Electron Identification in PHENIX at RHIC with a focus on the RICH Detector

presented by

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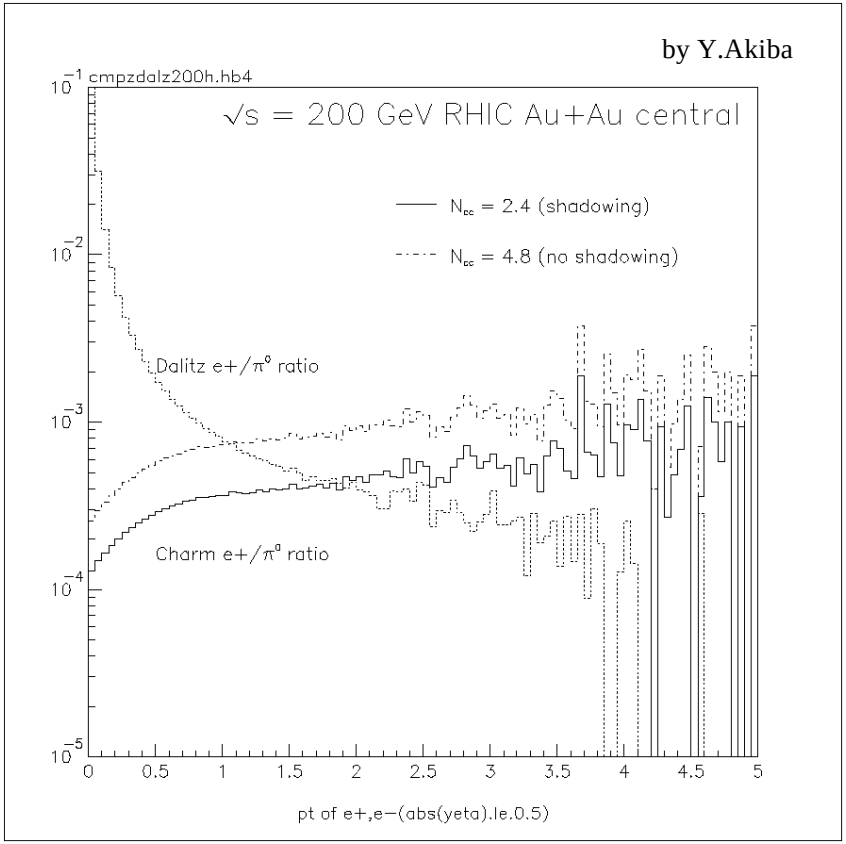
Presentation Outline

- Electron Measurement in PHENIX
- Electron ID Algorithm in PHENIX
- Ring Imaging Cherenkov Detector
- Hadron Rejection Power w/ RICH
- Hadron Mis-ID & Di-Electron Spectra
- Summary

Electron Measurement in PHENIX

- what to be measured
  - di-electron spectra
  - single electron spectra
- "background" sources
  - Dalitz decay
  - heavy quarks
  - photon conversion
  - hadron mis-ID
- requirements for eID
  - physics goal dependent
  - p_t dependent
  - roughly $10^2 \sim 10^4$

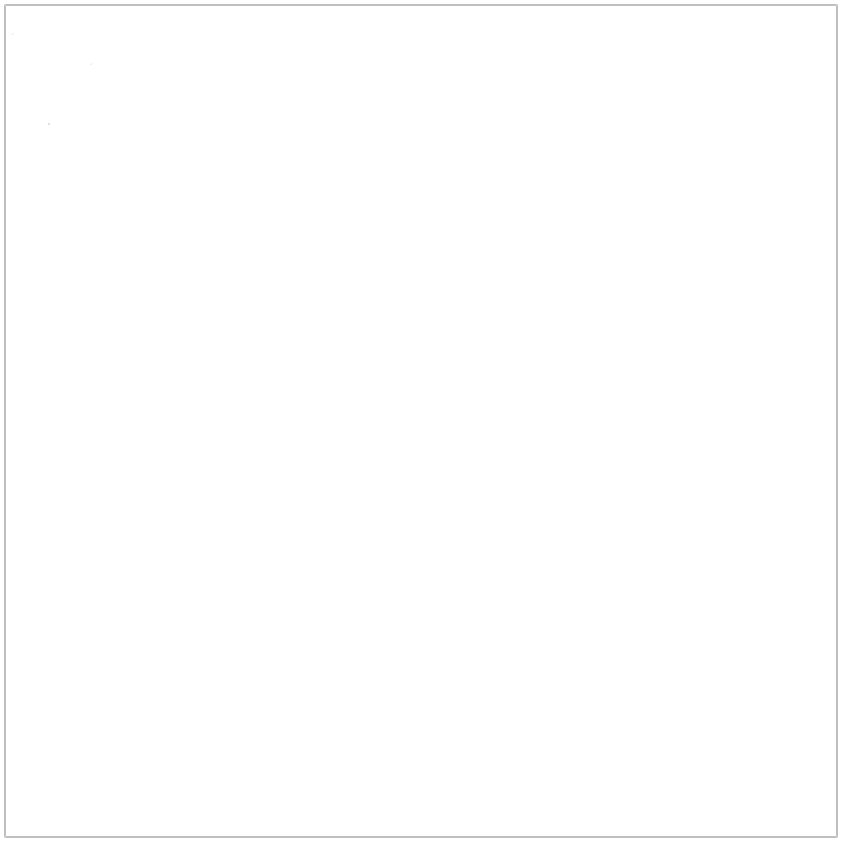


expected e/π ratio

Electron ID Algorithm in PHENIX

- current eID algorithm
  - tracking w/ DC, TEC , PC (+ EMCal)
  - eID w/
    - RICH (ring finding)
    - EMCal (E/p, ToF, shower shape)
    - TEC (dE/dx)
- PHENIX RICH
  - the primary electron ID device
  - especially important in low p_t region
  - sensitive to track angle (not to position)
    - current algorithm relies on external tracking
    - electron tracking may start from RICH + EMCal

Ring Imaging Cherenkov Detector



schematics of PHENIX RICH

- hadron rejection at 10^4 level for single track
- full acceptance coverage for PHENIX central arms

  $|y| < 0.35$; $\delta\phi = 90$ degrees x 2
- threshold gas Cherenkov

  C_2H_6 ; $\gamma_{th} \sim 25$

  eID p_t range : 0.2 ~ 4 GeV/c
- PMT array readout

  5,120 channels in 2 arms

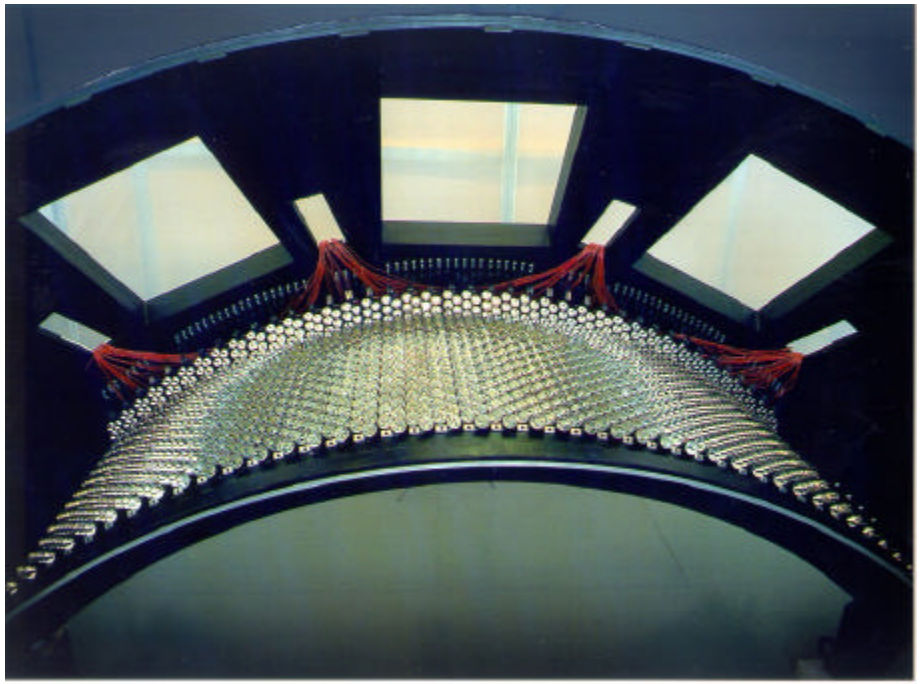
  pixel size ~ 1 degree x 1 degree
- prototype performance

  $n_0 > 100$ / cm ; $\langle n_{p.e.} \rangle \sim 20$

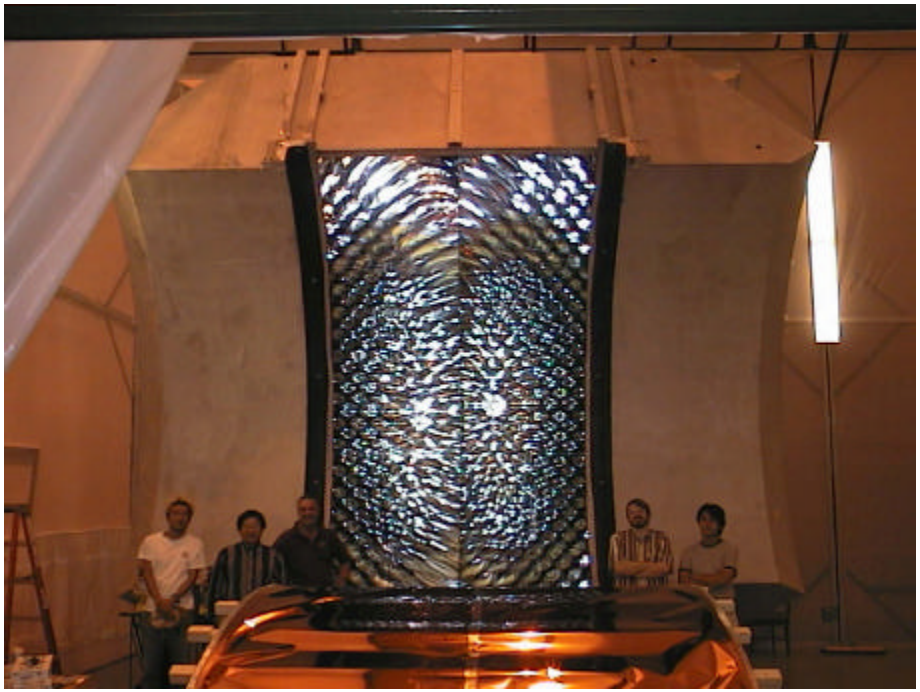
- PHENIX RICH group
  - CNS, U.Tokyo (H.Hamagaki, S.Nishimura, K.Oyama)
  - Florida State U. (R.Chappell, D.Crook, A.D.Frawley, M.Kennedy)
  - KEK (Y.Akiba, K.Shigaki)
  - Nagasaki IAS (K.Ebisu, H.Hara, Y.Nagasaka, Y.Tanaka)
  - ORNL (M.S.Emery, G.G.moscone, J.W.Walker, A.L.Wintenberg, G.R.Young)
  - SUNY at Stony Brook (R.Begay, J.Burward-Hoy, J.Ferriera, T.K.Hemmick, R.Hutter, S.Salomone)
  - U.Tokyo (R.S.Hayano)
  - Waseda U. (M.Hibino, J.Kikuchi, T.Matsumoto, T.Sakaguchi)

- first arm of the RICH is completed and installed in PHENIX

PMT arrays reflected on the mirrors; before installation of the front window

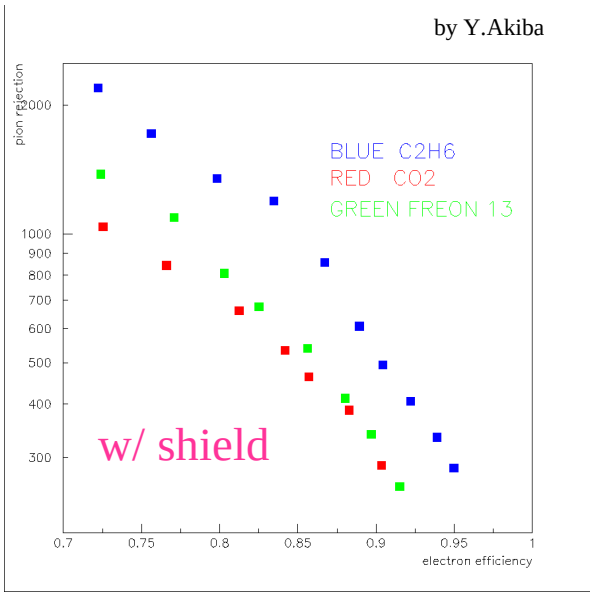


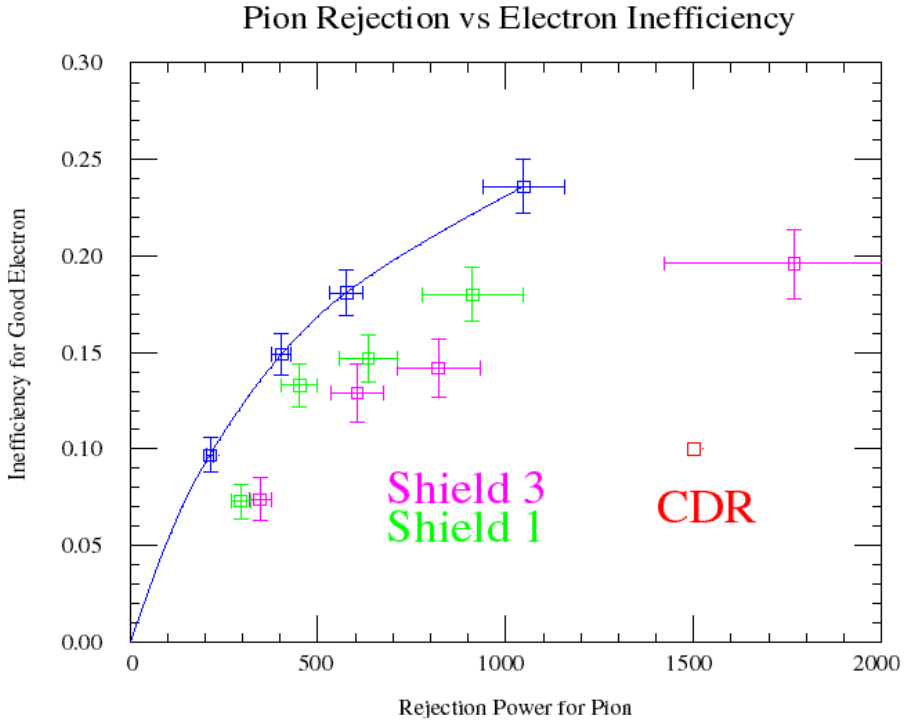
PMT array in the RICH gas vessel



Hadron Rejection Power w/ RICH

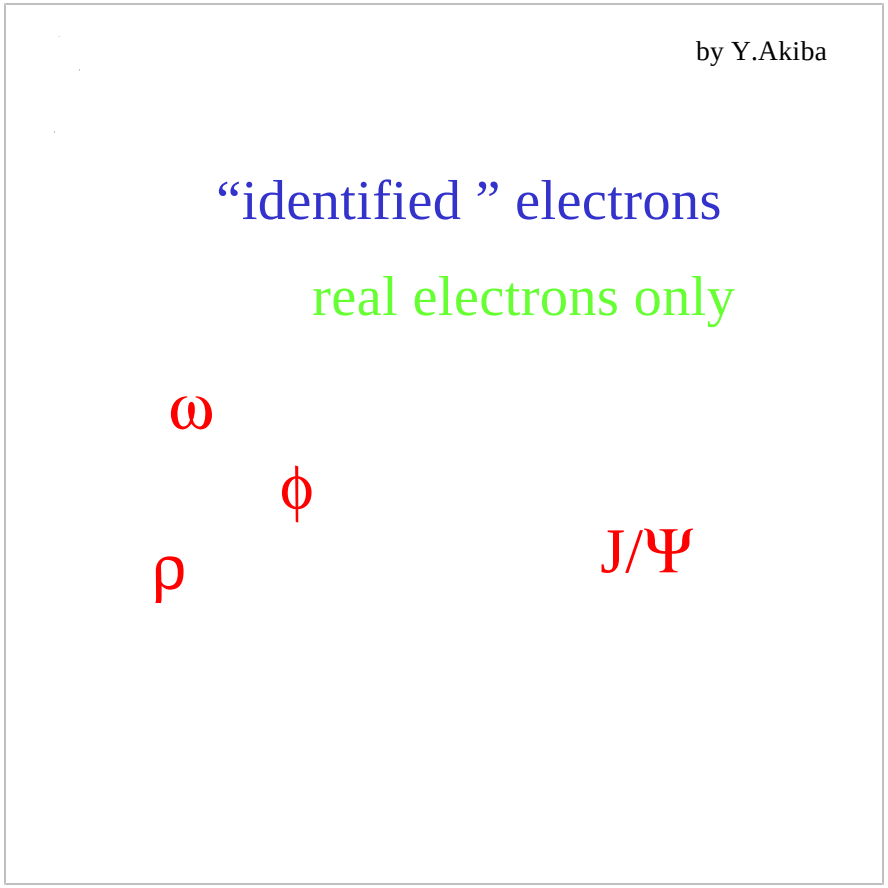
- simulated w/
  - various eID cuts
  - different radiator gases
  - possible shielding
- rejection power $\varepsilon_e/\varepsilon_h$
  - function of occupancy
  - 200 ~ 1500 in central Au+Au events





Hadron Mis-ID & Di-Electron Spectra

- effect of hadron mis-identification on di-electron spectra
  - hadron / real electron ~ 20 % after eID w/
    - RICH
    - rough EMCal E/p cut
  - increase of combinatorial background ~ 50 %



simulated di-electron spectrum

Summary

- PHENIX aims at electron measurement for
  - di-electron spectra (vector mesons, thermal photon, …)
  - single electron spectra (heavy quark, …)
- required hadron rejection power in PHENIX
  - $10^2 \sim 10^4$ depending on physics goals and p_t
- RICH : the primary eID device
  - first arm completed and installed in PHENIX
  - hadron rejection of 200 ~ 1500 achieved in simulations
- effect of hadron mis-ID on di-electron spectra
  - expected to be < 30 % of combinatorial background
    (w/ RICH and EMCal only)