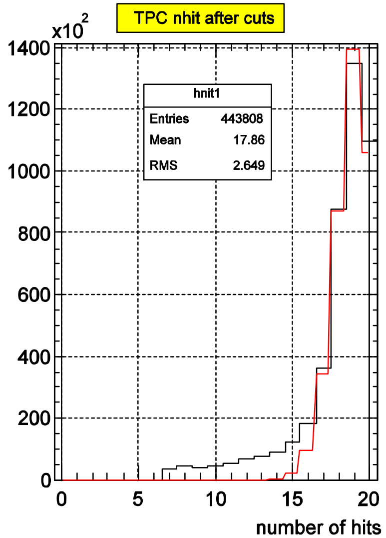
a)



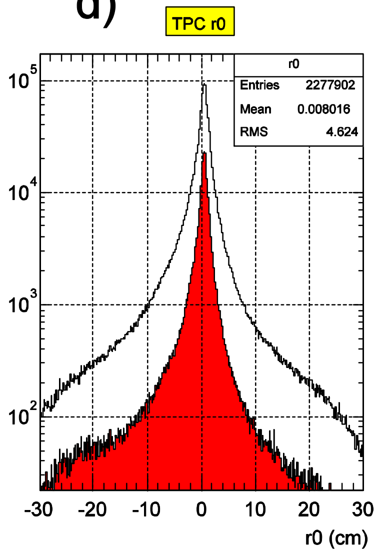
b)



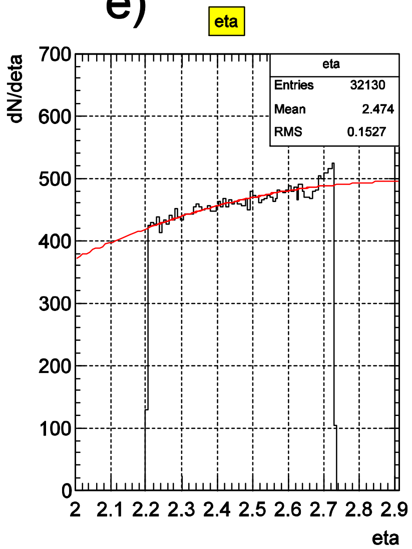
c)

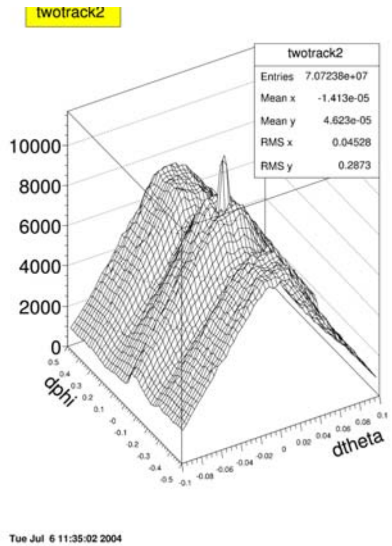


d)

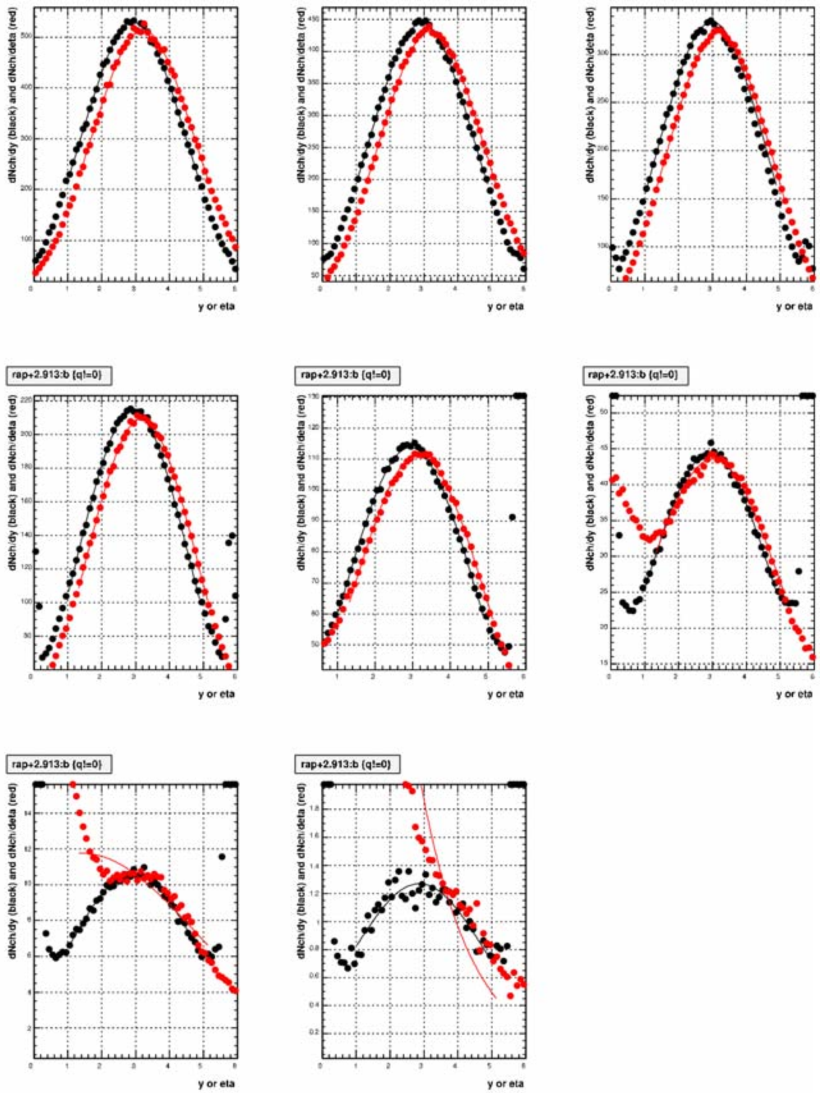


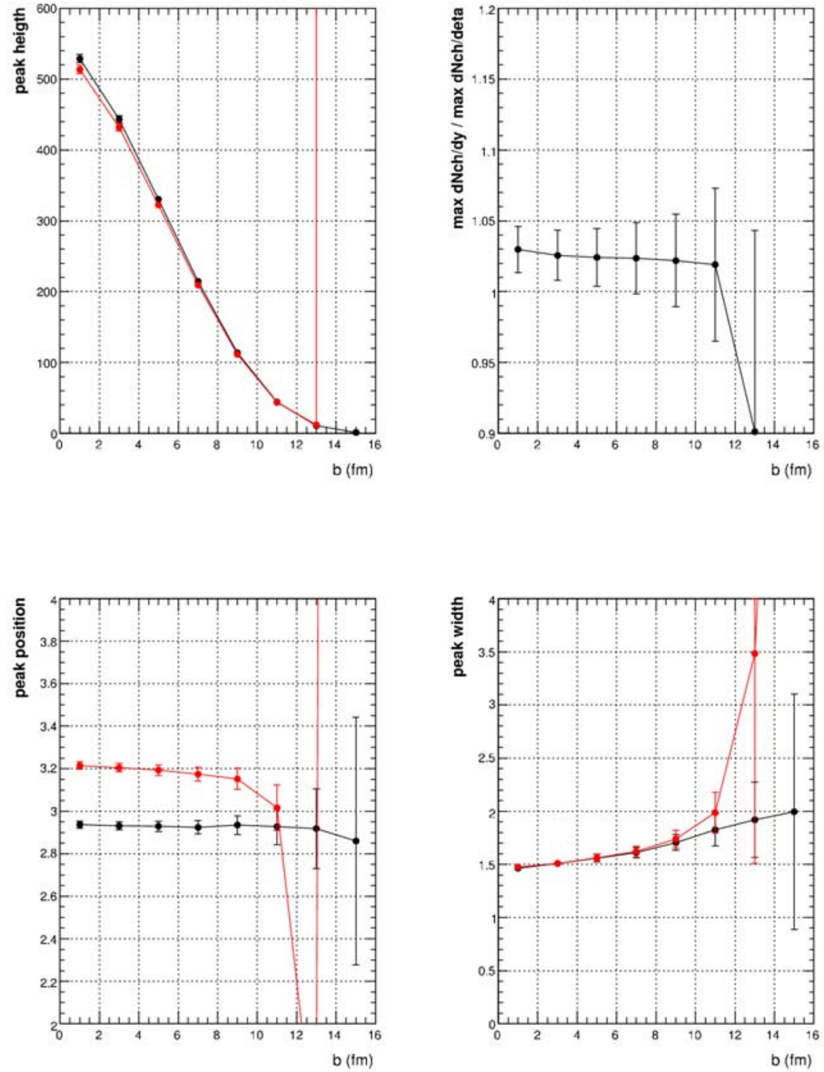
e)





URQMD


dNch/dy (black) and dNch/deta (red)
y or eta
rap+2.913:b {q!=0}


peak heigth
max dNch/dy / max dNch/deta
peak position
peak width
b (fm)