Luminosity at PHENIX

RSC Meeting

May 22, 2002

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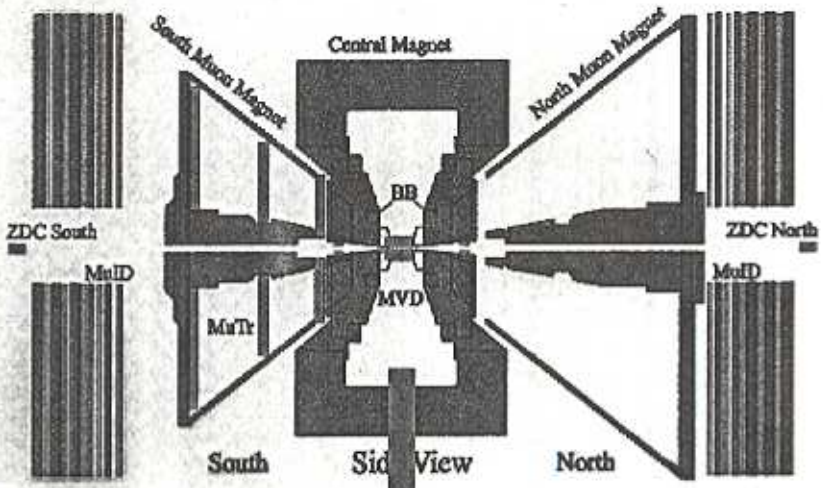
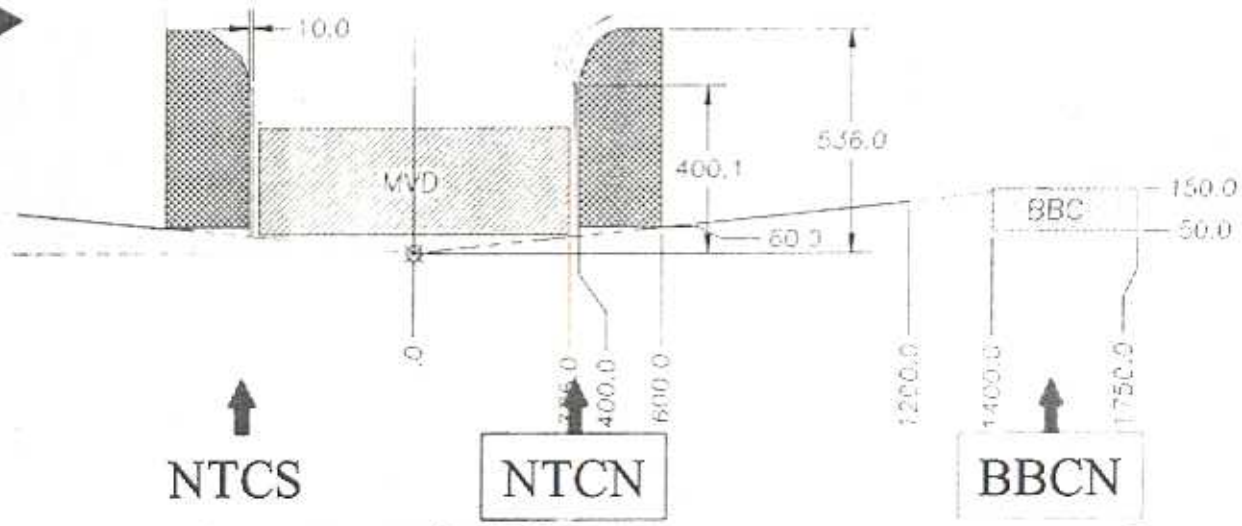
Instruments

- crossing-by-crossing scalers
  - for 120 crossings (60 crossings this year)
  - BBC / BBC⊕NTC_{wide} (min.bias trigger) / NTC_{narrow} / ZDC
  - live time only





min.bias trigger:

NTC_{wide}	~63%
BBC	~51%
BBC⊕NTC_{wide}	~74%

of inelastic reactions

Instruments

- scalers & spin-sorted scalers
  - BBC / BBC⊕NTC_{wide} (min.bias trigger) / NTC_{narrow}(spin-sorted) / ZDC(spin-sorted)
  - raw / live / pre-scaled
- beam current information
  - CDEV
  - for blue beam and yellow beam
  - raw data only (no live time cut)
- vertex information
  - vertex counters

Relative luminosity

- no critical item for A_N measurement in run-2

$$A_N = \frac{1}{P}\frac{\sqrt{N_{\uparrow L}N_{\downarrow R}} - \sqrt{N_{\downarrow L}N_{\uparrow R}}}{\sqrt{N_{\uparrow L}N_{\downarrow R}} + \sqrt{N_{\downarrow L}N_{\uparrow R}}}$$

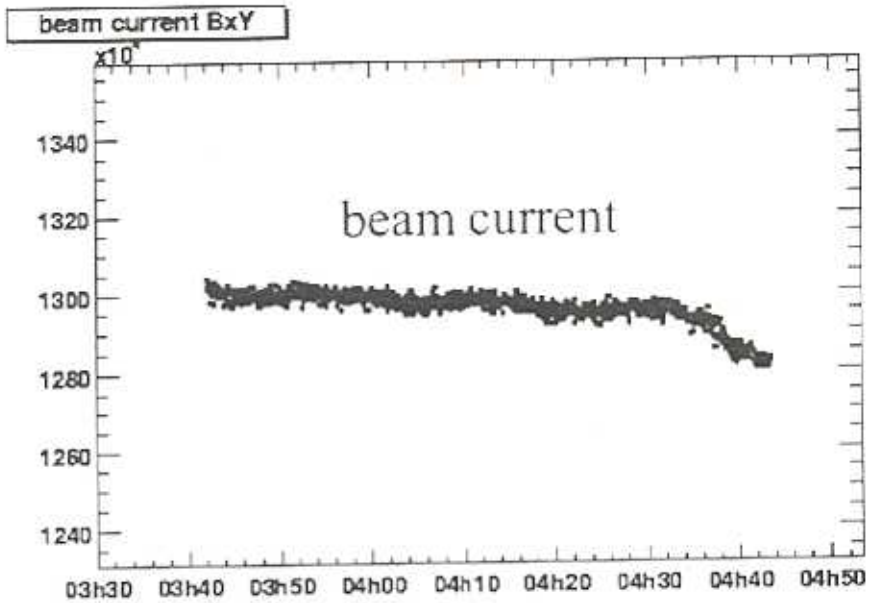
- important for A_{LL} measurement in run-3
  - 10^{-4} level precision required for sub-% level asymmetry measurement

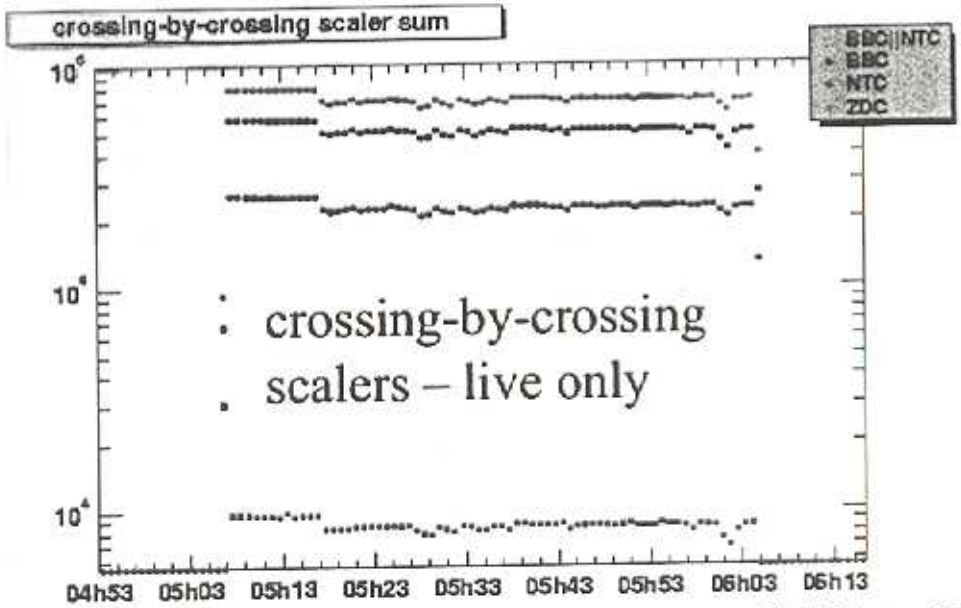
$$A_{LL} = \frac{1}{P_B P_Y}\frac{N_{++}/L_{++} - N_{+-}/L_{+-}}{N_{++}/L_{++} + N_{+-}/L_{+-}}$$

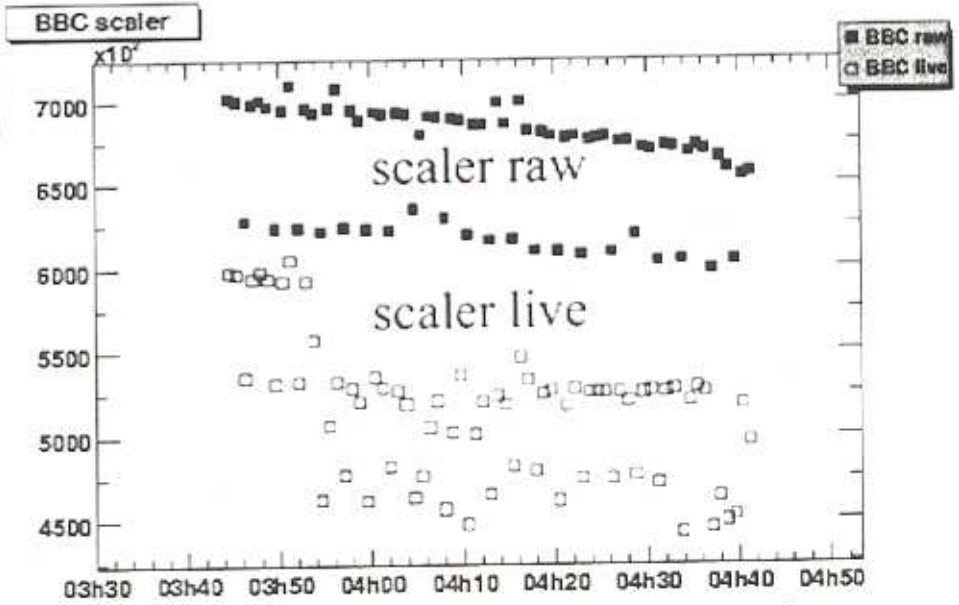
- normalization in the cross section measurement (as well as absolute luminosity)
  - stability of each luminosity monitor ?
  - which is the best ?

Relative luminosity

- beam current / scaler raw / scaler live
  - live/raw ratio ?
  - stability ?
  - ➔ crossing-by-crossing analysis
  - ➔ vertex cut ?

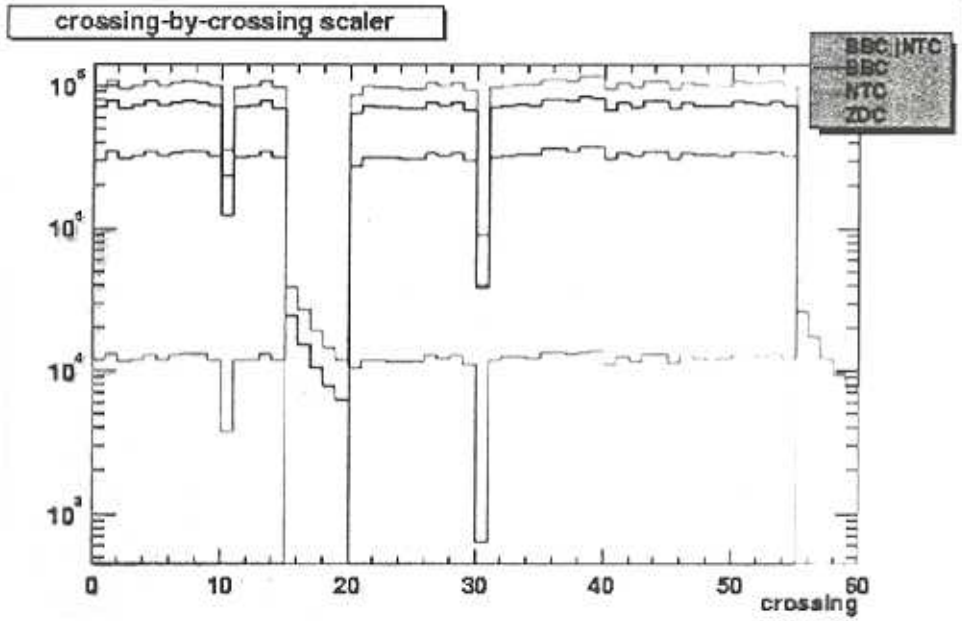


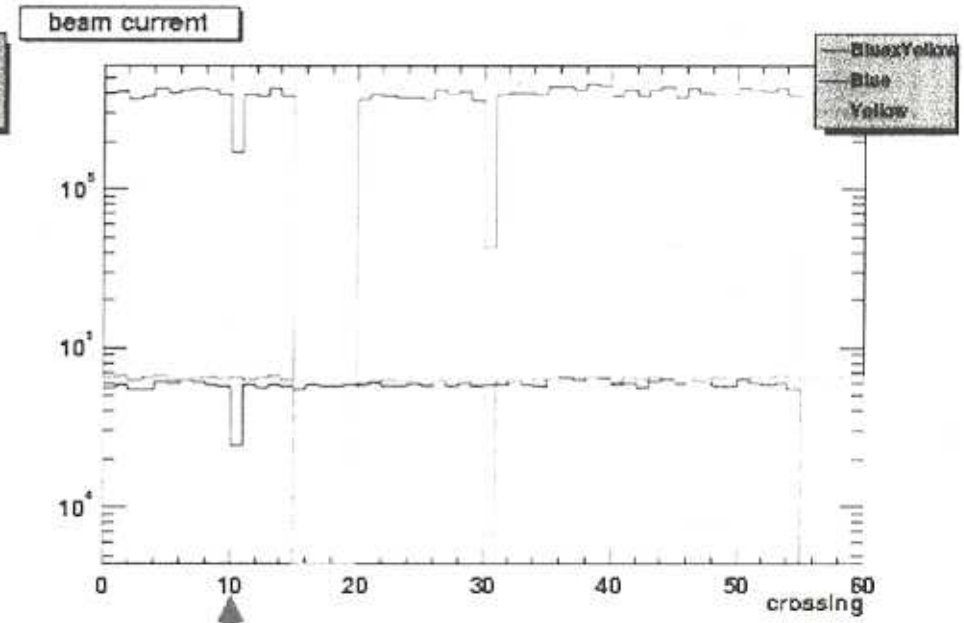




Relative luminosity

- crossing-by-crossing analysis
  - ratio between scalers, time dependence should be studied



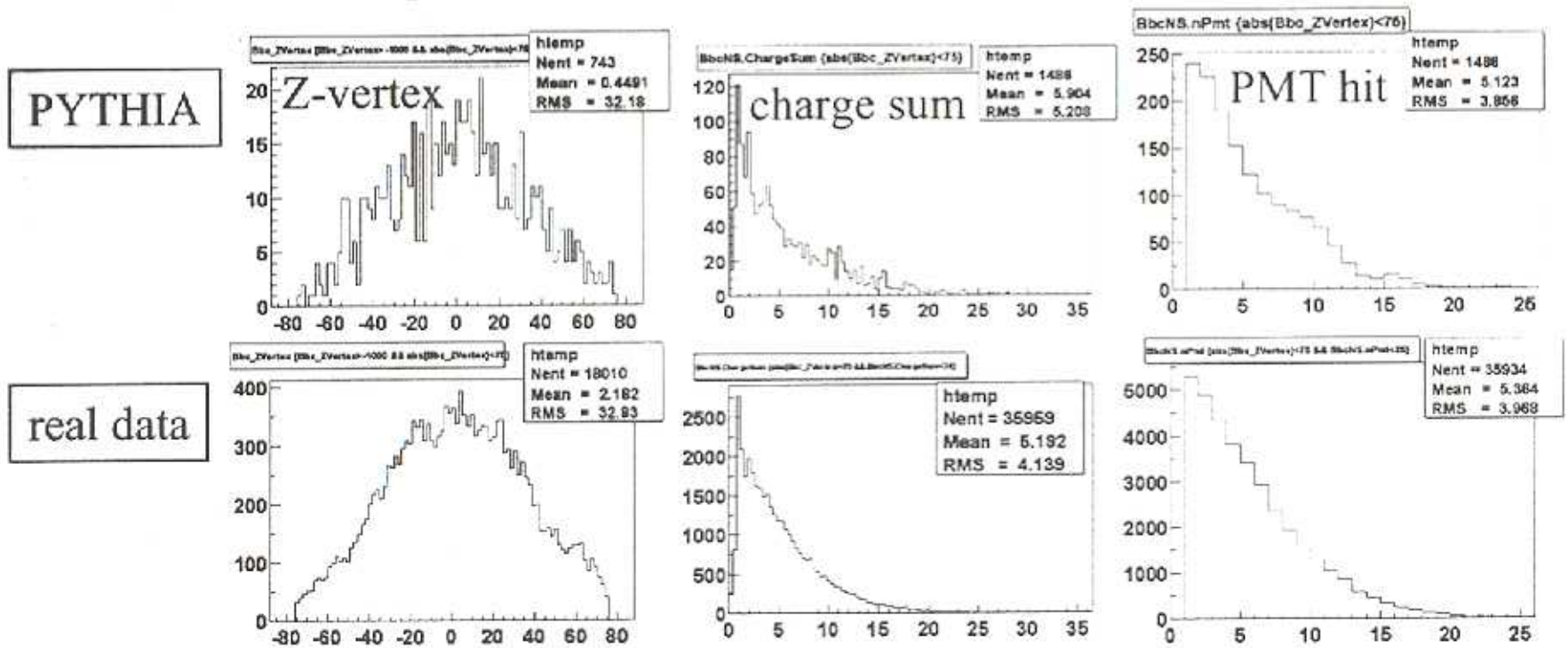


blue: bunch#10

yellow: bunch#10
large emittance
for chromaticity study

Absolute luminosity

- normalization in the cross section measurement
  - comparison of real data and simulation (PYTHIA etc.) to understand BBC/NTC efficiencies (and those of ZDC, …)
    - preliminary study by Hiroki Sato
      - NTC_{wide} ~63%, BBC ~51%, BBC⊕NTC_{wide} ~74% of inelastic reactions
    - detector responses need to be understood



Outlook

- absolute luminosity
  - efficiency study
    - real data study with clock trigger and non-min.biased EMCal trigger
    - simulation (PYTHIA etc.)
    - BBC charge/hit polar angle distribution
- relative luminosity
  - crossing-by-crossing analysis
    - time dependence
    - vertex cut
  - stability evaluation
    - database to provide integrated luminosity with error estimations