Simulation Study for low mass electron-pair measurements

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- Simulation Data and parameters
- Cocktail plot
- Dalitz rejection
- Signal Survival Rate

Simulation Data

- Particles were generated using Exodus (made by R. Averbeck)
  - → Proton, K^+, K^-, π^+, π^-, π^0, η, η', ω, ρ, ϕ, J/ψ, Υ
    Pt<10GeV/c with power low distribution.
    |Rapidity| < 1.5
  - → Particle decays were also simulated.
    - → Dalitz decays of $\pi 0$, η, η'
    - → Vector mesons (ω, ρ, ϕ, J/ψ, Υ) decays
- Electrons and positrons from charm decays were generated by PYTHIA and merged to EXODUS output
- Photon conversions were simulated using PISA (done by C. Aidala, for details, see tomorrow's talk)
  - 4 layers of Silicon, TPC and HBD included

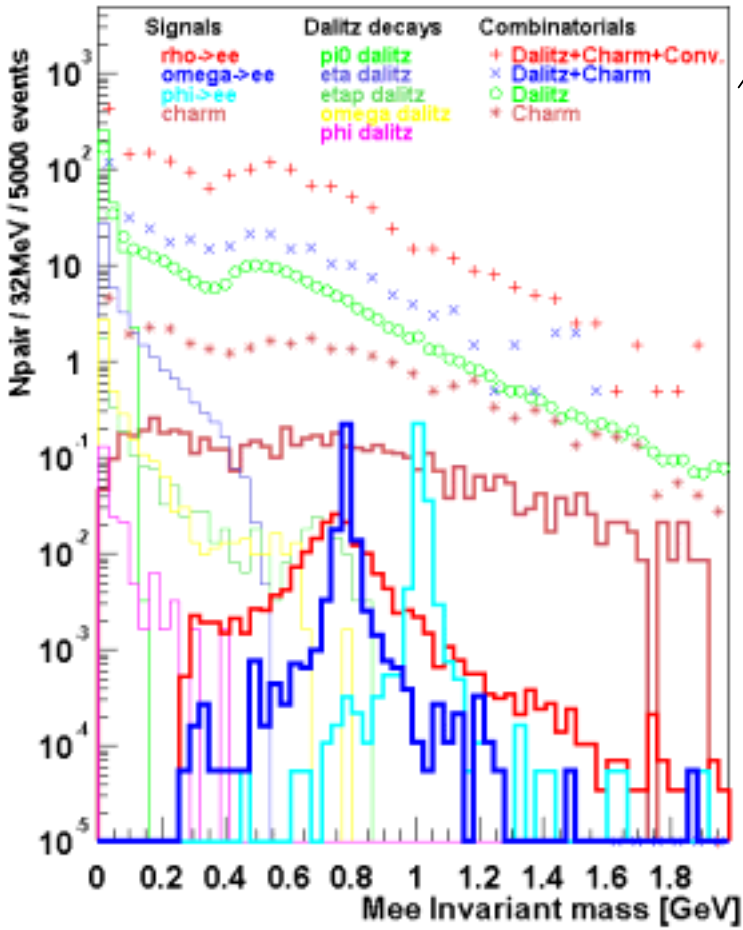
Simulation Parameters

- Central events (dN_charge/dy(y=0) = 650)
- 3.0 million events
- Ratio to dN/dy
  - π^+ or π^- 0.401
  - K^+ or K^- 0.062
  - Proton 0.039
  - Pi 0 0.445
  - Eta 0.062
  - Eta prime 0.0080
  - Rho 0.056
  - Omega 0.054
  - Phi 0.0107
- Charm
  - Ncharm/event = Nbinary * σ (p-p charm) / σ(total p-p)
    - σ(total p-p) = 41 mb, σ (p-p charm) = 648 μb
      Nbinary = 1000, thus Ncharm/event = 15.8

Assumptions for the calculation

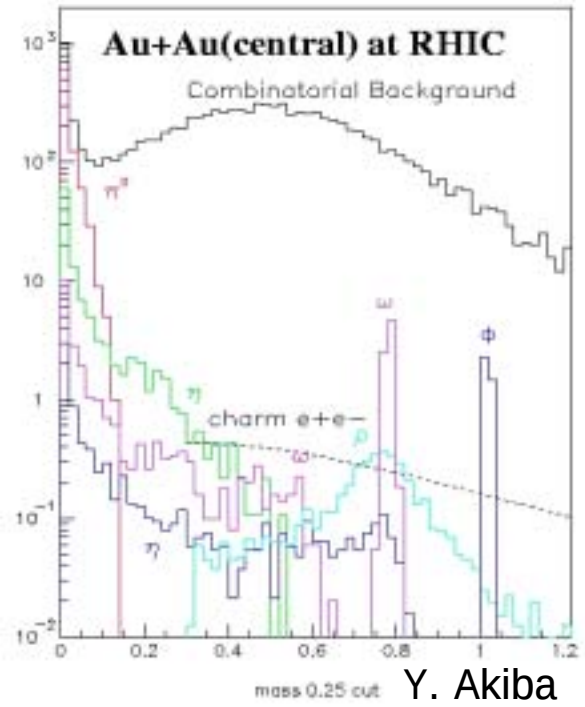
- Both electron and positron from vector meson decays going to the PHENIX acceptance (Pt > 200 MeV/c, $|\eta| <$ 0.33 and 2*($|\phi| <$ 90 degree)).
- The rejection factor for pion.
  - In the PHENIX acceptance:
    - 200 for all momentum (RICH and EMC)
    - 200 below 4 GeV/c (TPC/HBD)
  - Out of the PHENIX acceptance:
    - 200 below 4 GeV/c (TPC/HBD)
- Momentum of electron is required above 10MeV/c. Perfect (100%) efficiency for electron identification and tracking is assumed. Perfect resolution.

Cocktail Plot (Central event)



S/N at ϕ ~ 1/70

Include electrons from conversion at the first layer of Si only.



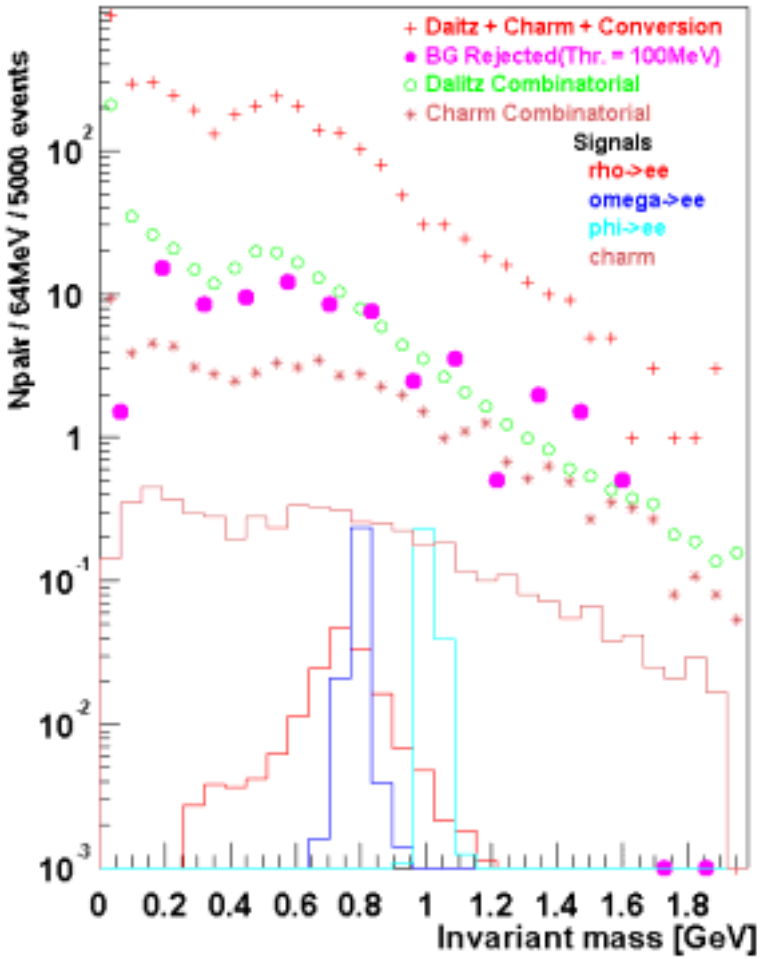
Y. Akiba

S/N at ϕ ~ 1/20

Dalitz Rejection

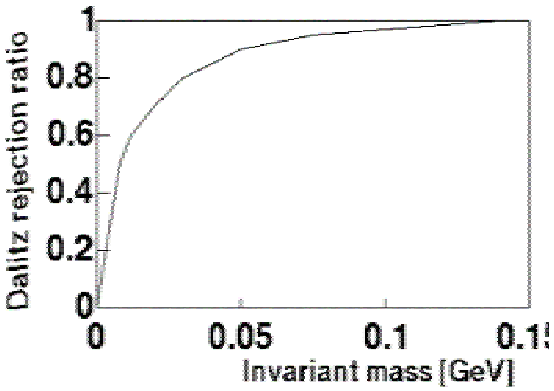
- Dalitz rejection scheme
  - → Invariant mass is calculated with all combination of opposite sign pair.
  - → Find the smallest mass pair, and if those invariant mass is less than the cut value, these tracks are rejected.
  - → Continue until the smallest mass will be above the cut value.

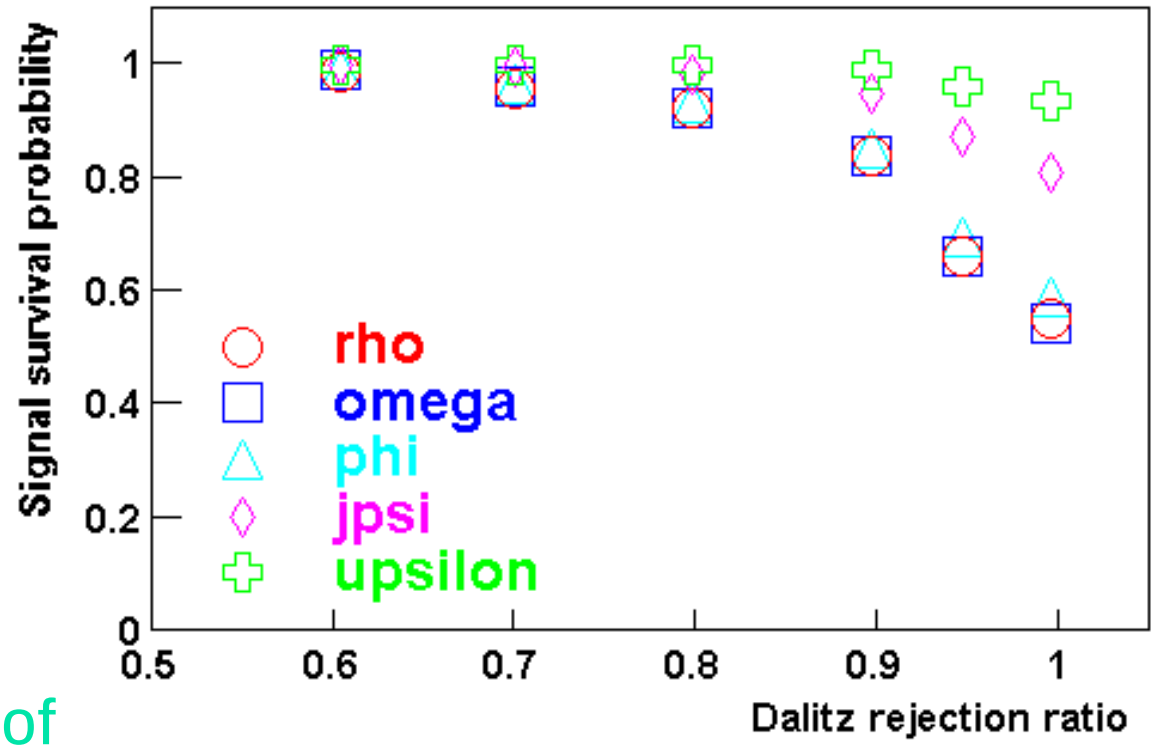
Cocktail plot after rejection



- S/N (take full width)
  - ➔Rho – 1/320
  - ➔Omega – 1/40
  - ➔Phi - 1/9
- S/N is improved by the factor of 5 – 10.

Signal Survival Probability





- Survival probability of ρ,ω,ϕ is ~70% for Dalitz rejection ratio of 95% (Thr. = 100 MeV).

Summary

- A simulation includes the electron-pairs from charm decays and conversion was done.
- A TPC and HBD which can reduce the Dalitz and conversion backgrounds.
- The large charm cross section in heavy ion collisions is another significant source of background which cannot be eliminated by Dalitz rejection.