Re–evaluation
of
Electron Identification Capability
of the
PHENIX RICH

Electron Measurement Workshop
at
PHENIX Collaboration Meeting
in
Costa Mesa, CA

March 4, 1997

presented by

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Introduction

**Hadron rejection power of the RICH
was claimed to be 1500–2000
in the CDR era (1993)**

**Since then many things have appeared
to make its performance worse :**

- **realistic detector descriptions
(*e.g.* DC support frame)**
- **realistic (?) event genarator
(UA1 –> HIJING, *i.e.* higher multiplicity)**
- **realistic vertex distribution
(fixed –> σ ~ 22 cm)**
- **reduced segmentation of the RICH
(6400 –> 5120 PMT's)**

**Its performance has to be updated
for physics discussions :**

- **'CDR figure' (di–electron spectrum) update**

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How to Define e−ID Capability

Clear definition is important :

– **to compare different designs / configurations / algorithms**

– **to study performance with more than one detectors combined**

Two factors to be measured :

– **efficiency for electrons**
– **rejection power for hadrons and muons**

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Analysis Tools

PISA :

- '10K' PISA project (with HIJING)
  lead by C.F.Maguire
- 'background' full event generation
- enough pions to study rejection power

PISORP :

- capable to merge 'signals' into background
- allows to study efficiency for electrons

Needed resources :

- PISA output file occupies
  ~ 0.6 GBytes / 100 central Au+Au events
- PISORP for RICH takes
  ~ 10 sec per central Au+Au event
  on Indy (R4600 132 MHz) with local disks

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How to Fix e−ID Cuts

**Keep efficiency for electrons
and measure rejection power ?**

- **what kind of electrons ?**
- **momentum dependence ?**

**Fix the cuts
and measure efficiency and rejection ?**

- **better and easier for systematic studies**
- **consistency check with changing cuts**

- **this method was used in this study**

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What to Analyze

Data sets (from C.F.Maguire) so far analyzed :

- 600 central Au+Au HIJING events
  without shield
- 300 central Au+Au HIJING events
  with shield prototype 3
- 281 central Au+Au HIJING events
  with shield prototype 1

RICH e–ID capability :

- rejection power for pions
- efficiency for electrons in full background
  at various momenta

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Results

'Standard' cuts
(which give 95 % efficiency for electrons in single–track events) :

– reject pions by ~ 1000
– but lose 20–25 % of good electrons in central Au+Au HIJING events

Looser cuts :

– rejection power drops to ~ 200 to keep 90 % efficiency for electrons in central Au+Au HIJING events

Worse than in CDR era by a factor near 10 !

What Makes It So Bad ?

PMT occupancy ratio is a critical factor :

- **pion misidentification increases**
  by accidental overlapping
  ~ (occupancy ratio)$^{\alpha}$ with $\alpha > 1$
- **electron inefficiency increases**
  by distorted ring pattern
  ~ (occupancy ratio)

See breakdown of sources of
electrons firing the RICH PMT's :

- **DC support frame is still dominant**
  (after the aperture was widened by 11 cm)
- **detectors themselves (especially PC1)**
  also have significant contributions

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What to Do

(First, more statistics is coming)

Software : Any more way to improve it ?

- timing information of each PMT
  (not very effective)
- better pattern recognition
  to remove conversion electron pairs
  (to be tried)

Hardware : Can we reduce the PMT occupancy ?

- DC frame shield ?
  (cf. another presentation by KS)
- thinner PC1 ?