Measurement of Identified Charged Pions at High p_t in PHENIX Year 1

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at

PHENIX Hard Scattering PWG Meeting

on

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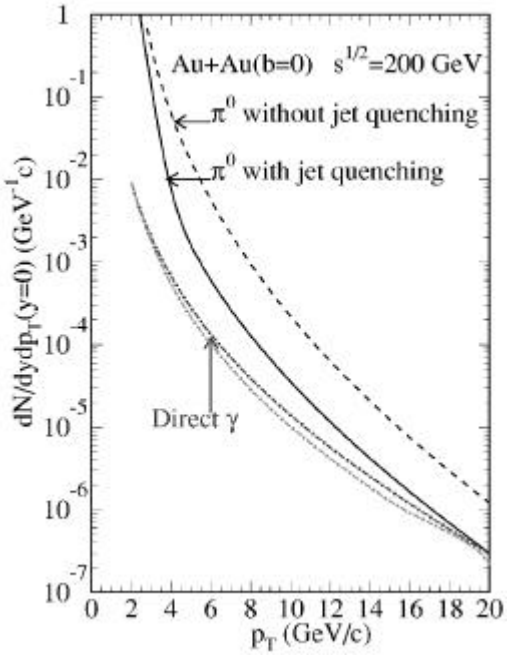
Presentation Outline

- Physics Goals and Approaches
- How Well Can We Measure Identified Charged Pions (and Kaons) at High p_t in Year 1 ?
  - Statistics in Year 1
  - Momentum Resolution
  - PID Capability
- Summary, Concerns, Homework

Physics Goals and Approaches

- high p_t tail of identified π^+ and π^-
  - quark energy loss (jet quenching)
  - tracking + RICH
- π^+/π^- ratio at high p_t
  - quark fragmentation dominance
  - tracking + RICH
- K/π ratio at high p_t
  - quark fragmentation dominance / HI effects at low p_t
  - tracking + RICH + TOF

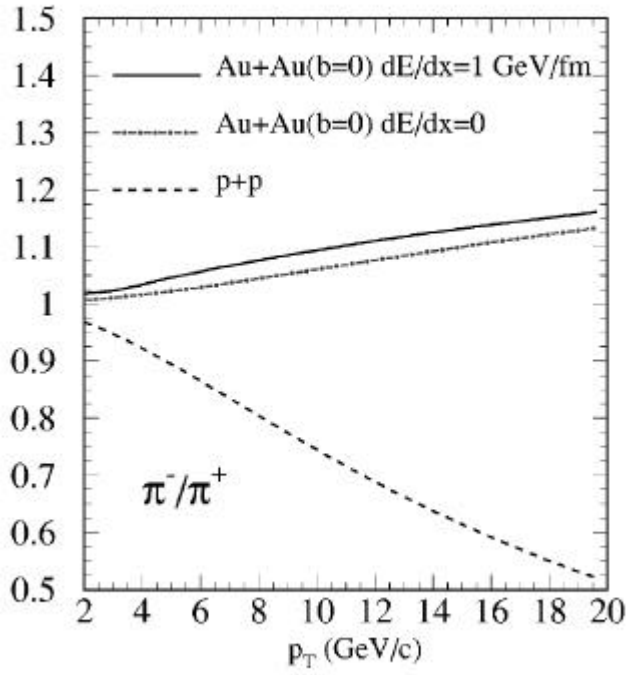
Quark Energy Loss & Jet Quenching



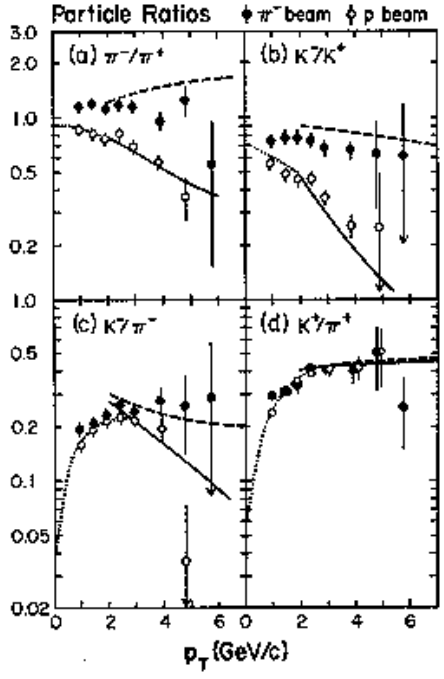
X.-N.Wang, PRC58 (1998) 2321
Au+Au at √s = 200 GeV

- good year 1 physics
  - cross checking with inclusive γ and π^0 measurement
  - feasible with PHENIX Year 1 configuration
- benefit of πID
  - (identified π : inclusive h) ~ (π^0 : inclusive γ)

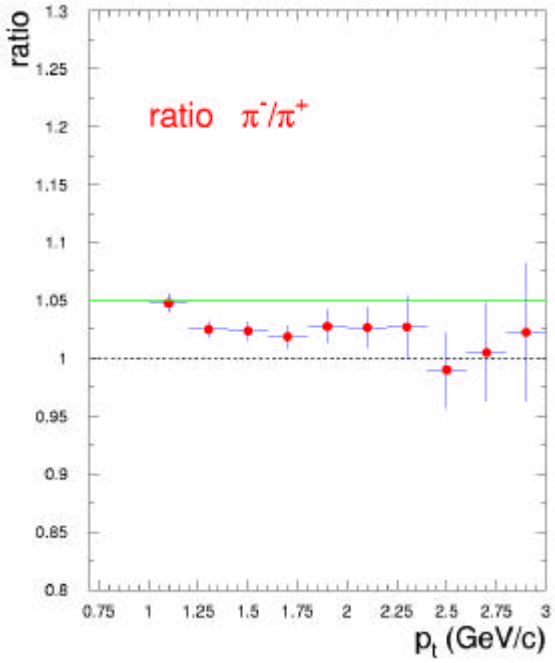
Quark Fragmentation Dominance



X.-N.Wang, PRC58 (1998) 2321
p+p, Au+Au at √s = 200 GeV



R.D.Field, Application of pQCD
p+p, π^-+p at E_{lab} = 200 GeV

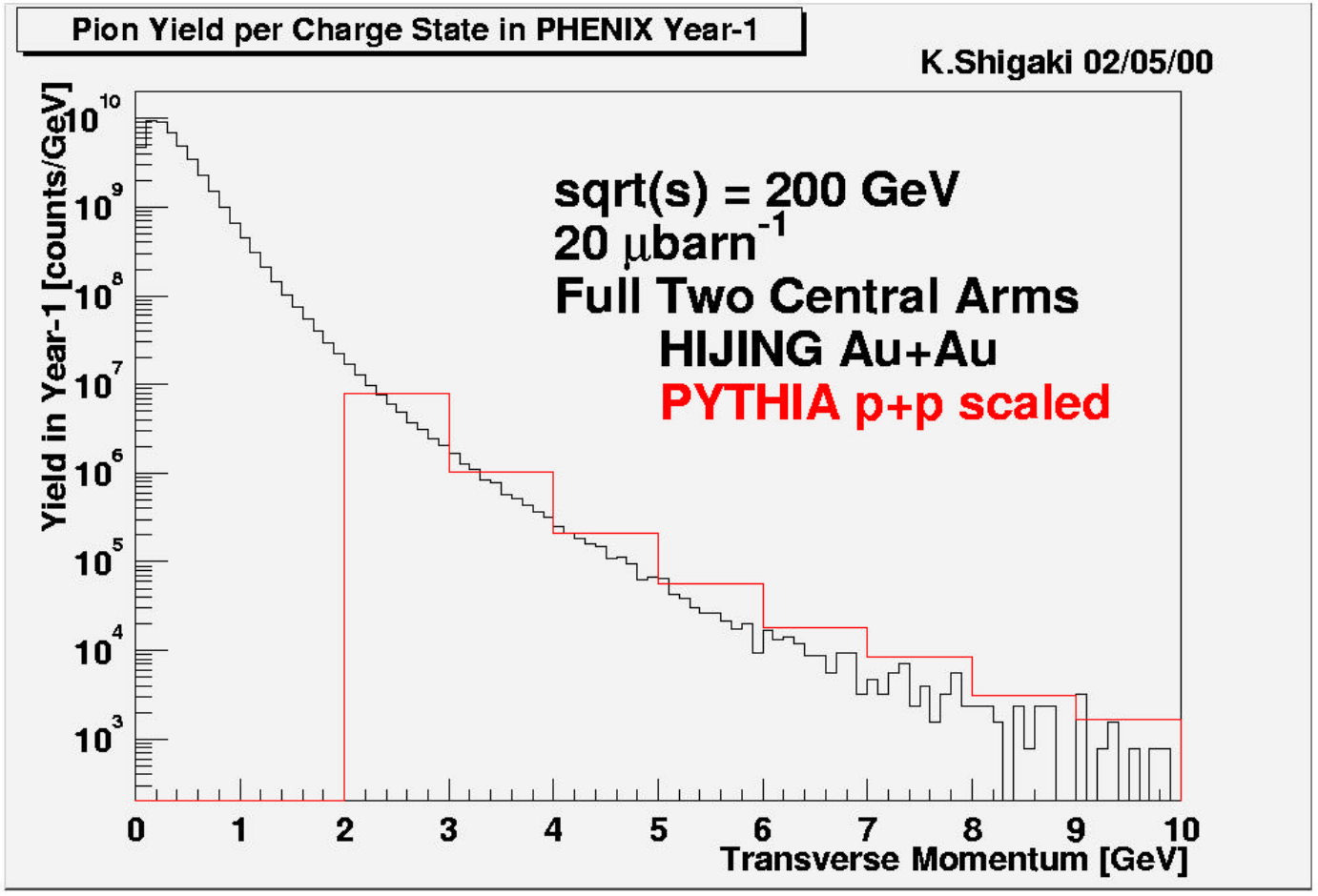


F.Ceretto, thesis
CERES Pb+Pb

Expected Pion Statistics in Year-1

- assumptions
  - $\sqrt{s}$ = 200 GeV (no longer correct)
  - integrated luminosity = 20 $\mu barn^{-1}$
  - 2 full central arms (DC/RICH)
- employed generators
  - HIJING minimum bias Au+Au
  - PYTHIA p+p scaled to Au+Au
- statistical limit ~ 10 GeV
  - ~ 10^3 counts/GeV/charge state at p_t = 10 GeV
  - jet quenching should be clearly observable

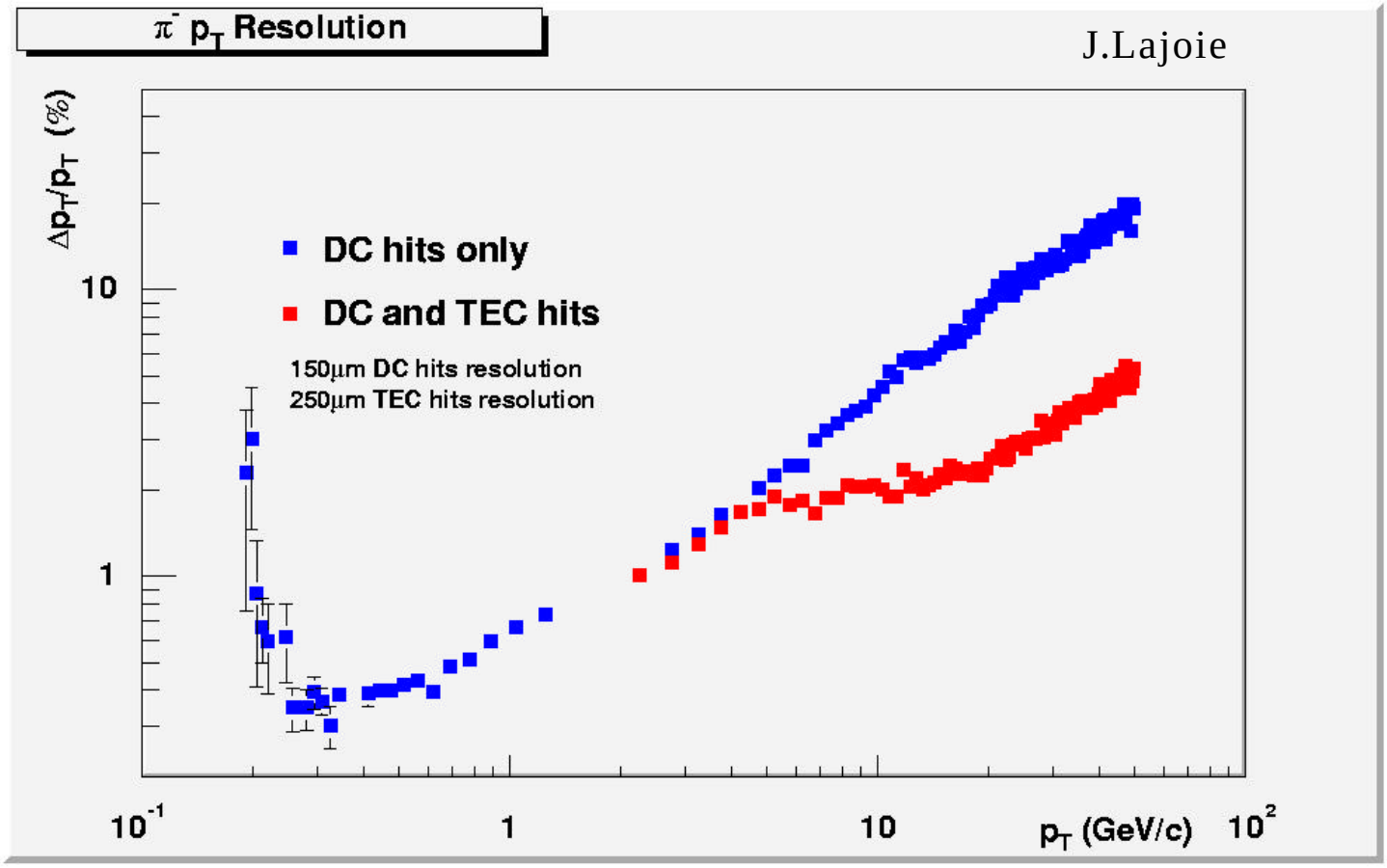
Expected Pion Statistics in Year-1



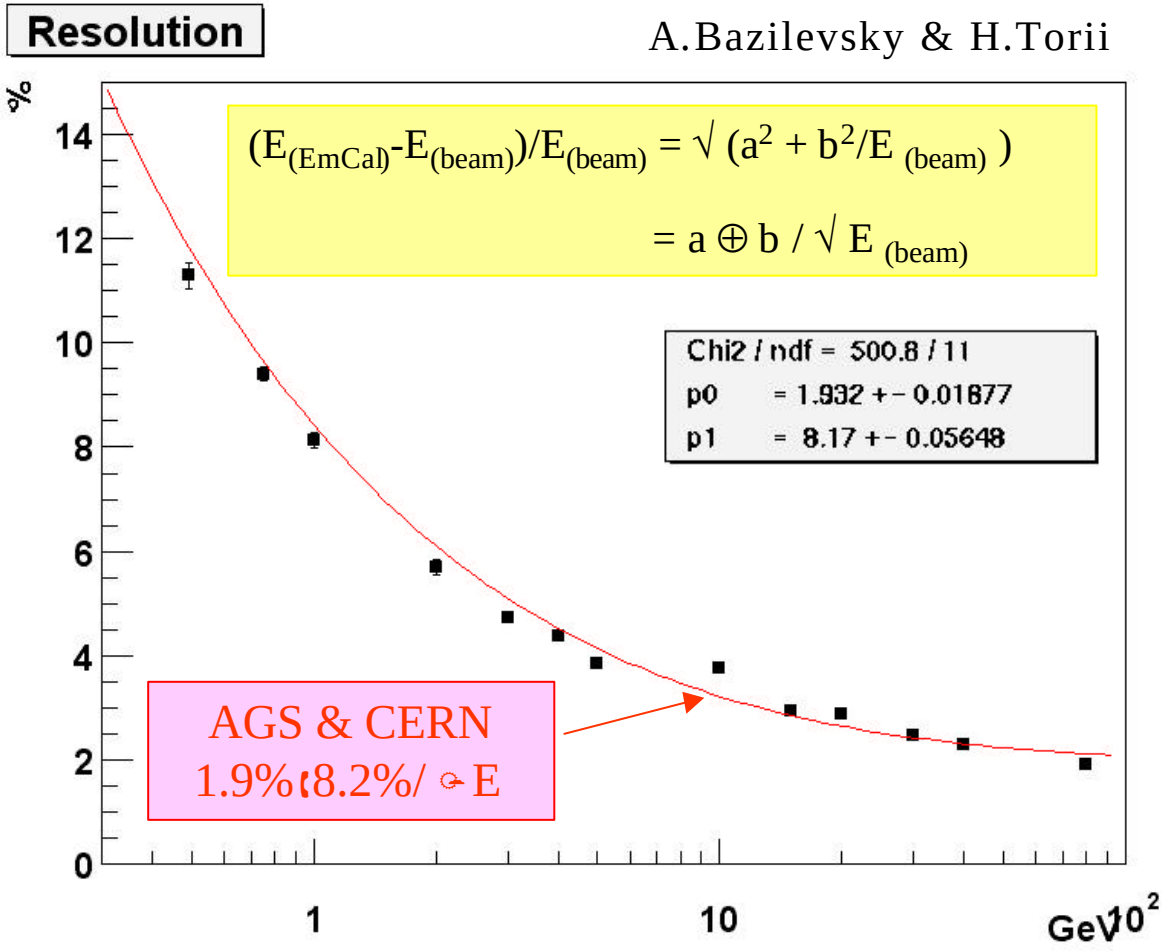
Momentum Resolution

- momentum resolution estimated in MDC-2
  - perfect tracking with detector resolution by J.Lajoie
  - 2 % at p_t = 5 GeV, 4.5 % at 10 GeV with DC only
  - ~ 2 % at p_t < 10 GeV with DC + TEC
  - good enough for the physics goals
- *cf.* EMCal resolution for π^0
  - beam test analysis by A.Bazilevsky, H.Torii
  - 1.9 % $\oplus$ 8.2 % / $\sqrt{E}$
  - 4 % for π^0 at 5 GeV, 3 % at 10 GeV

Momentum Resolution



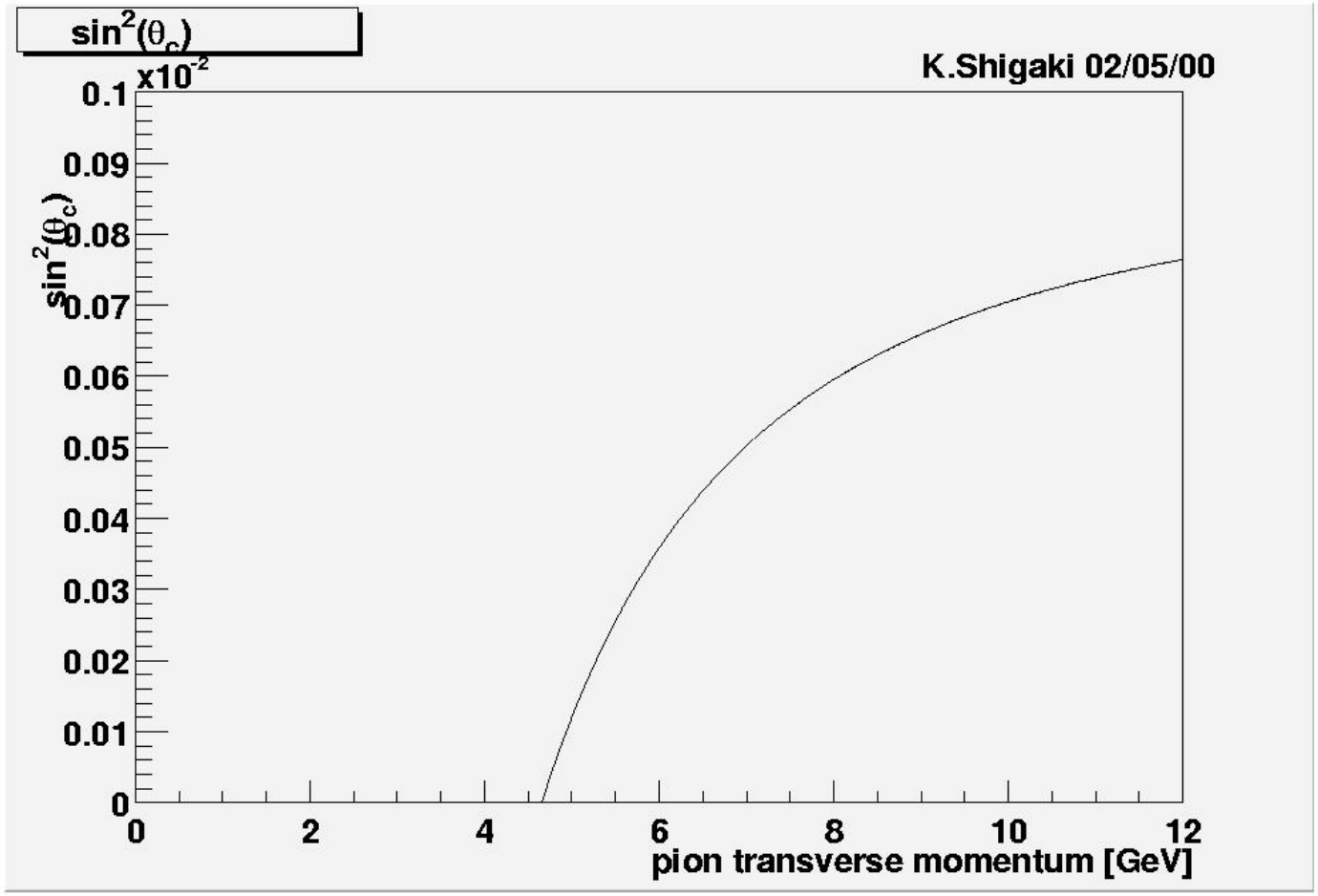
EMCal Resolution



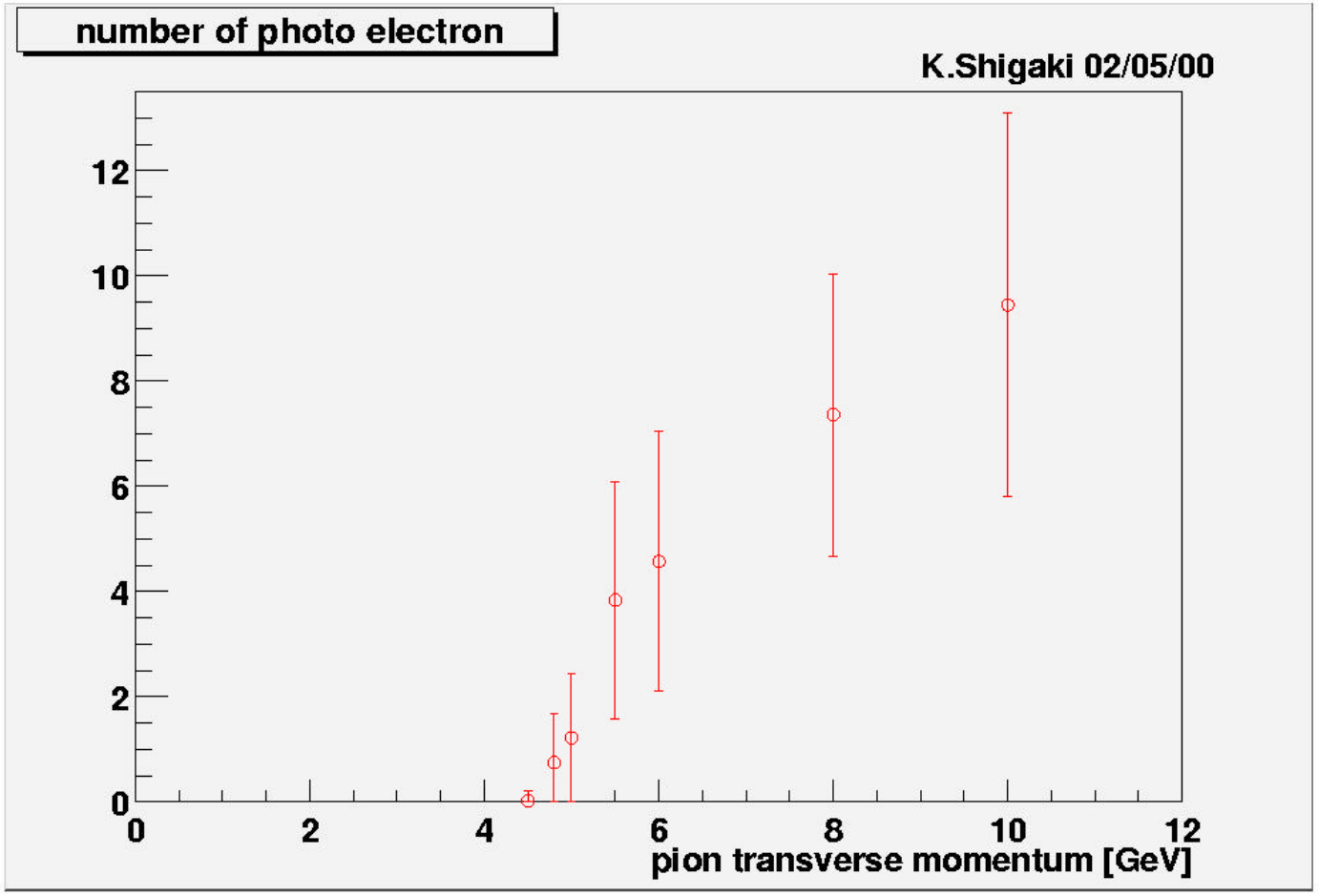
Particle Identification Capability

- RICH with CO_2 in Year 1
  - $\gamma_{th} = 33$
  - π threshold = 4.7 GeV
  - effective πID above ~ 5.5 GeV
  - πID requirements much less stringent compared to eID
- TOF
  - p/K track-by-track (4σ) separation up to 4.0 GeV
  - p/K separates at 2σ at 6 GeV;
    yields should be accessible via multi-parameter fitting
  - momentum window for p/K/π yields

RICH Response to Pions near Threshold



RICH Response to Pions near Threshold



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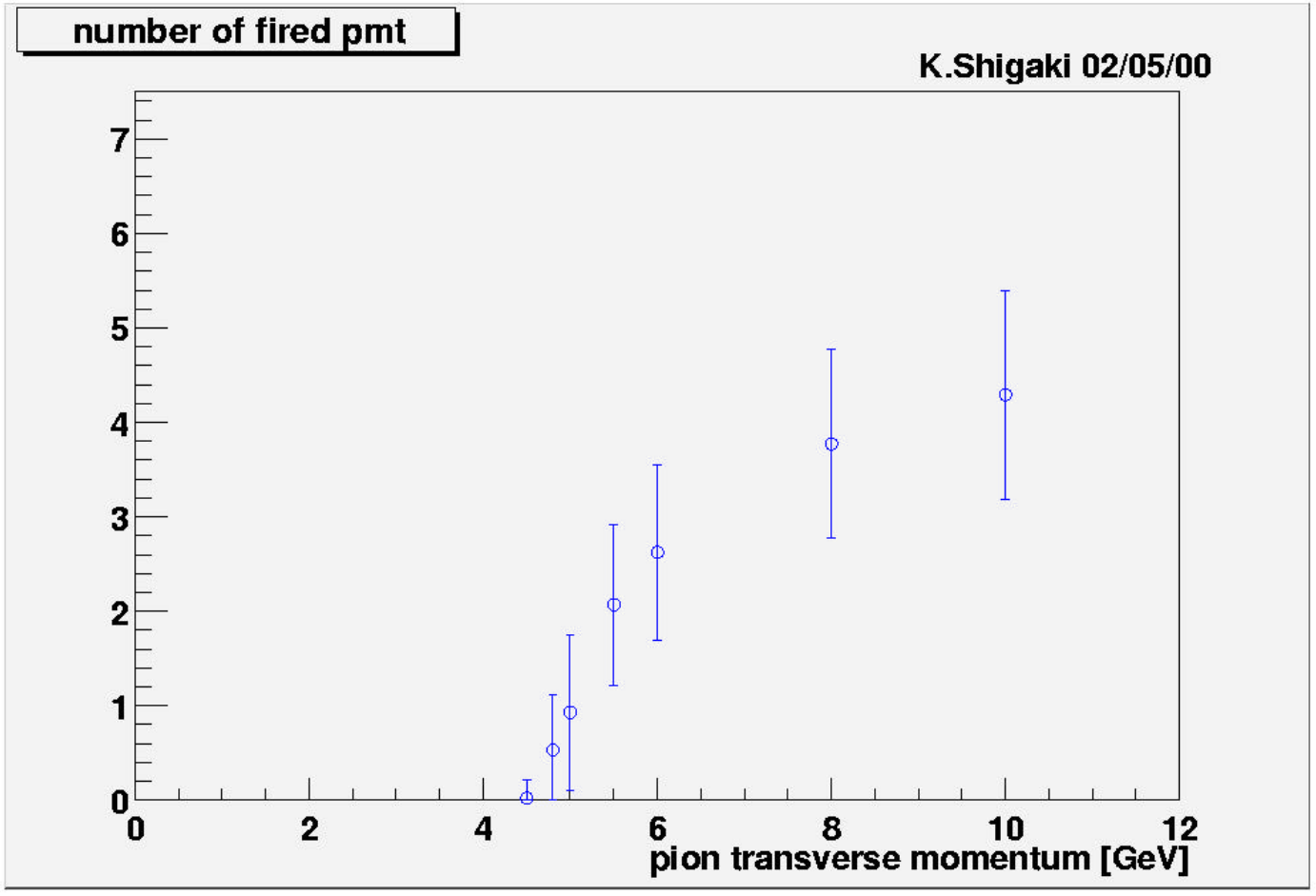
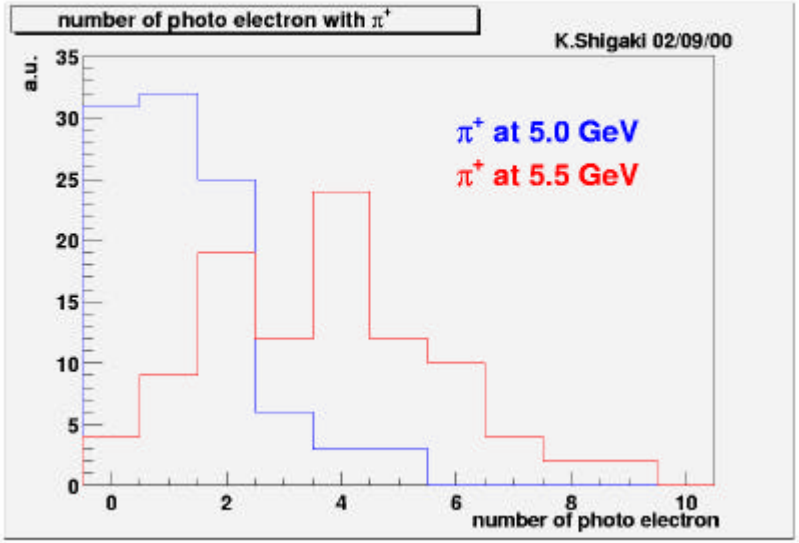
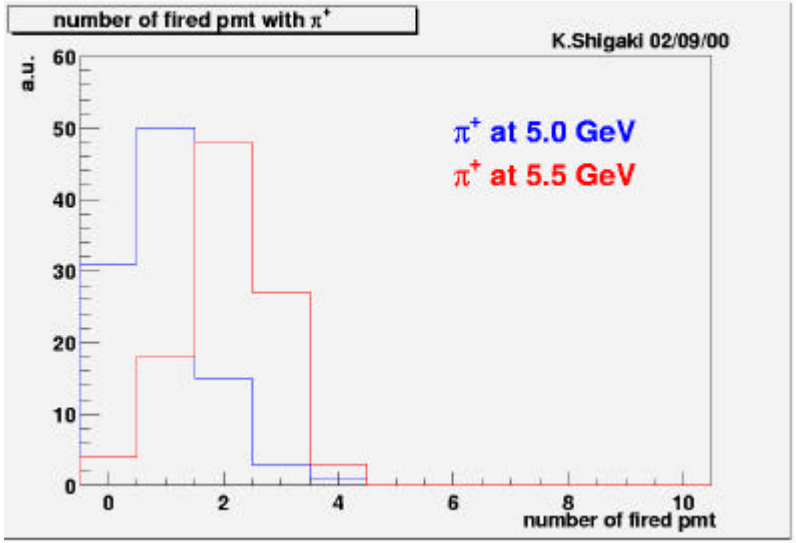


RICH Response to Pions near Threshold





- effective πID range
  - above ~ 5.5 GeV with CO_2
  - *cf.* above ~ 4.0 GeV with C_2H_6

Summary, Concerns, Homework

- high p_t charged pions can be measured in Year 1 with tracking (DC) and RICH
  - measurable p_t range : from ~ 5.5 GeV to ~ 10 GeV
  - jet quenching should be clearly observable
- p/K/π ratio also can be measured in a small p_t window with tracking/RICH/TOF
- need to reevaluate statistics with up-to-date Year 1 conditions
  - $\sqrt{s}$ = 150 GeV ?
  - integrated luminosity ?
- need to tune RICH PID for near-threshold πID