Preliminary results from the 2000 run of CERES on low-mass e^+e^- pair production in Pb-Au collisions at 158 A GeV

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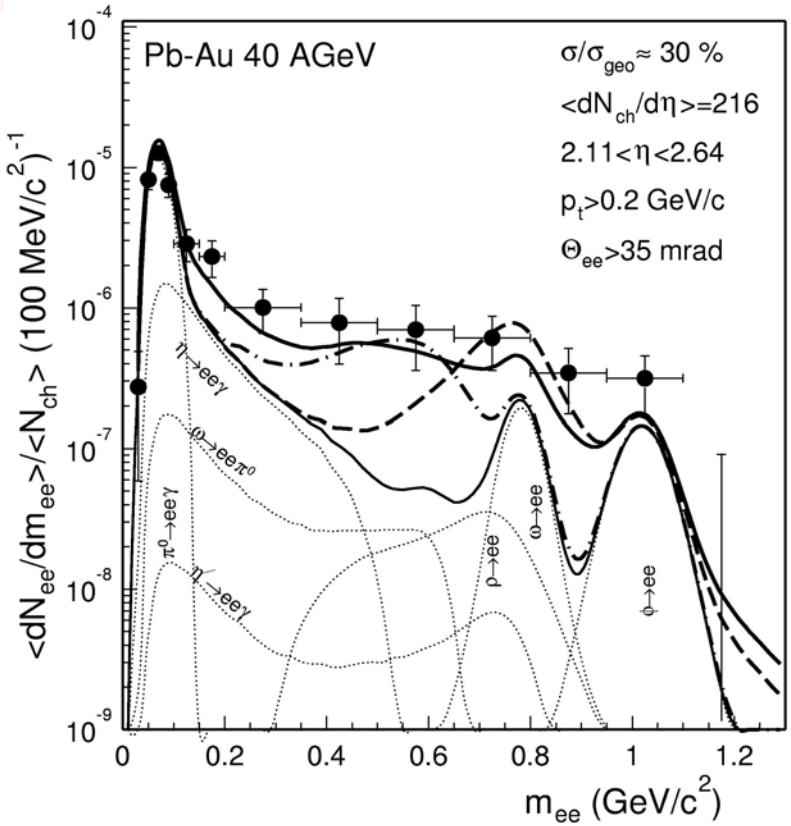
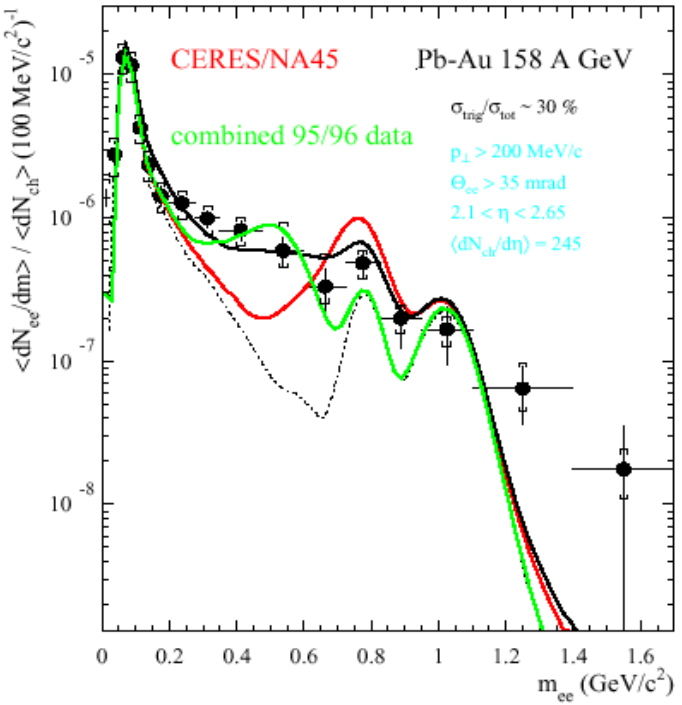
Outline

- Motivation
- The 2000 CERES set-up and run
- Analysis procedure
- Present status of results
- Summary and outlook

Motivation (I)

CERES has observed a strong enhancement of low-mass pairs at the SPS
Interpretations invoke in-medium modification of the ρ meson





Goals of run in 2000:

- improve mass resolution to see the ω and the φ
- improve significance of data (better S/B ratio) to discriminate among the models

Motivation (II): φ meson

the simultaneous measurement of $\phi \rightarrow e^+ e^-$ and $\phi \rightarrow K^+ K^-$

powerful tool to evidence in-medium effects

- Central Pb-Pb 158 A GeV
- NA49:

  $\varphi \rightarrow K^+K^-$ T = 305 MeV

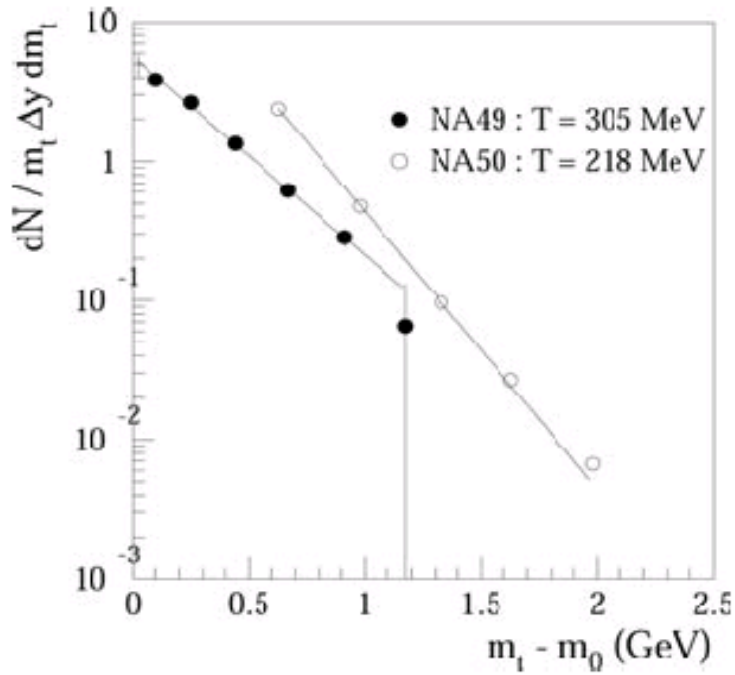
  dN/dy = 2.35
- NA50:

  $\Phi \rightarrow \mu^+\mu^-$ T = 227 MeV

  No specific quote of dN/dy

(but in the overlap region NA50 exceeds NA49 by factors 2-4)

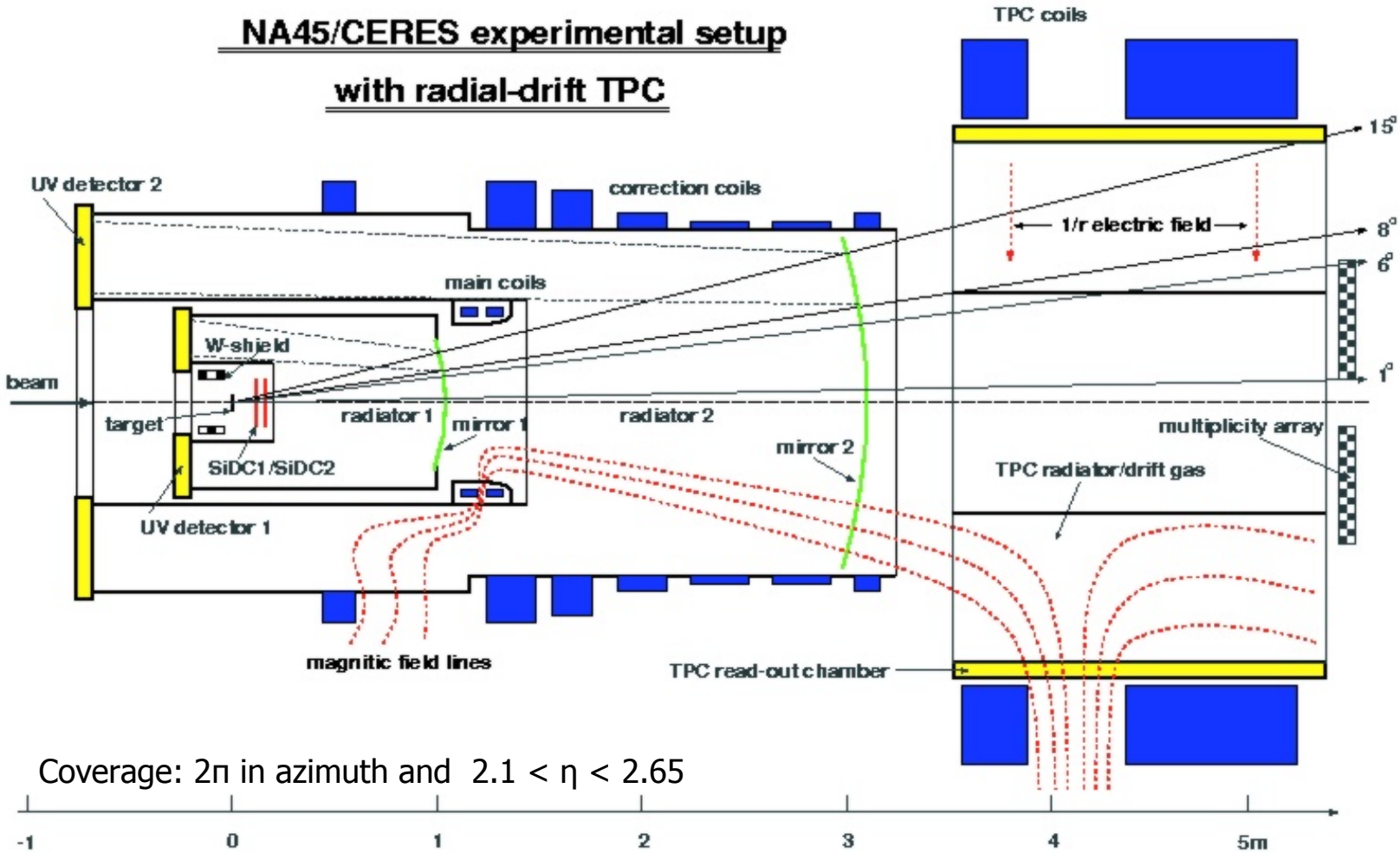
Integrating the mt spectrum gives dN/dy ~ 13



D.Rohrich J.Phys. G 27, 355 (2001)

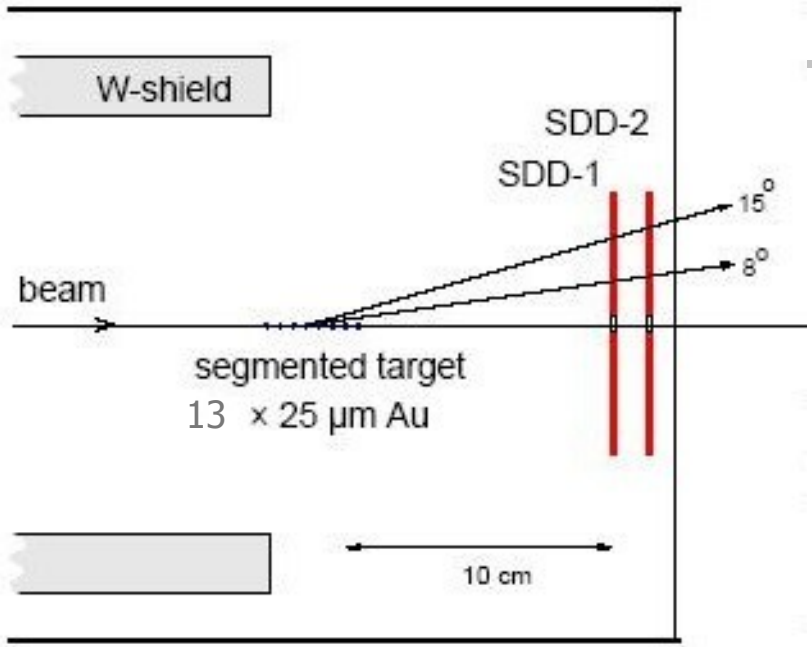
CERES has the unique capability to measure simultaneously $\varphi \rightarrow K^+K^-$ and $\varphi \rightarrow e^+e^-$

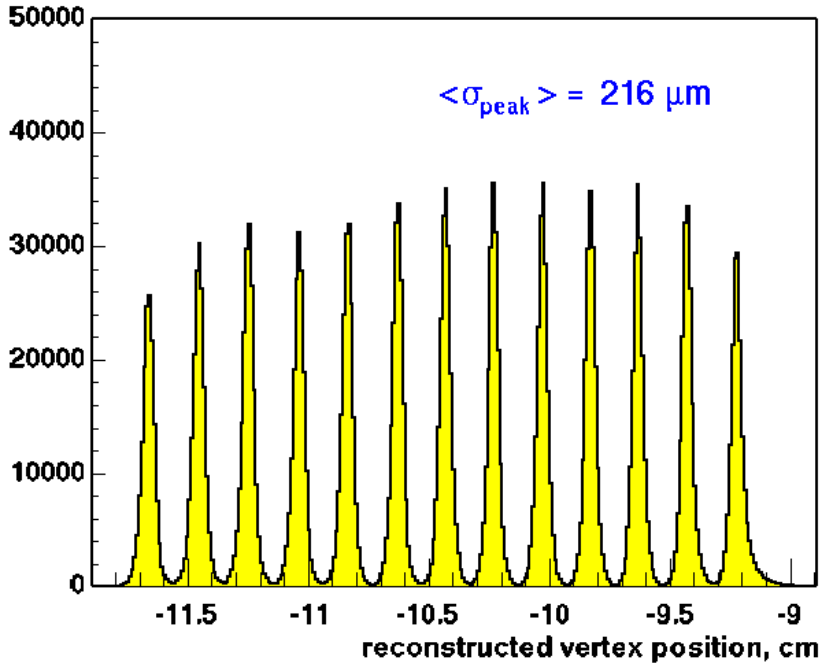
CERES 2000 Experimental set-up



- Pb-Au at 158 A GeV
- Sample size: 33M central events (top 8% of geometrical cross section)
  present analysis based on 20 M events

Target Area and Silicon Drift Chambers Si1-2





Segmented target: 13 Au disks of 25μ thickness, 600μ diameter

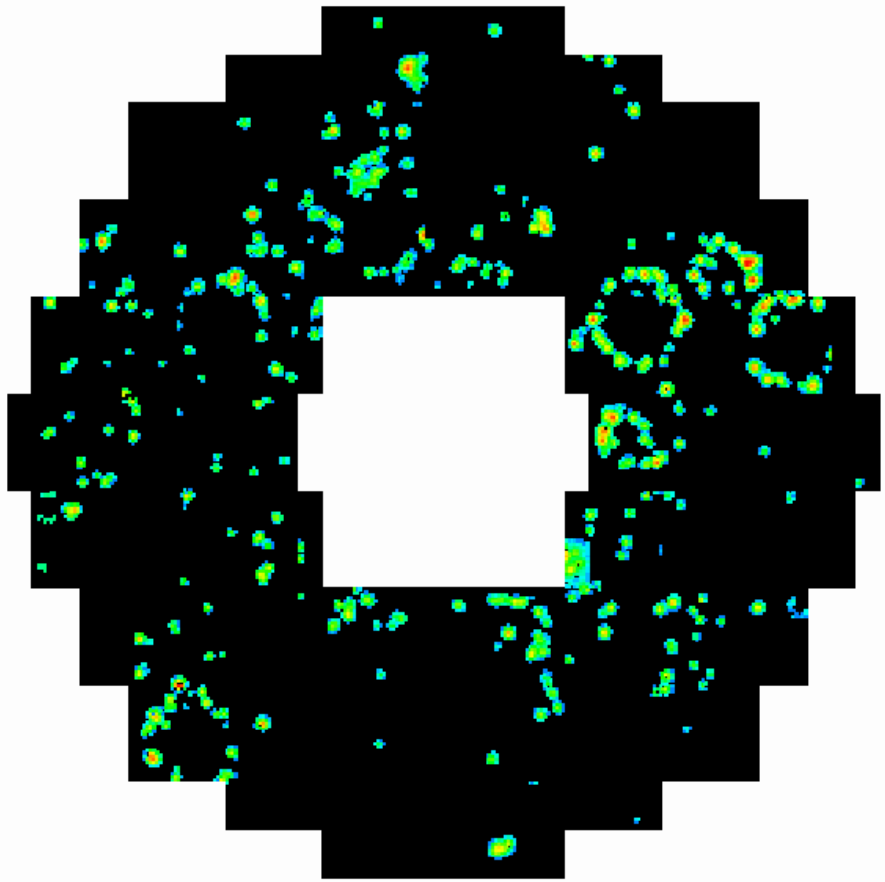
Silicon Drift Chambers:

- provide vertex σ_z = 216 μ
- provide event multiplicity η = 1.9 -3.9
- powerful tool to recognize conversions at the target.

RICH

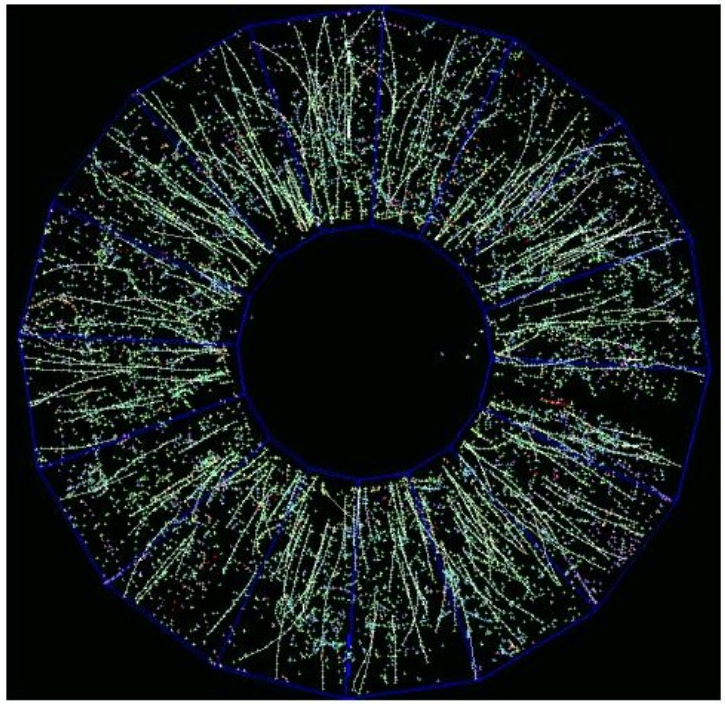
- The main tool for e-ID
- Use a Hough transformation to find the rings
- Use the number of hits per ring and sum analog to differentiate between single and double rings

RICH 1 event display

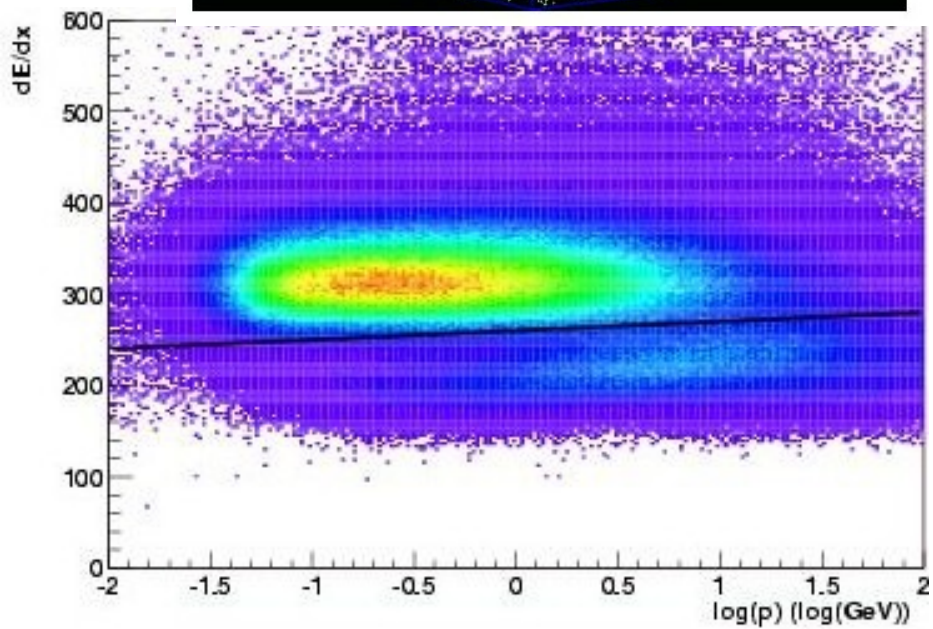


TPC

Central Pb-Au event



- Provide momentum measurement
- Improved mass resolution: 4% @ φ inferred from position resolution and confirmed by line shape of resonances (Λ and K_s).
- Provide additional e-ID through dE/dx.



The Experimental Challenge

- Need to detect a very weak source of e^+e^- pairs
  hadron decays ($m>200$ MeV/c^2 $p_T > 200$ MeV/c) — $4.\ 10^{-6}$ / π^o
- in the presence of hundreds of charged particles
  central Pb-Pb collision — $dN_{ch} / dy \approx 500$
- and several pairs per event from trivial origin
  π^o Dalitz decays — 10^{-2} / π^o
  + γ conversions — 2 . radiation length / π^o

huge combinatorial background $\propto (dN_{ch} / dy)^2$
(pairing of tracks originating from unrecognized π^0 Dalitz decays and γ conversions)

CERES strategy:

- **Redundant e-id through RICH-1, RICH-2 and TPC dE/dx**
- **exploit the small opening angle of π^0 Dalitz decays and γ conversions**
- **single electron p_t cut of 200 MeV.**

Analysis Procedure (I)

- Construct Global track
  Vertex /Si1-2 → RICH1/2 → TPC

- Quality cuts:
  - Ensure that there are no fake tracks (use 2σ momentum dependent matching
  - Redundant e-id with RICH1, RICH2 and TPC dE/dx.

- Rejection of conversions
  - fully reconstructed conversions
  - partially reconstructed conversions

- Rejection of partially reconstructed π^0 Dalitz decays

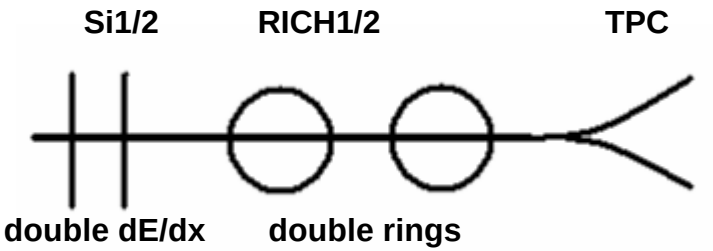
- All remaining tracks with $p_t > 200$ MeV/c are paired together
  (with the exception of tracks from fully reconstructed π^0 Dalitz decays)
  The residual combinatorial background is subtracted using the like sign pairs:

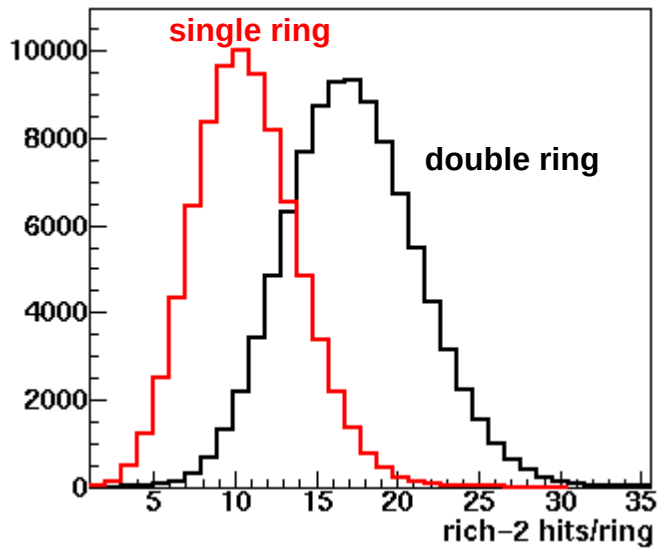
$$S = N_{+-} - 2\sqrt{(N_{++}\, N_{--})}$$

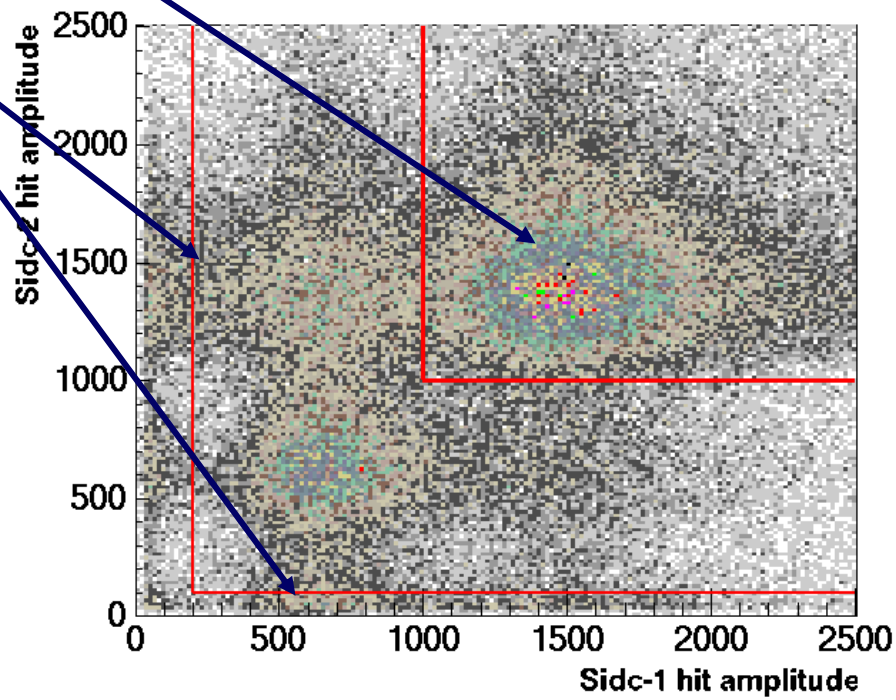
Analysis Procedure (II):

Rejection of Conversion Pairs

- Fully reconstructed conversions are easily recognized by their typical pattern.
- Conversions originating in the target are effectively rejected by double dE/dx signal in the Sidc detectors.
- Conversions in Sidc-1 or Sidc-2 are identified by low dE/dx tails in Sidc dE/dx distributions.
- Remaining conversions rejected by cuts on hits/ring and sum analog amplitude.



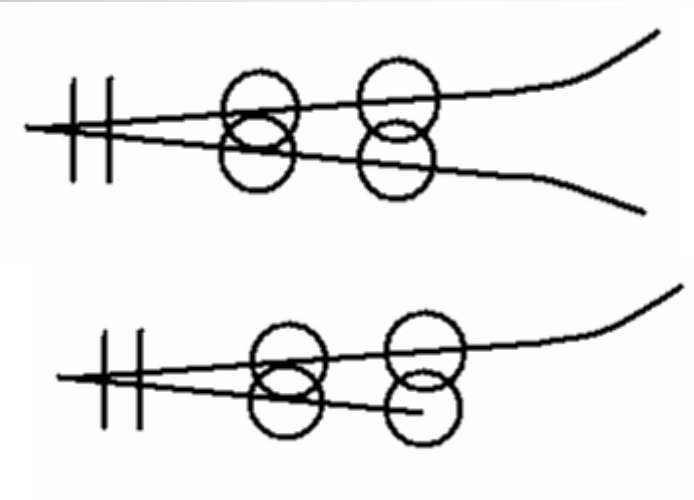




Analysis Procedure (III)

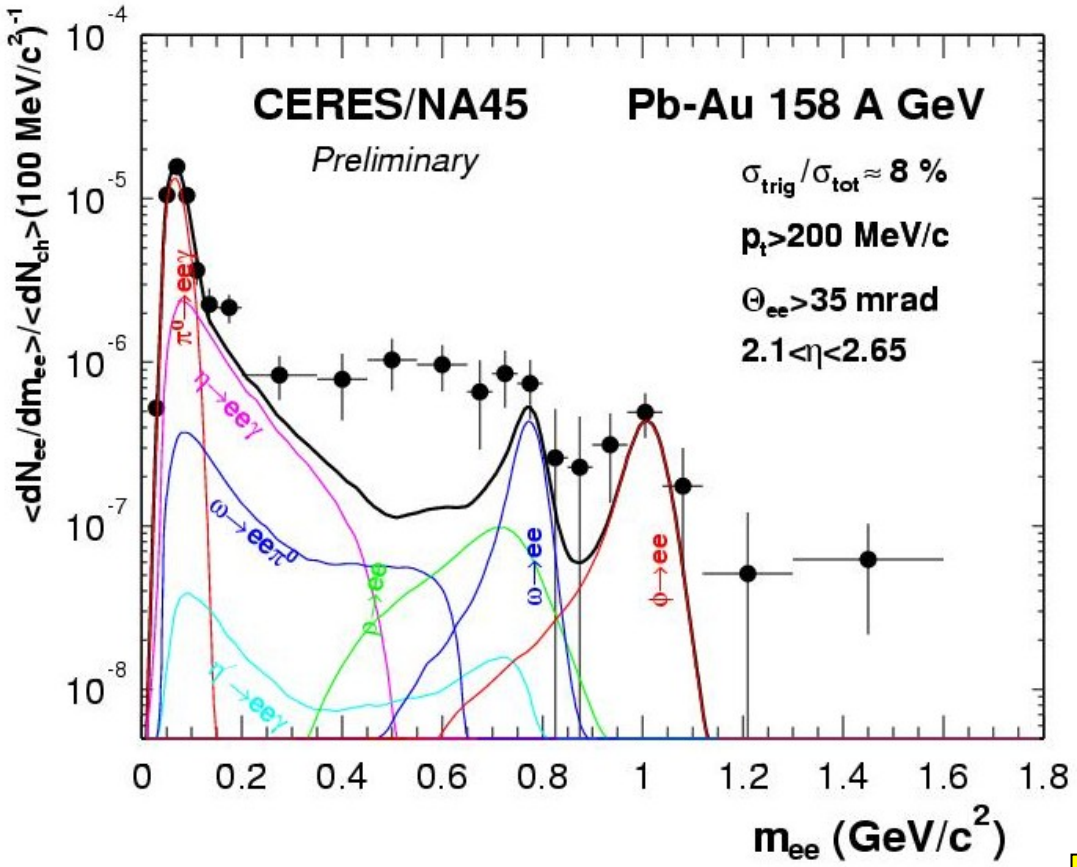
π0 Dalitz

- Fully reconstructed Dalitz
  (m<150 MeV θ < 50 mrad)
- Partially reconstructed Dalitz
  (not yet applied)



A total of ~10 cuts are applied aiming at reducing the huge combinatorial background while preserving reasonable reconstruction efficiency
→Use fully reconstructed Dalitz decays to monitor reconstruction efficiency
→ use the like sign pair yield to monitor the background suppression.

Results: present status

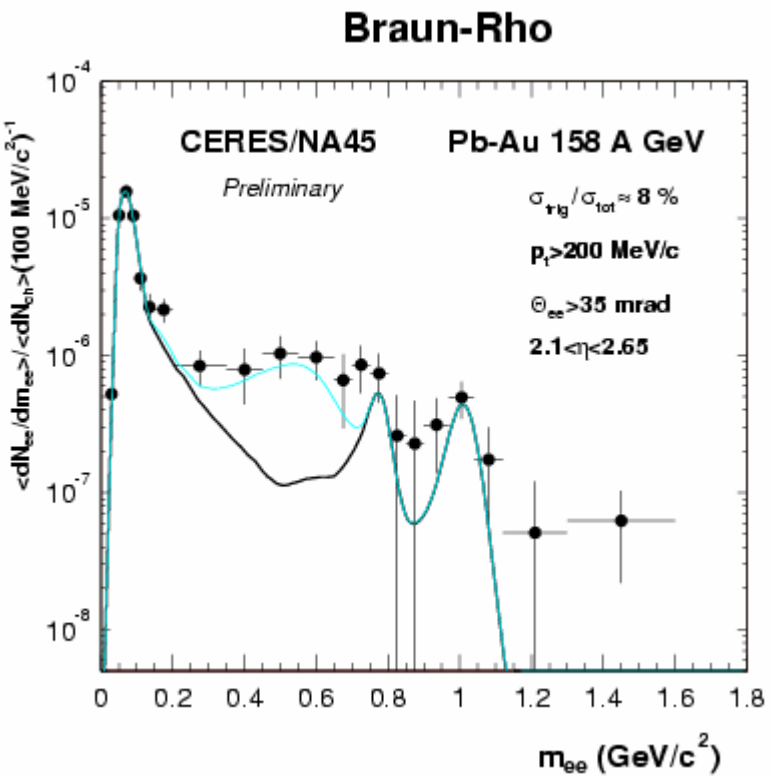


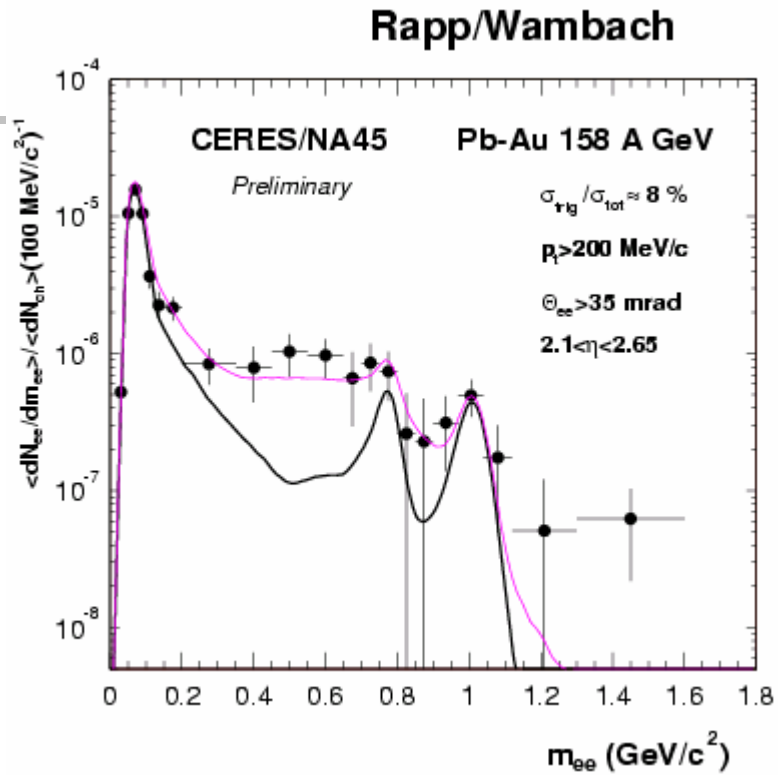
- Statistical errors only
- Data normalized to cocktail at the π^0 Dalitz
- Enhancement (data/cocktail) for m > 0.2 GeV/c^2:
  2000 run: 2.8 ± 0.4

Mass range [GeV/c2]	Yield	S/B	S_{eff}
m < 0.2	3135±118	1/1.8	680
m > 0.2	2037±256	1/ 15.7	63
0.9<m<1.1	222±66	1/7.5	14

- **Φ peak is visible**
- **Open pairs sensitivity comparable to 95/96 results**

Comparison to models





Dropping ρ meson mass
→ transfer strength to low masses

ρ meson broadening
→ transfer strength to both low and high masses

The region between the ω and the φ is the most sensitive to discriminate between the two approaches

Summary and outlook

- mass resolution of ~4%

  We may reach enough sensitivity to discriminate among theoretical models
- Much work still to be done
  - Improve analysis (cut on partially reconstructed π^0 Dalitz, tracks with back-to-back rings ….)
  - Increase statistics by recuperating at least part of the 13M events not yet analyzed

  → improve significance by a factor of ~2
  - Absolute normalization, systematic errors
- In spite of limited K identification, $\varphi \rightarrow K^+K^-$ can be measured along with the $\varphi \rightarrow e^+e^-$