Understanding of the Absolute Luminosity at PHENIX

RSC Meeting

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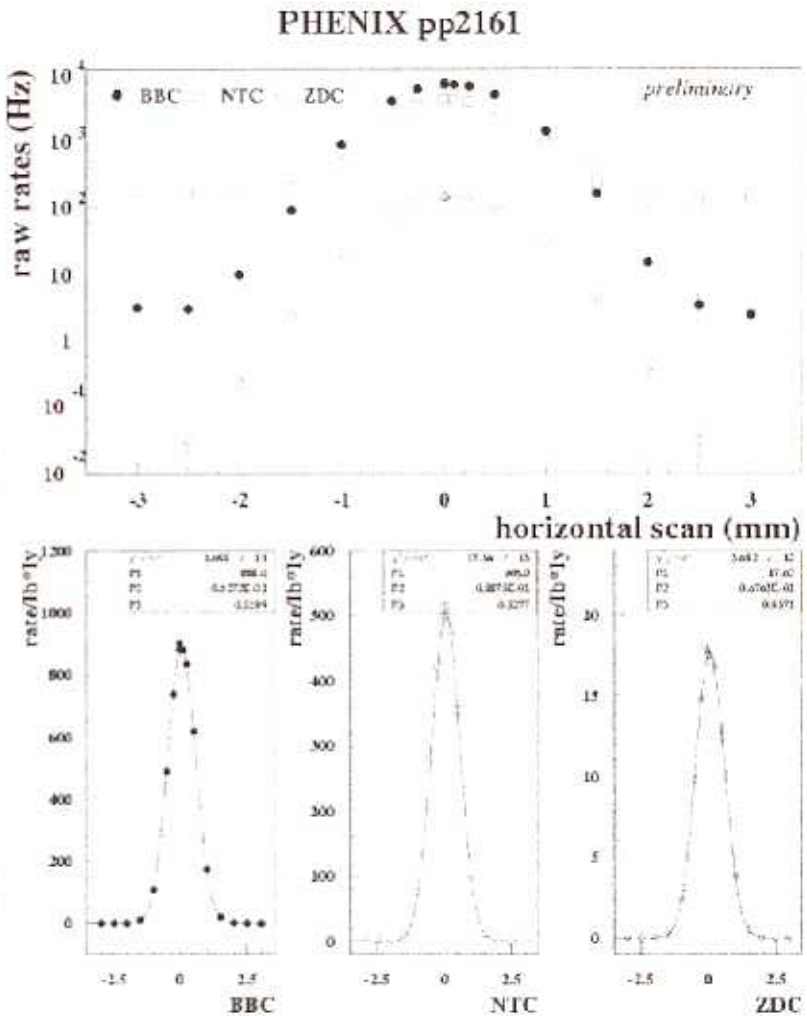
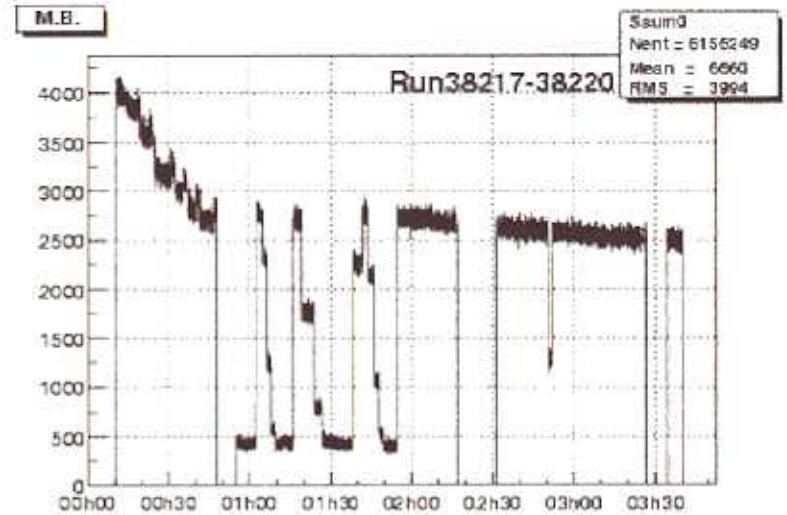
Vernier scan analysis

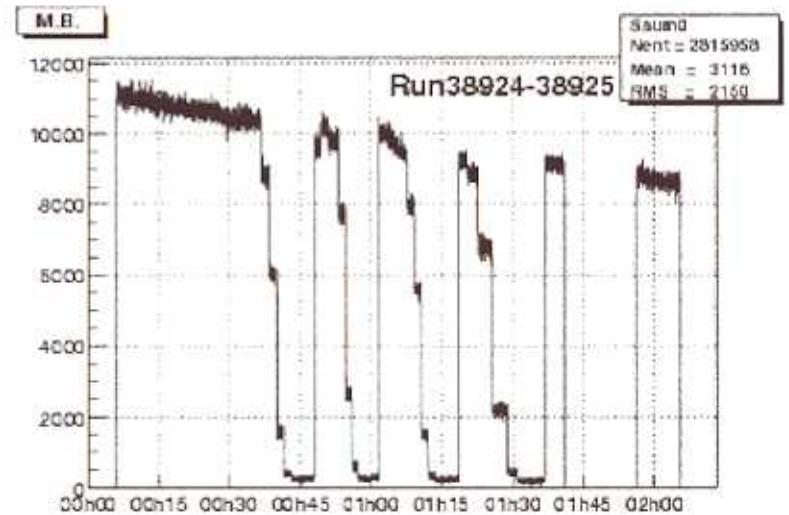
- 2 vernier scans at PHENIX
  - fill 2136
    - Jan 3 0:30-1:20
    - σ_{BBC}=12.3mb
      - σ_X=0.485mm σ_Y=0.485mm
    - ➔11.5mb with measured position
    - ➔12.5mb with current product at PHENIX
  - fill 2160
    - Jan 6 22:50-23:55
    - σ_{BBC}=12.1mb
      - σ_X=0.520mm σ_Y=0.529mm
    - ➔11.3mb with measured position
    - ➔12.6mb with current product at PHENIX
    - σ_{NTCn}=7.0mb
    - σ_{ZDC}=0.25mb



Vernier scan analysis

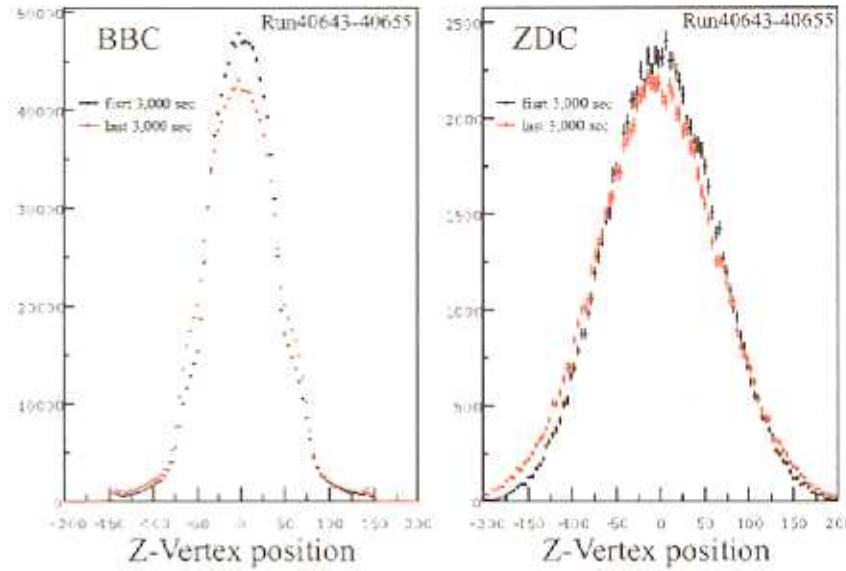
- 2 vernier scans at PHENIX
  - fill 2136
    - Jan 3 0:30-1:20
    - PHENIX run 38218
  - fill 2160
    - Jan 6 22:50-23:55
    - PHENIX run 38924
- Corrections
  - to evaluate inelastic cross section
  - BBC efficiency
    - PYTHIA/GEANT simulation
  - BBCLL1 vertex cut
    - |z| < 75cm cut
    - vertex distribution dependent
    - evaluated with measured vertex distribution

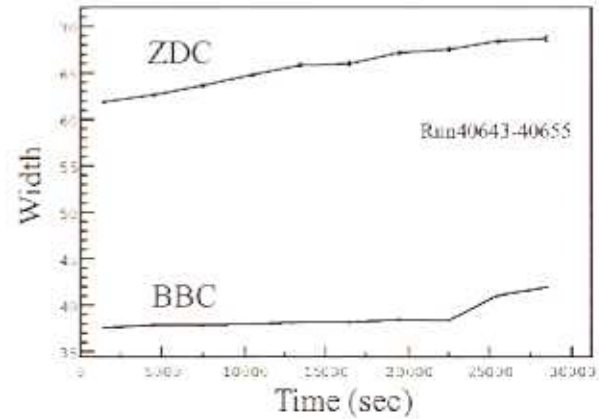




Vernier scan analysis

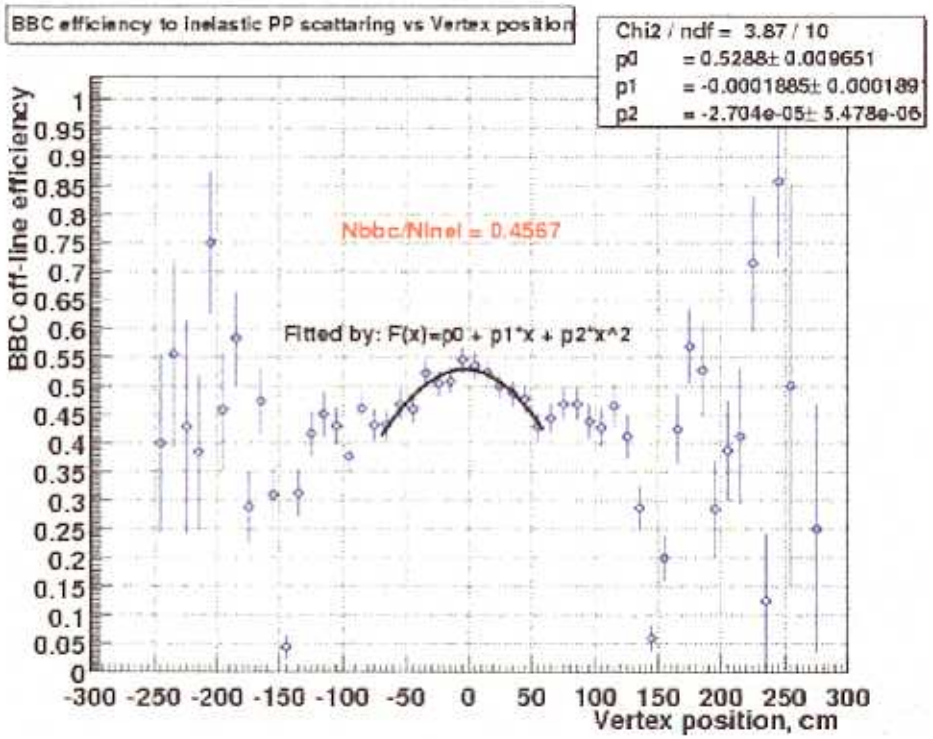
- Corrections
  - vertex distribution
    - changing in a fill
    - ZDC vertex in vernier scan period: $\sigma = 50–70$cm





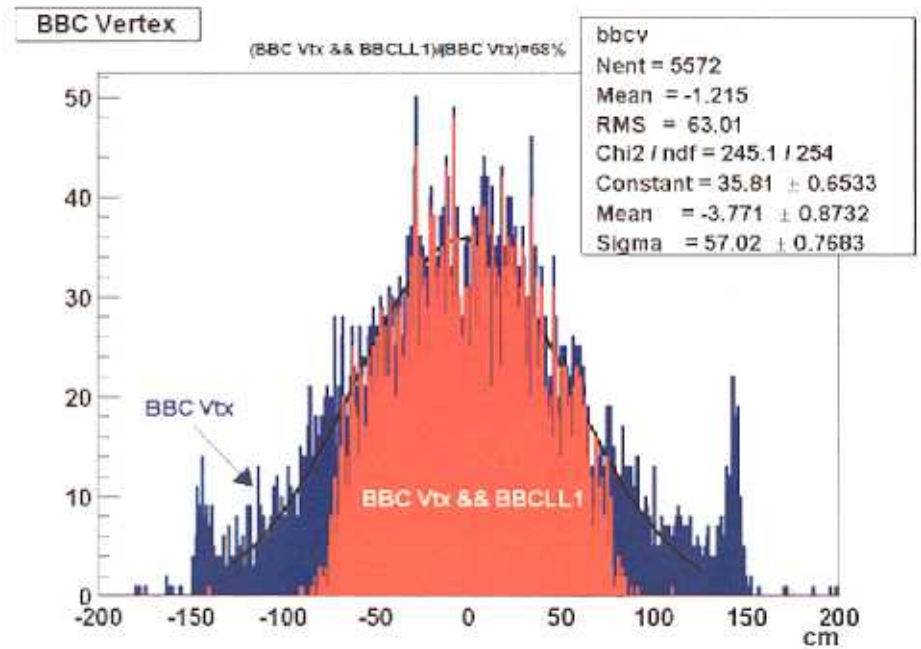
Vernier scan analysis

- Corrections
  - BBC efficiency
    - PYTHIA/GEANT simulation
    - 46% for $|z| < 75$cm with $\sigma_{BBC} =$ 60–80cm
    - stable at $z = 0$
      - 51% for $|z| < 40$cm
    - error evaluation ??
      - need to understand PYTHIA event structure in forward direction



Vernier scan analysis

- Corrections
  - BBCLL1 vertex cut
    - uncertainty in beam-gas background subtraction with BBCLL1 no vertex cut trigger
      - 68–72%
    - uncertainty in BBCLL1 ↔ BBC offline with clock trigger
      - 63%
    - 68 ± 5%

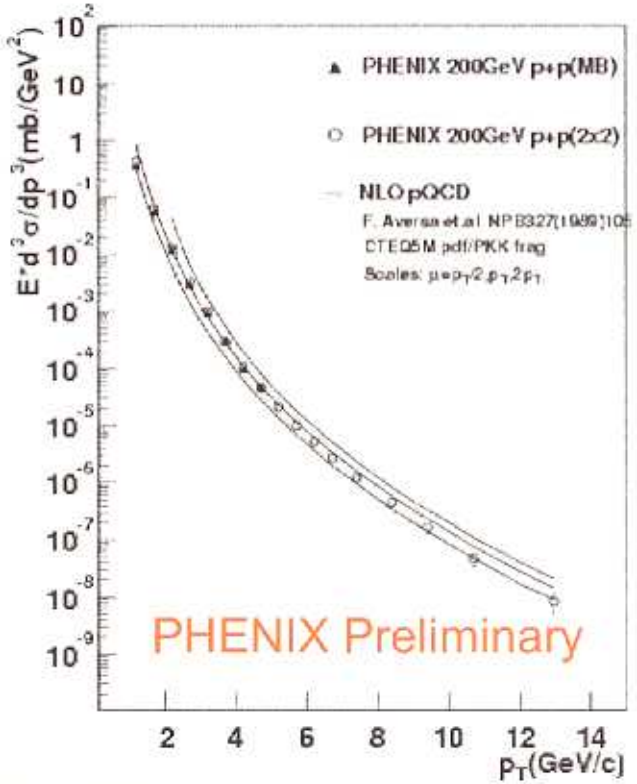


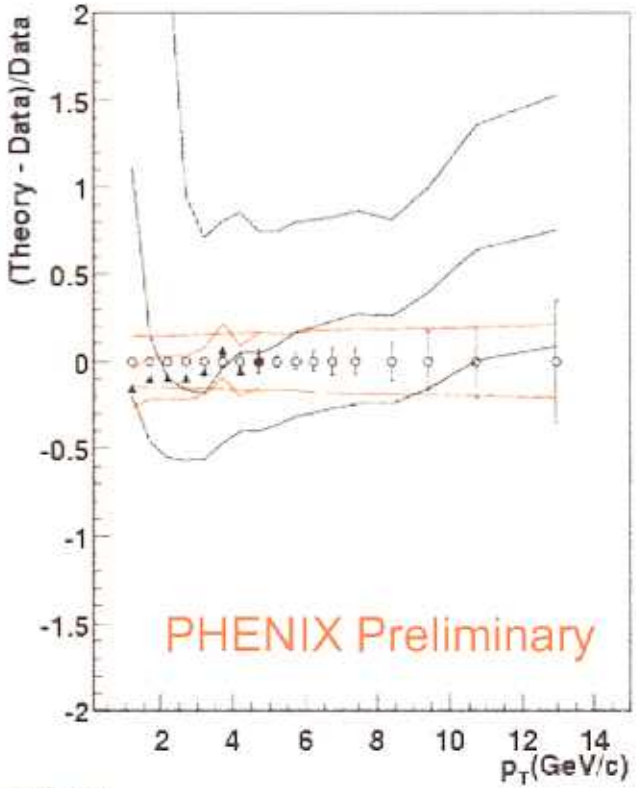
Vernier scan analysis

- Inelastic cross section evaluation
  - $\sigma_{inel} = 12.5 / 0.46 / 0.68 = 40$ mb
  - in PYTHIA / PDG: 42mb
  - 5% difference
- Error evaluation
  - vernier scans
    - offset correction ~3%
    - hourglass effect ~3%
  - corrections at PHENIX
    - BBC efficiency ??
    - BBC vertex cut ~7%
  - 10% level error

π^0 analysis

- Cross section measurement
  - based on $|z| < 30$cm cut
    - $\sigma_\pi(p_T) = N_\pi(p_T)[|z| < 30\text{cm}] / L[|z| < 30\text{cm}]$
    - $L[|z| < 30\text{cm}] = \sigma_{inel} \cdot \varepsilon$
    - $\varepsilon = 51\%$ for BBC at $z = 0$





Summary

- In our π^0 measurement, systematic uncertainties except in absolute luminosity is 15–20%
- We expect our absolute luminosity measurement has 10% level precision
- Anything else ?

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