Recent Results from CERES

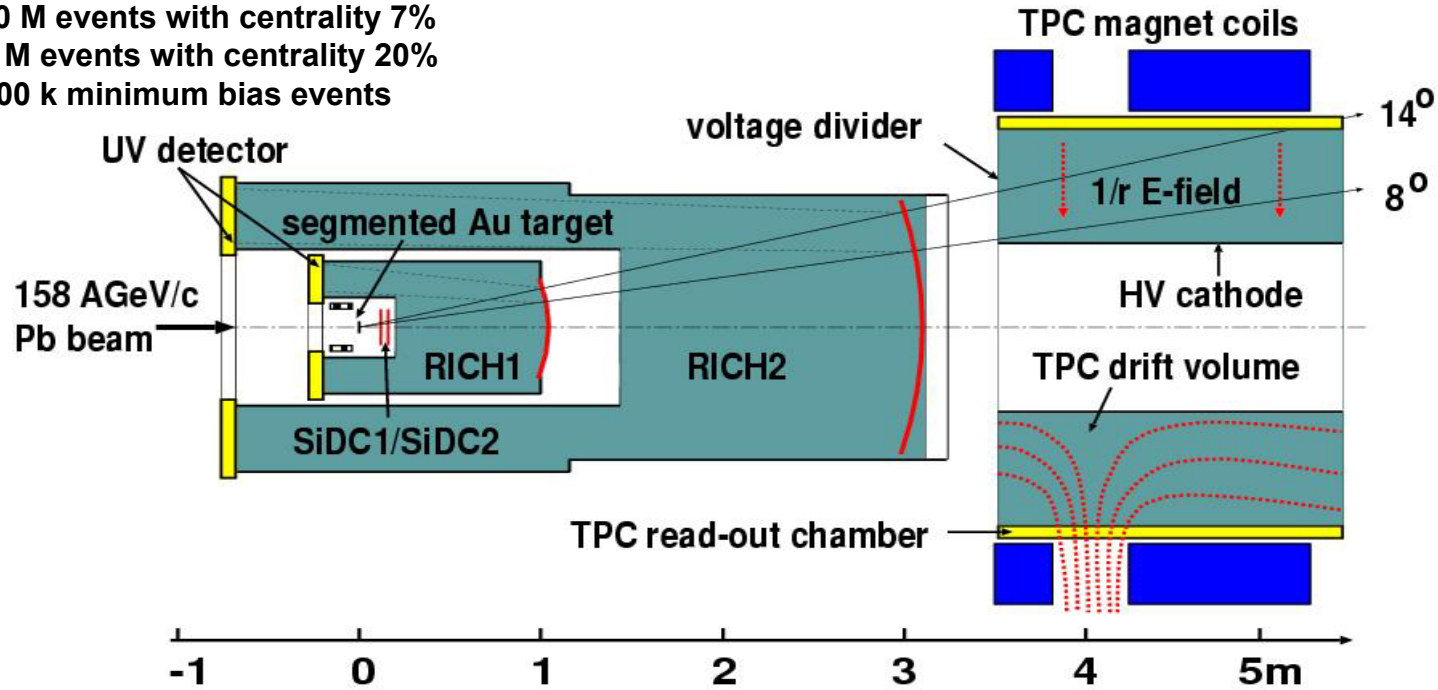
D. Miśkowiec for the CERES Collaboration

Quark Matter 2005, Budapest

- introduction
- e^+e^- continuum and in-medium effects
- leptonic and hadronic decays of ϕ
- elliptic flow of Λ
- pion-proton correlations
- fluctuations of mean pt
- high-pt angular correlations
- summary

setup with TPC: 1999 and 2000

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



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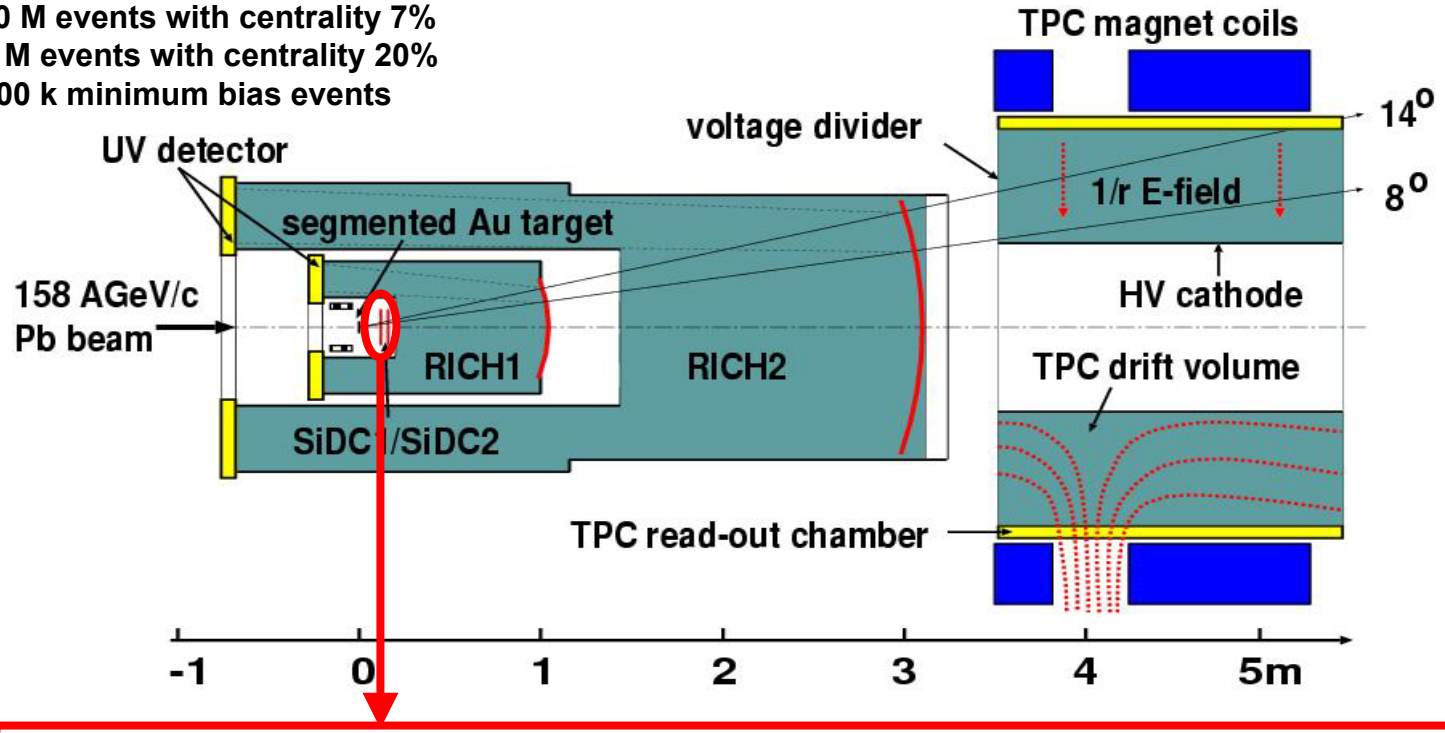
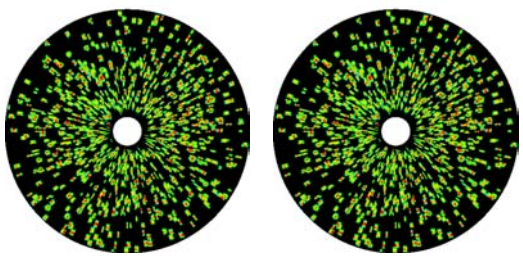
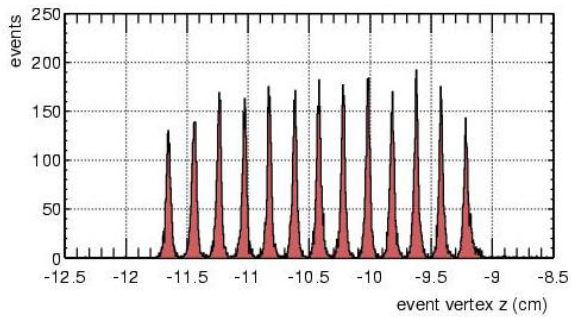


SD: event vertex, track vertex and angle





event Δz = 0.2 mm
track $\Delta\theta$ = 0.2 mrad
$\Delta\varphi$ = 2 mrad

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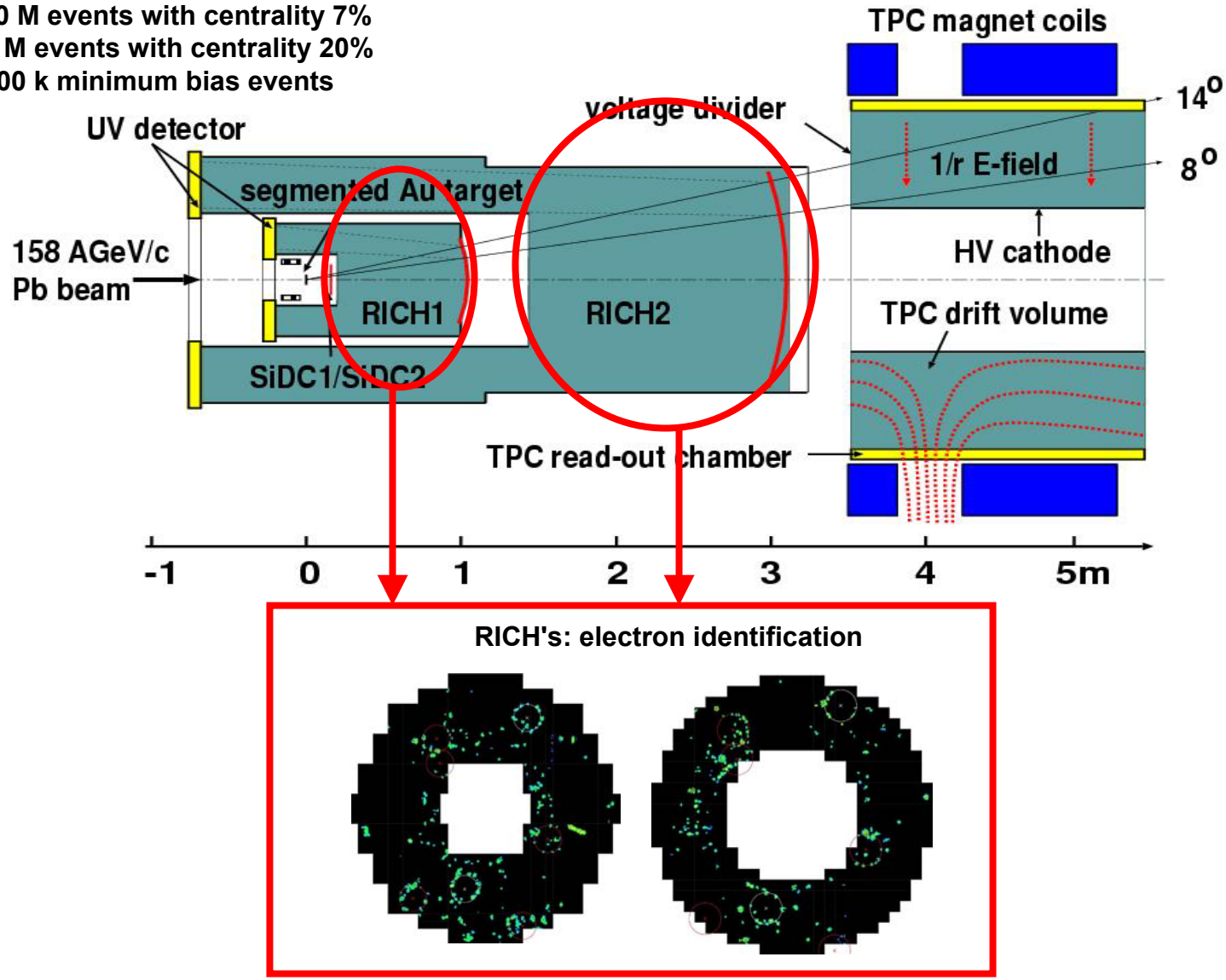

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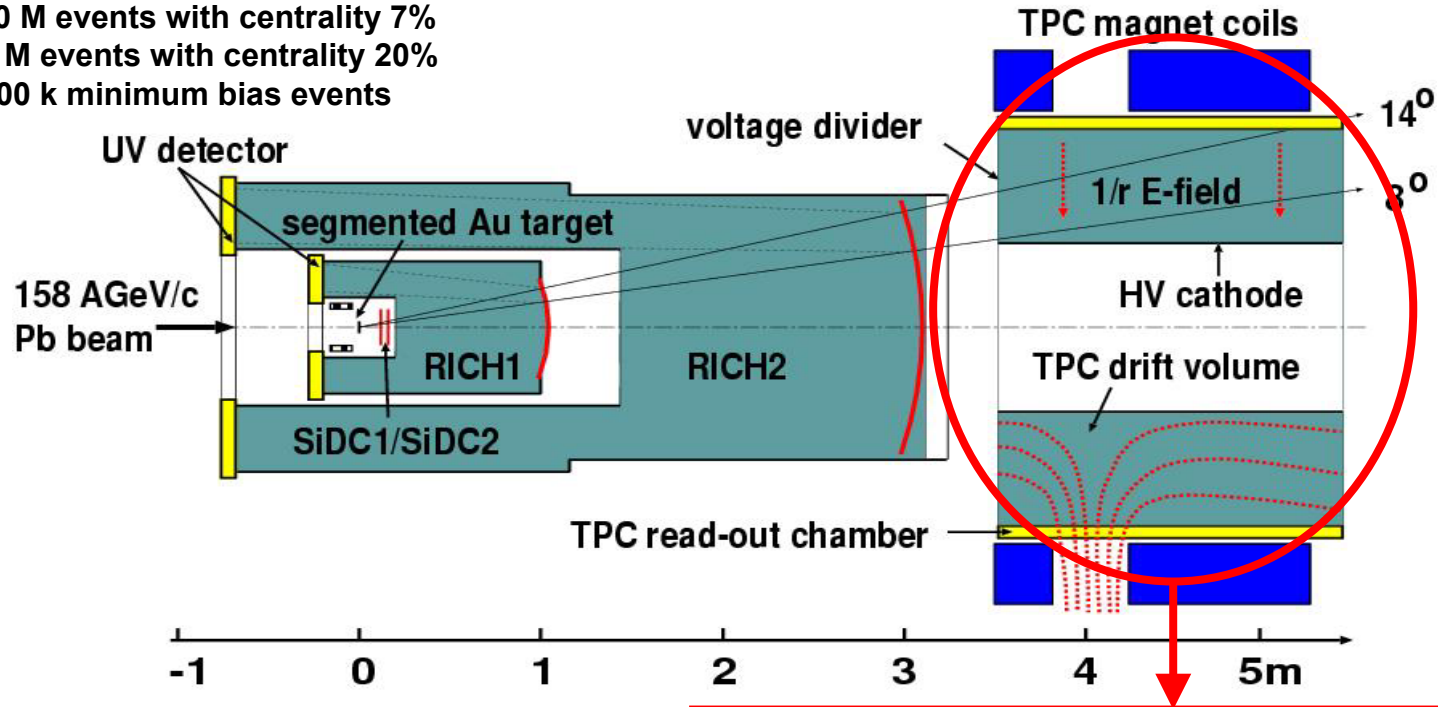
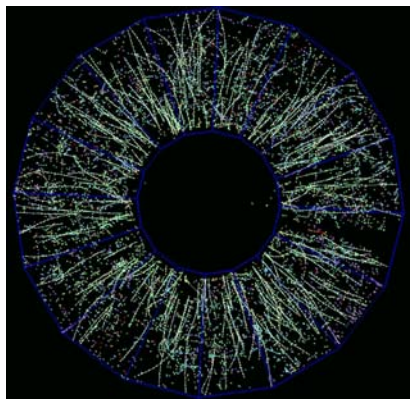


radial drift TPC: momentum and energy loss



$\Delta p/p = 2\% \oplus 1\% * p/GeV$

$\Delta m/m = 3.8\ \%$ for ϕ

$\Delta(dE/dx)/(dE/dx) = 10\%$

centrality determination

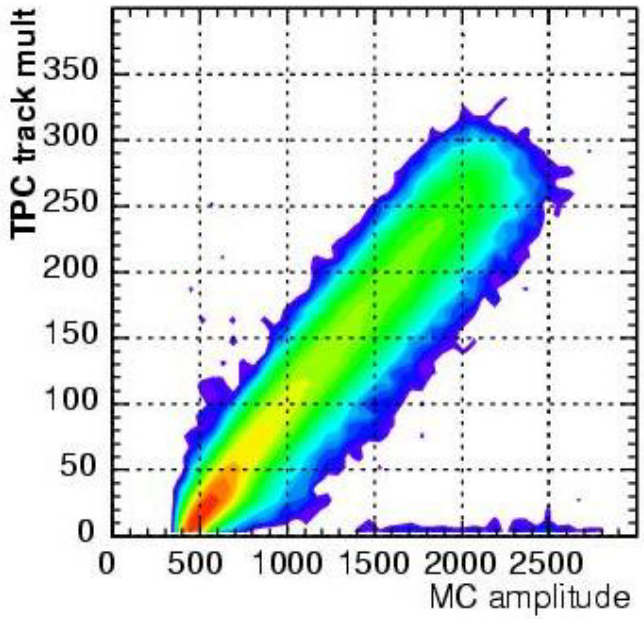
Pb+Au at 158 GeV per nucleon

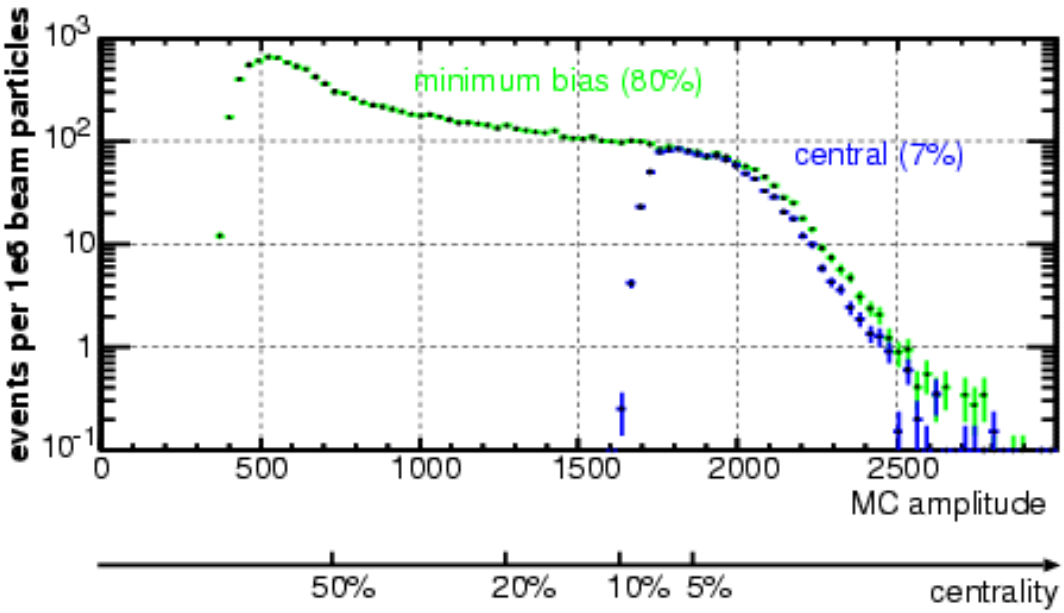
centrality deduced from the multiplicity of charged particles around mid-rapidity

MC scintillator amplitude $2.95 < \eta < 4.05$

TPC track multiplicity $2.10 < \eta < 2.80$

mid-rapidity $y = 2.91$

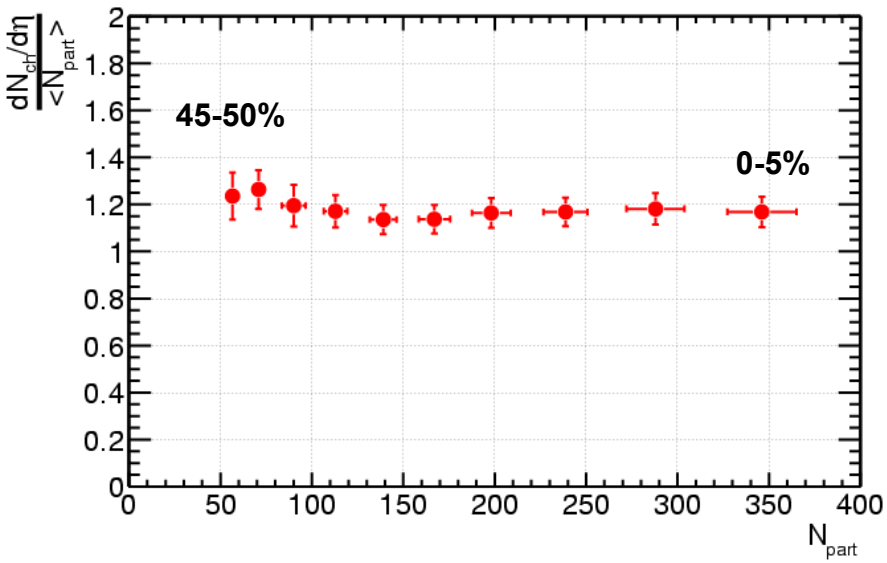




charged particle multiplicity

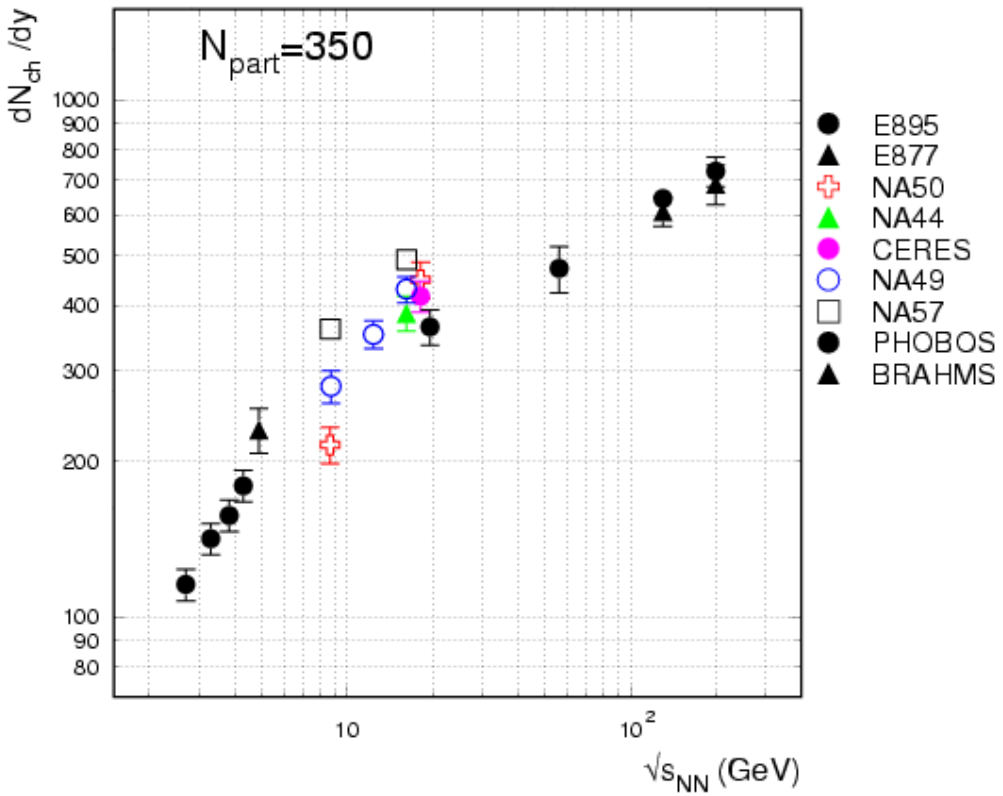
Pb+Au at 158 GeV per nucleon

charged particle multiplicity determined from hits in the two silicon detectors



flat N_{ch} per participant

dNch/dη in central collisions of Au or Pb compilation by A. Andronic



good agreement in dNch/dη between CERES, NA49, NA50, and NA44

e^+e^- analysis

Pb+Au at 158 GeV per nucleon, run 2000
about 20 M events after quality cuts
centrality 7%

tracking
↓
electron identification
↓
π^0-Dalitz and γ-conversion rejection
↓
pairing
↓
subtraction of background
(like-sign or mixed events)
↓
efficiency correction
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mass spectrum

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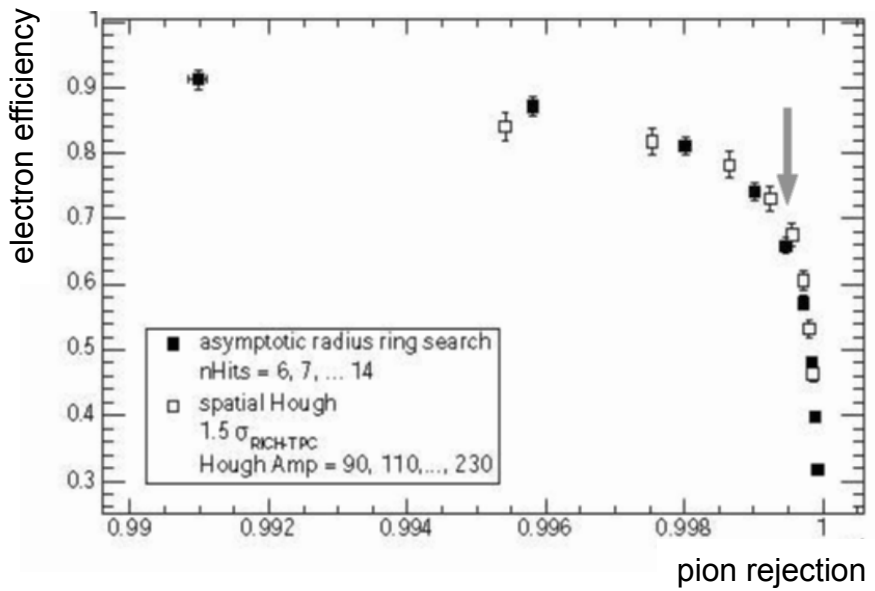
RICH performance determined from the experiment



RICH performance determined from exp data

electron efficiency 70%
pion suppression factor $2 \cdot 10^3$
(combined RICH & TPC: $4 \cdot 10^4$)

e^+e^- analysis

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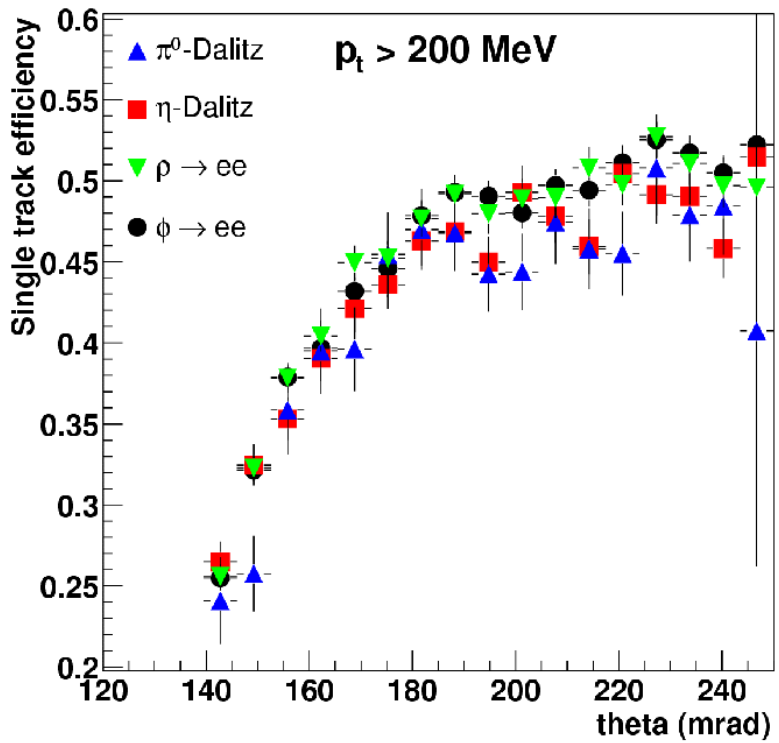
Monte Carlo: tracks embedded in experimental events

overall electron efficiency well understood in terms of the single track efficiency

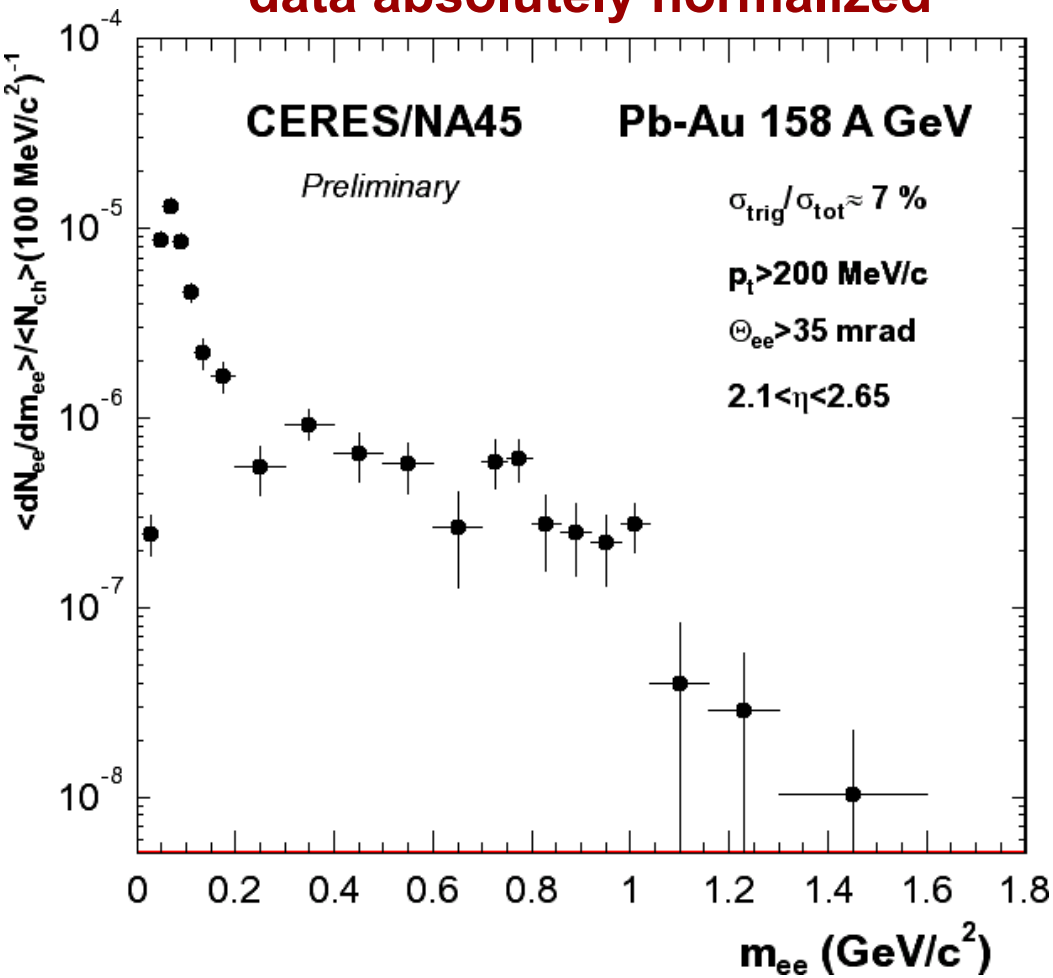


e^+e^- mass spectrum

Pb+Au at 158 GeV per nucleon

Sergey Yurevich

data absolutely normalized



2571±224 e^+e^- pairs with m_{ee} > 0.2 GeV

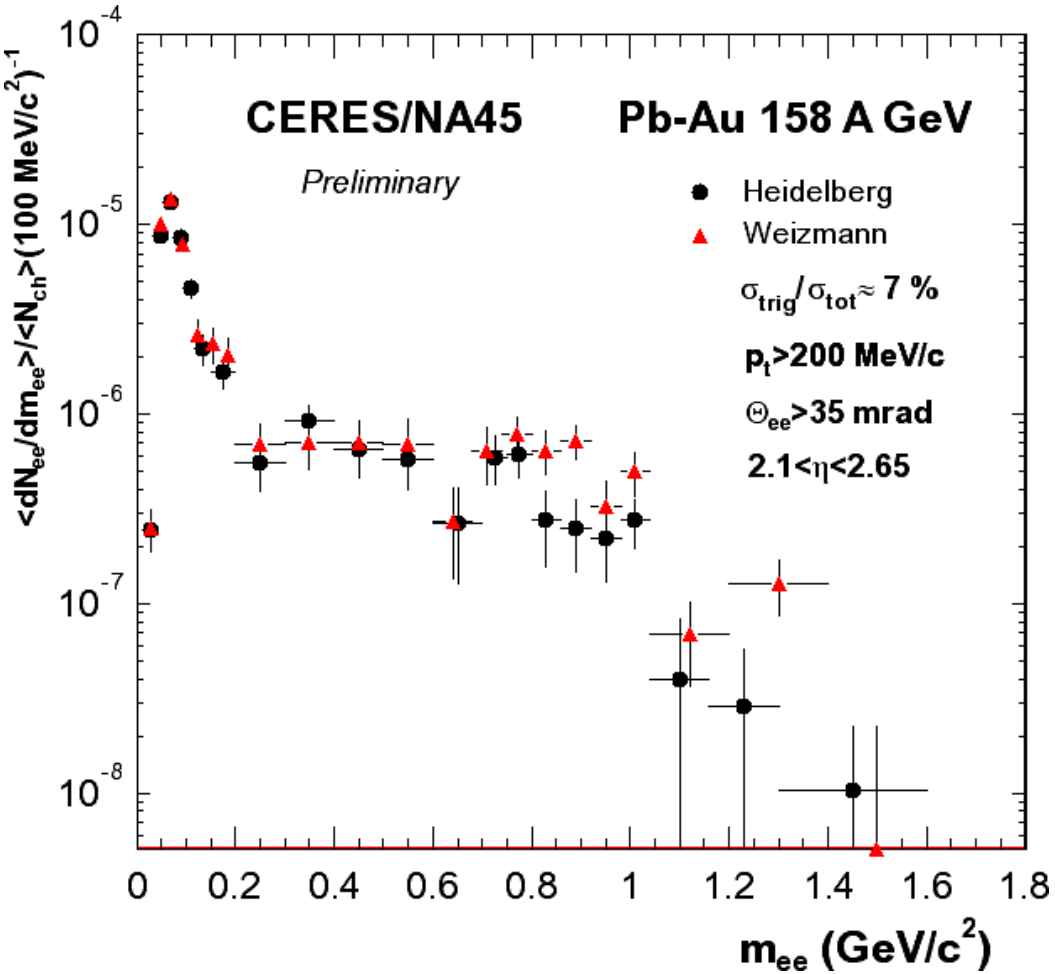
S/B = 1/21

$\langle dN_{ch}/d\eta \rangle$= 335

e^+e^- mass spectrum

Pb+Au at 158 GeV per nucleon

Sergey Yurevich, Heidelberg University
Alexander Cherlin, Weizmann Institute
Oliver Busch, GSI Darmstadt



two physics analyses give identical results

third analysis:

track all charged particles, for each track determine pid

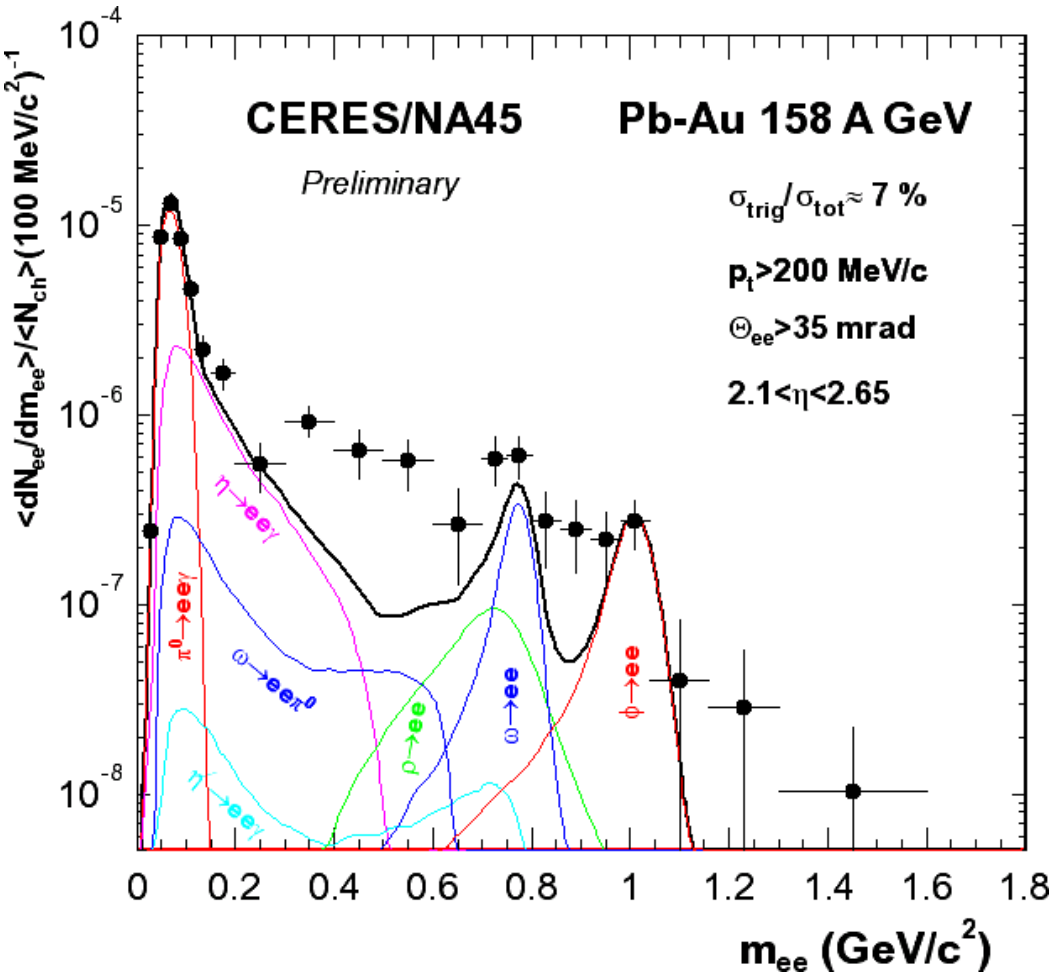
→ identical shape, absolute efficiency not yet finished

e^+e^- mass spectrum: enhancement

Pb+Au at 158 GeV per nucleon

Sergey Yurevich

comparison to the hadron decay cocktail



enhancement over hadron decay cocktail

for 0.2 GeV < m_{ee} < 1.1 GeV: 2.35±0.31 (stat)

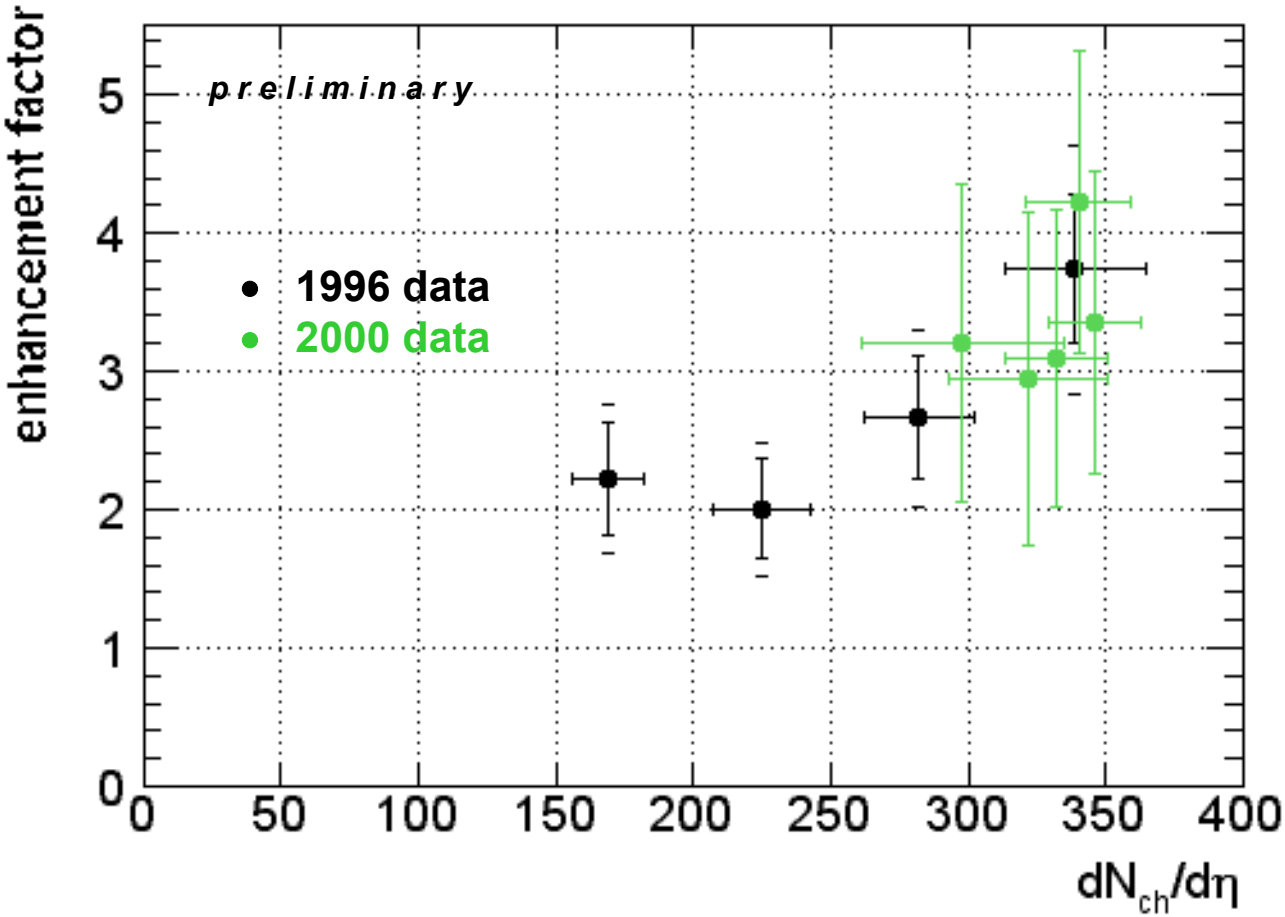
for 0.2 GeV < m_{ee} < 0.6 GeV: 2.80±0.50 (stat)

overall systematic uncertainty of normalization: 21%

e^+e^- enhancement: centrality dependence

Pb+Au at 158 GeV per nucleon

Sergey Yurevich

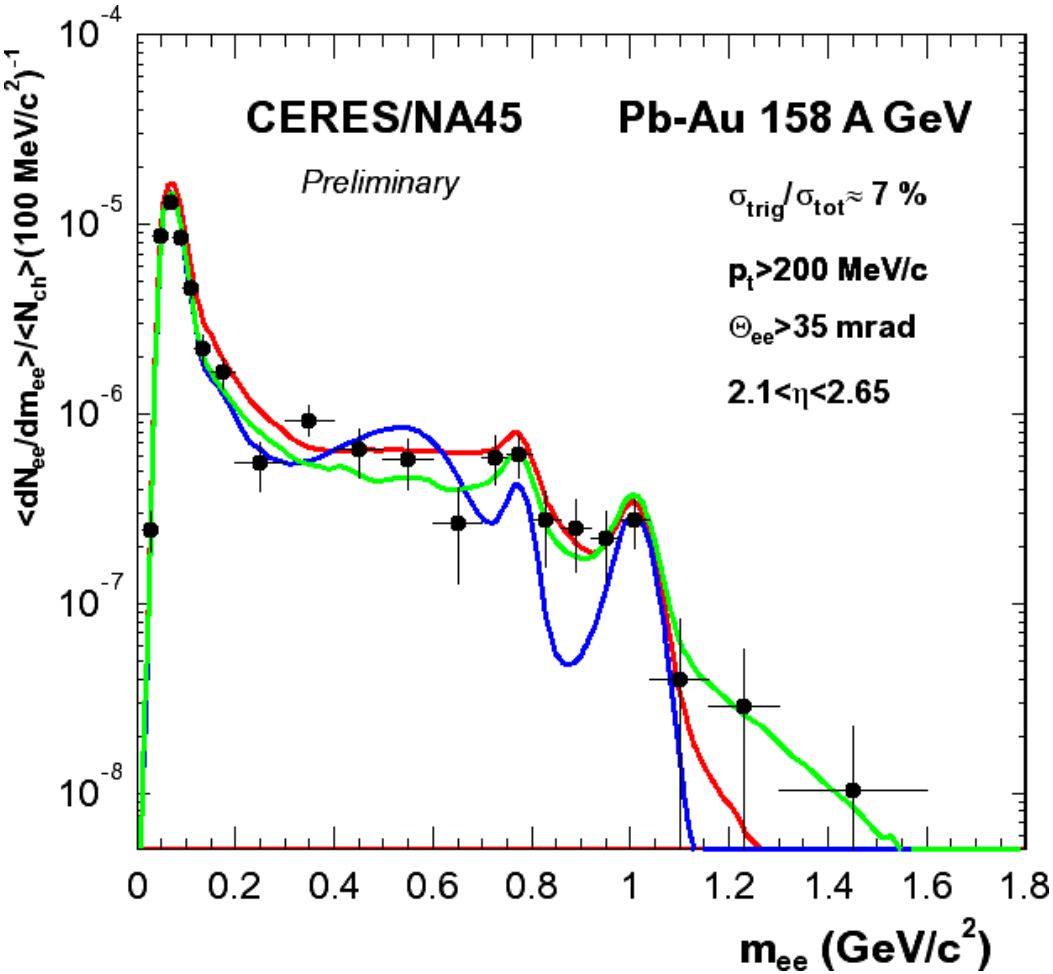


the 2000 data fits into the previously observed centrality trend

e+e- mass spectrum: comparison to the models

Pb+Au at 158 GeV per nucleon

Sergey Yurevich



calculation by R.Rapp using Rapp/Wambach medium modification of rho spectral function

calculation by R.Rapp using Brown-Rho scaling

B. Kämpfer, thermal emission

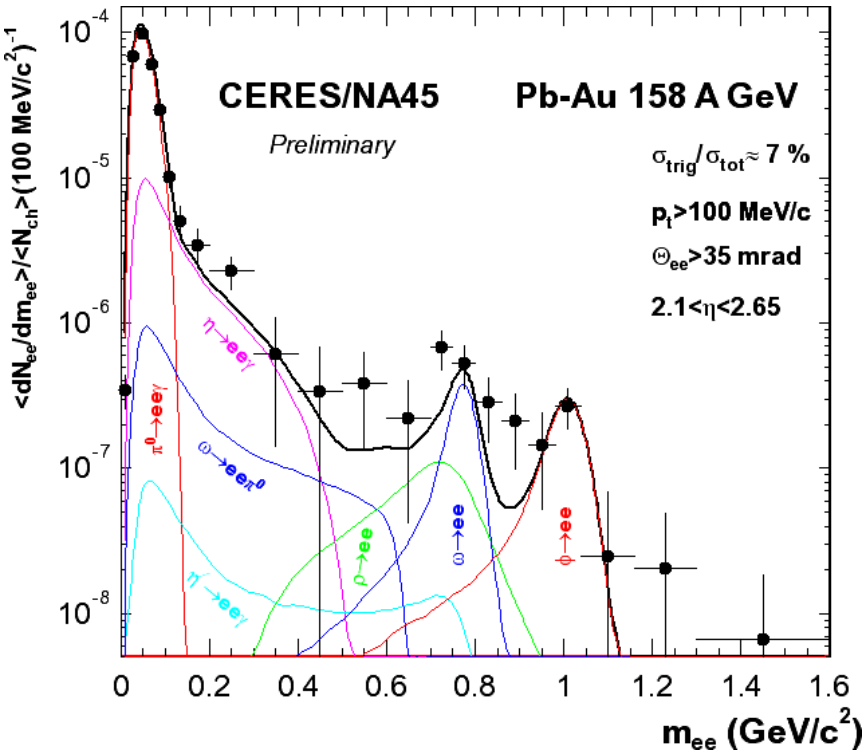
...added to the cocktail.

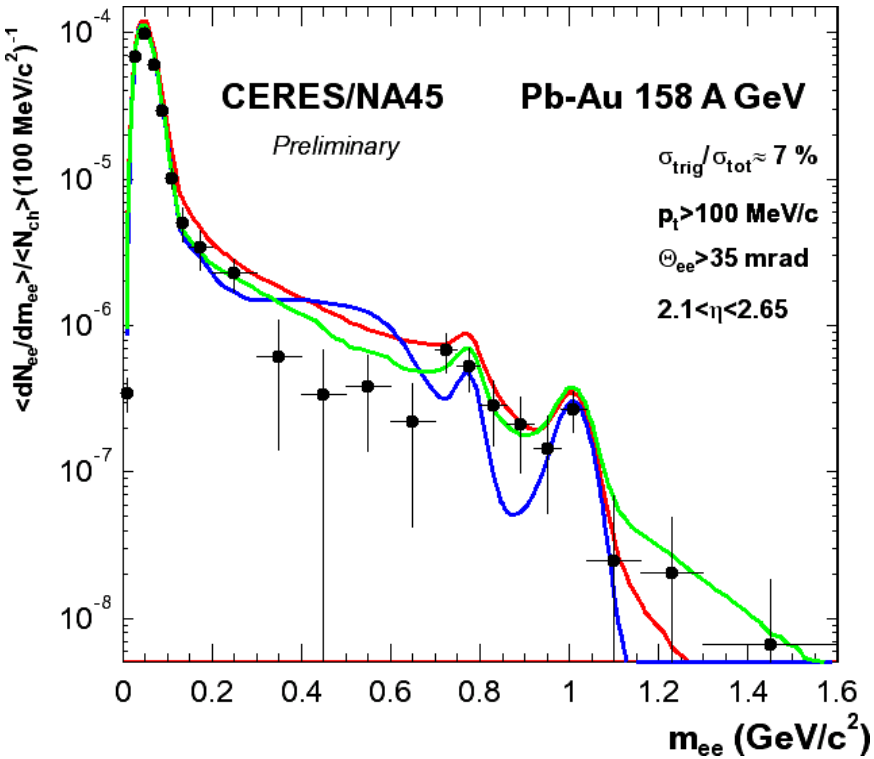
in the 0.8 < m < 0.98 GeV region:
Brown-Rho curve: $\chi^2/n = 2.4$
the other two curves: $\chi^2/n \sim 0.3$

e+e- mass spectrum: lowering the pt-cut

Pb+Au at 158 GeV per nucleon

Sergey Yurevich





S/B = 1/87

enhancement for 0.2<m<0.6: 1.52 ± 0.36

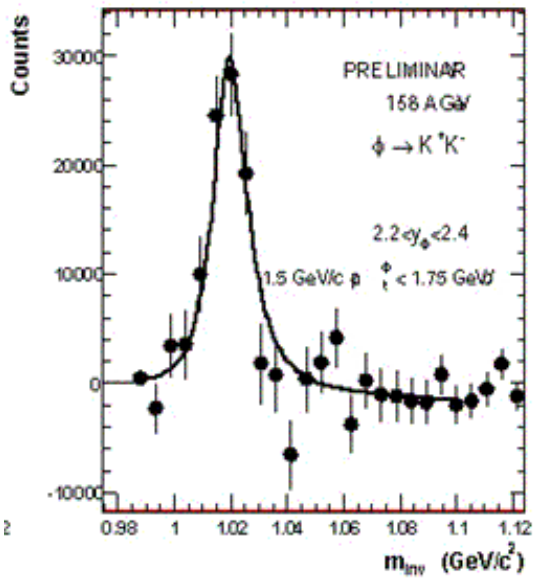
poor signal-to-background ratio due to the π^0-Dalitz electrons

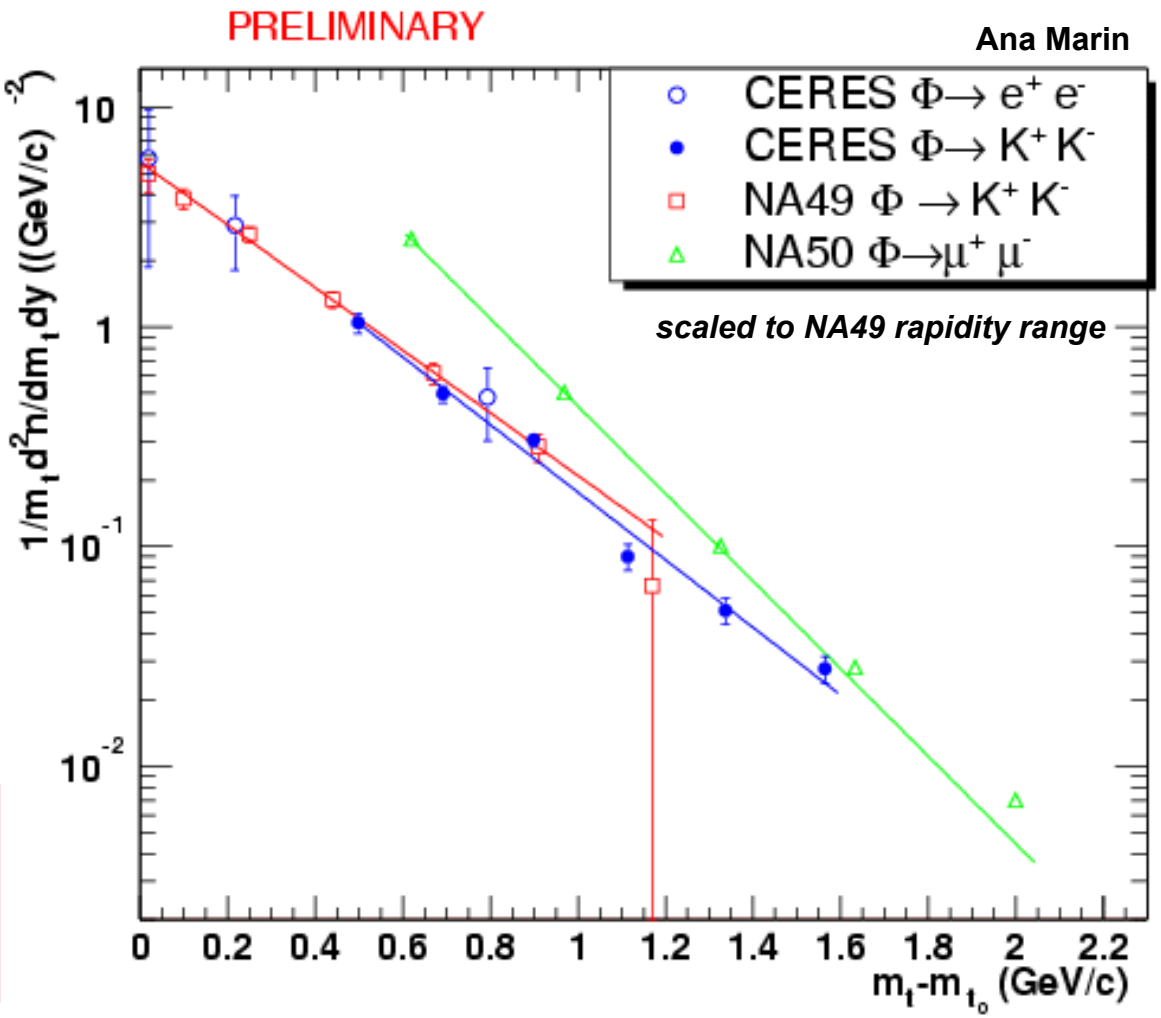
pt spectrum of the ϕ

$\phi \rightarrow e^+e^-$ extracted from the e^+e^- mass spectrum;

ϕ puzzle: D. Röhrich, J.Phys.G 27(2001)355

$\phi \rightarrow K^+K^-$



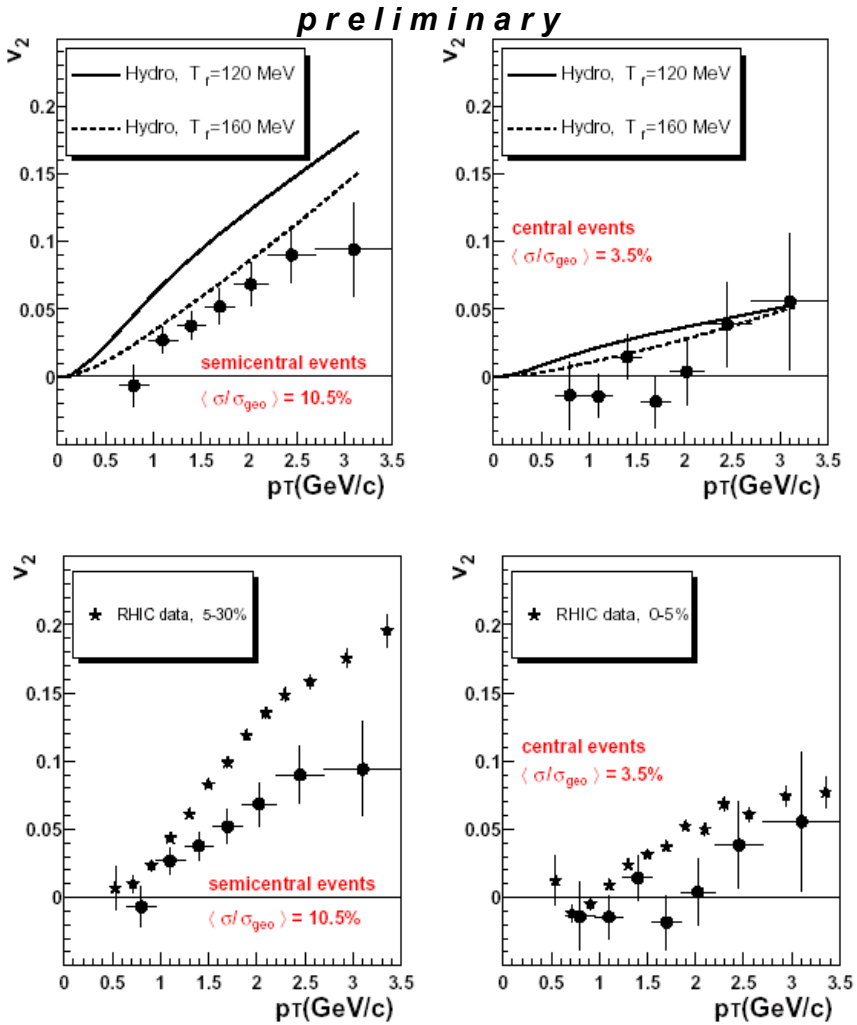


CERES ϕ spectra observed in the leptonic and the hadronic decay channels agree

Λ flow

Pb+Au at 158 GeV per nucleon

Jovan Milosevic, visit his talk on Friday afternoon



comparison with hydro (P. Huovinen):

calculation with T=160 MeV describes the Λ and π flow

comparison with STAR PRL 92(2004)052302:

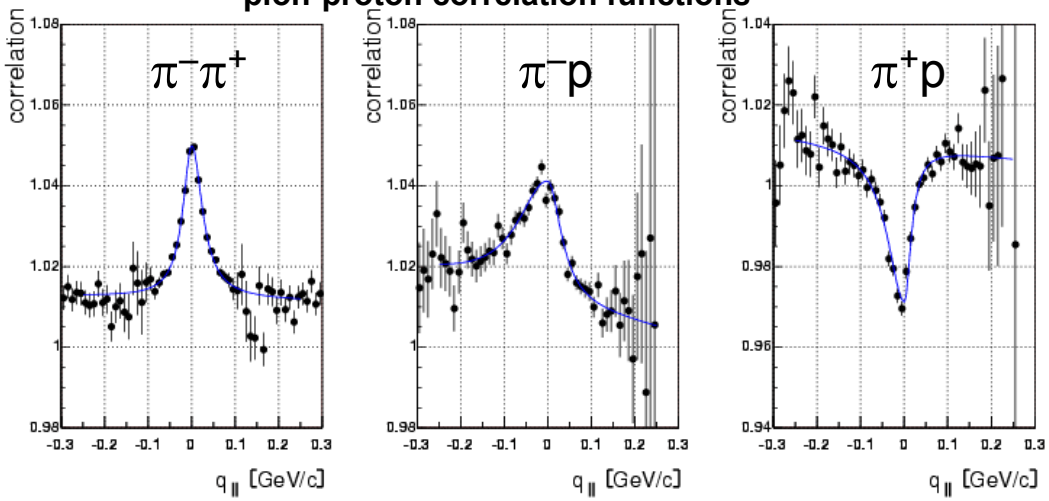
similar pt dependence about 60% in magnitude

pion-proton correlations

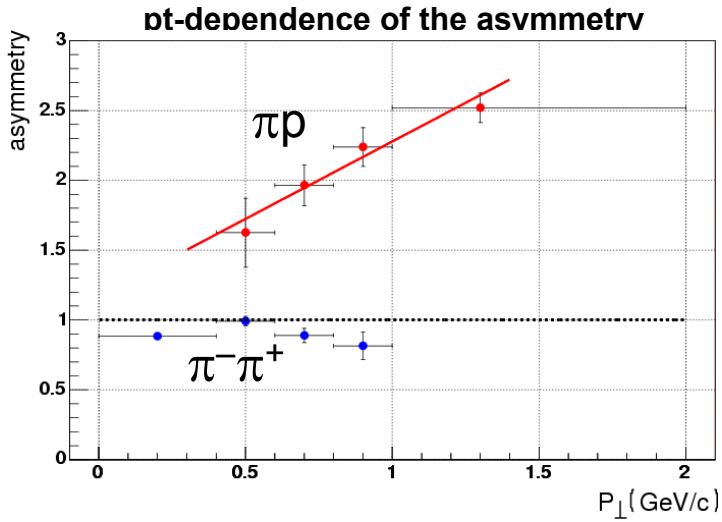
central Pb+Au at 158 AGeV

Dariusz Antonczyk, see his poster

pion-proton correlation functions



pt-dependence of the asymmetry



asymmetry := σ_{left} / σ_{right}

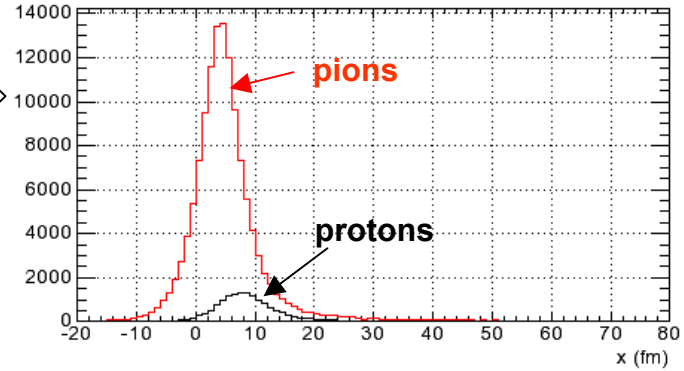
the proton source is located at a larger transverse radius* than the pion source

asymmetry of the correlation function is related to the asymmetry of the relative source distribution (Lednicky, Phys.Lett.B373(96)30)

most probable origin: transverse flow

sensitive to the details of reaction dynamics

pion and proton sources in UrQMD



pt fluctuations

measures of fluctuations

$\sigma_{pt\ dyn}^2$	difference between the variances of pt and mean pt
Σ_{pt}^2	same divided by mean pt
$\langle \Delta pt_i, \Delta pt_j \rangle$	pt covariance
Φ_{pt}	difference between the standard deviations of pt and mean pt

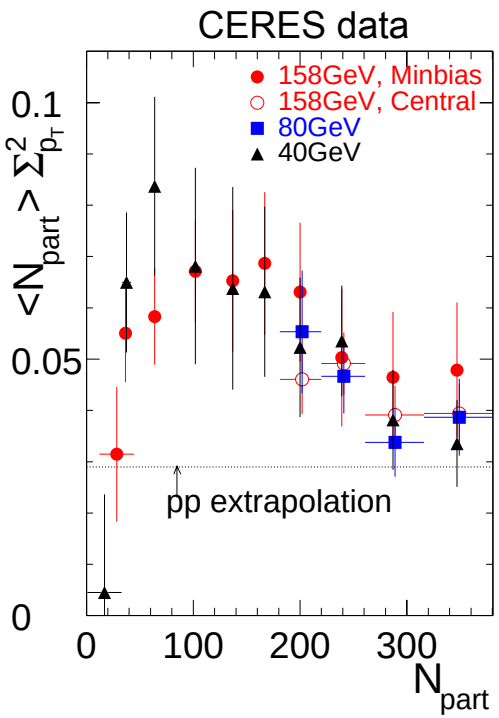
relations

$$\sigma_{pt\ dyn}^2 = \sigma_{\langle pt \rangle}^2 - \sigma_{pt}^2 / \langle M \rangle$$

$$\Sigma_{pt} = \sigma_{pt\ dyn} / \langle pt \rangle$$

$$\langle \Delta pt_i, \Delta pt_j \rangle \cong \sigma_{pt\ dyn}^2$$

$$\Phi_{pt} \cong \langle M \rangle \sigma_{pt\ dyn}^2 / 2\sigma_{pt}$$



interesting non-monotonic behavior: strongest in peripheral collision

similar dependence observed by NA49, STAR, PHENIX

→ **what is the origin?**

pt fluctuation

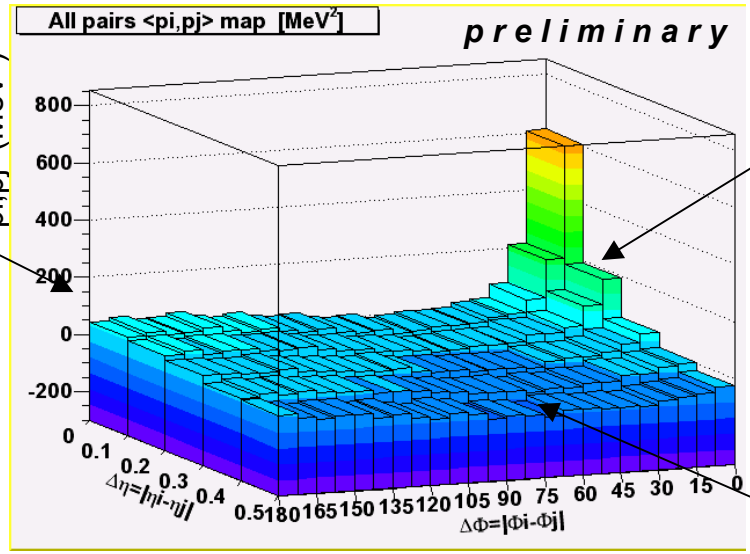
Pb+Au at 158 GeV per nucleon

Georgios Tsiledakis

away-side correlations

elliptic flow, jets?

$0.1 < p_T < 1.5$ GeV/c



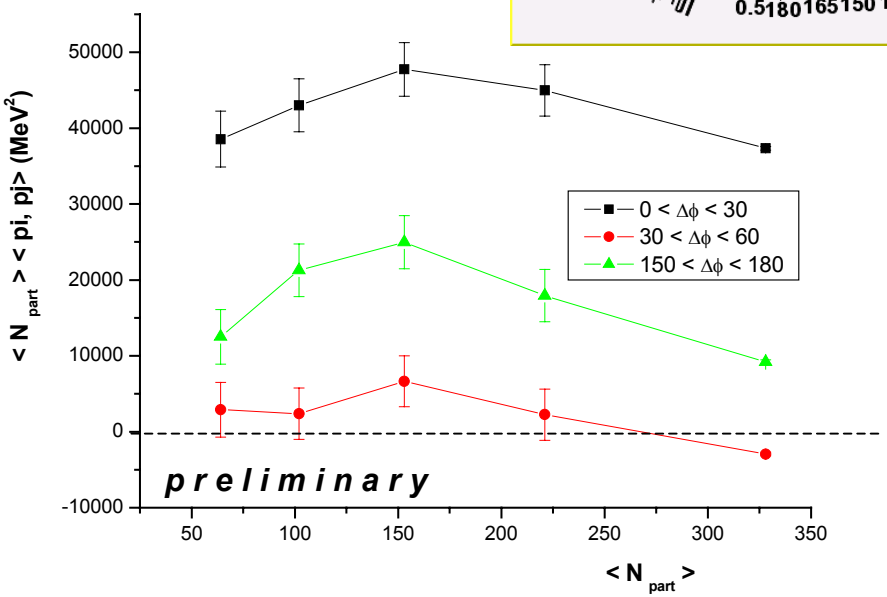
short range correlations

confined to Q_{INV}<70 MeV narrower and weaker for unlike pairs → HBT and Coulomb?

rich structure → averaging over Δφ and Δη is dangerous

decline with Δη

reproduced with event mixing trivial effect of pt(η) dependence?

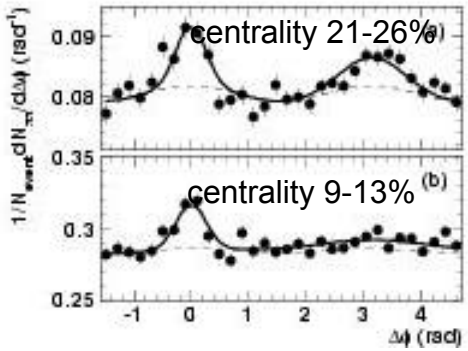


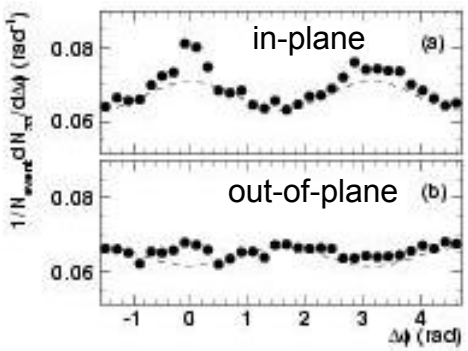
short range and away-side correlation produce the observed centrality dependence

region around Δφ = 45° is not affected by the elliptic flow, HBT, Coulomb, jets → look here for the critical point

angular correlations of high-pt particles

Pb+Au at 158 GeV per nucleon



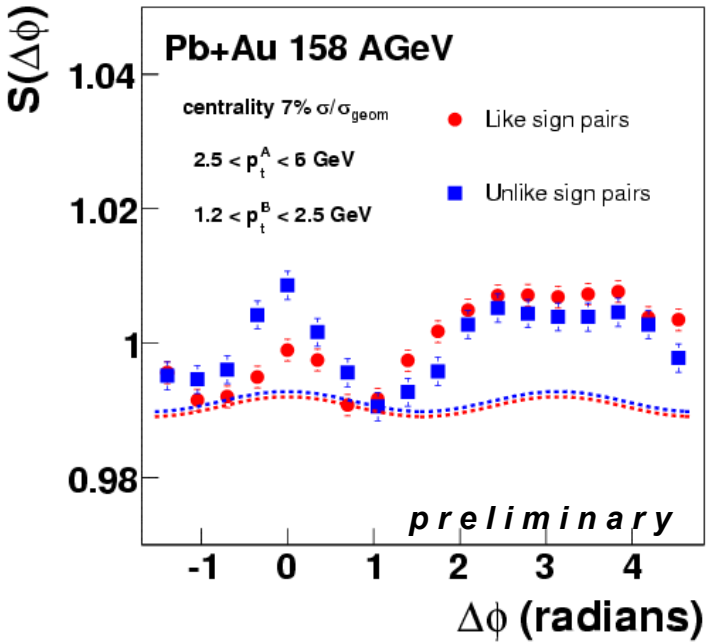


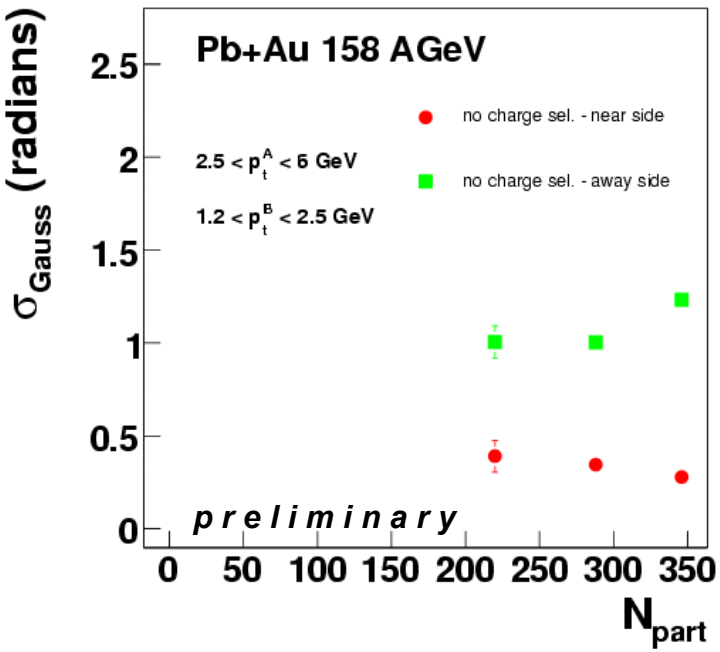
J. Bielcikova, 1996 data
PRL 92 (2004) 032301

p_t > 1.2 GeV

p_t > 2.5 GeV

analysis of 2000 data in progress see poster by Mateusz Ploskon





summary

- e^+e^- low mass excess corroborated
- Brown-Rho scaling less favored by the data
- $\phi \rightarrow e^+e^-$ consistent with $\phi \rightarrow K^+K^-$, no puzzle
- mass dependence of the elliptic flow (when comparing Λ and π) similar to hydro
- evidence for displaced sources of pions and protons in the non-identical particle correlation functions
- pt fluctuations resolved in $\Delta\eta$ and $\Delta\varphi$ → several contributions identified
- high-pt correlations in central collisions show a very broad away-side peak, like at RHIC
- ongoing analyses: K^0, charm, Δ, ...

CERES Collaboration

D. Adamova, G. Agakichiev, **D. Antonczyk**, A. Andronic, H. Appelshäuser, V. Belaga, J. Bielcikova, P. BraunMunzinger, **O. Busch**, A. Castillo, **A. Cherlin**, S. Damjanovic, T. Dietel, L. Dietrich, A. Drees, S. Esumi, K. Filimonov, **K. Fomenko**, Z. Fraenkel, C. Garabatos, P. Glässel, G. Hering, J. Holeczek, V. Kushpil, B. Lenkeit, **W. Ludolphs**, A. Maas, A. Marin, **J. Milosevic**, A. Milov, D. Miskowiec, R. Ortega, Yu. Panebrattsev, O. Petchenova, V. Petracek, A. Pfeiffer, M. Ploskon, **S. Radomski**, J. Rak, I. Ravinovich, P. Rehak, W. Schmitz, J. Schukraft, H. Sako, S. Shimansky, S. Sedykh, J. Stachel, M. Sumbera, H. Tilsner, I. Tserruya, **G. Tsiledakis**, T. Wienold, B. Windelband, J.P. Wessels, J.P. Wurm, W. Xie, **S. Yurevich**, V. Yurevich

NPI ASCR, Rez, Czech Republic
GSI Darmstadt, Germany
Frankfurt University, Germany
Heidelberg University, Germany
JINR Dubna, Russia
Weizmann Institute, Rehovot, Israel
SUNY at Stony Brook, USA
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