Forward neutron pPPG

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Today's issues

- Effect of p_T shapes for cross section
  - ISR vs. HERA
- Discussion with p_T resolution
  - HERA, PHENIX and ISR
- BPM
  - Fill#6931, 7293-7296

Cross section conversion

ISR

$$E\frac{d^3\sigma}{dp^3} \approx \frac{x}{2\pi}\frac{d^2\sigma}{dxp_T dp_T} = \frac{x}{\pi}\frac{d^2\sigma}{dxdp_T^2}$$

HERA

$$E\frac{d^3\sigma}{dp^3} = a\cdot\exp\left(-b_1\cdot p_T\right)$$

$$\frac{1}{\sigma_{inc}}\frac{d^2\sigma_{LN}}{dxdp_T^2} = a(x)\cdot\exp\left(-b_2(x)\cdot p_T^2\right)$$

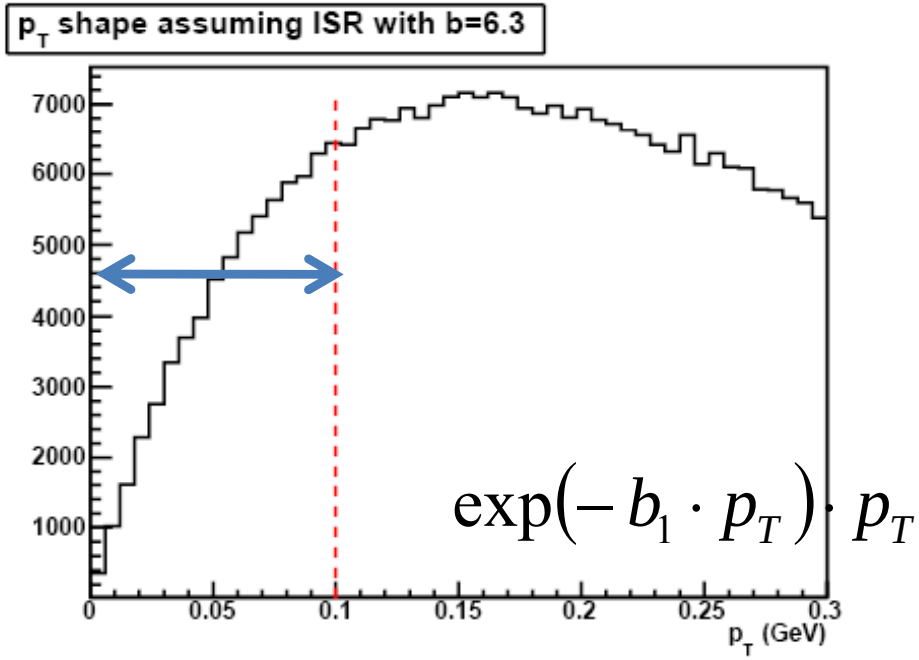
$$\frac{d\sigma}{dx} \approx \frac{\pi}{x}2\int_{Acc.} E\frac{d^3\sigma}{dp^3}p_T dp_T$$

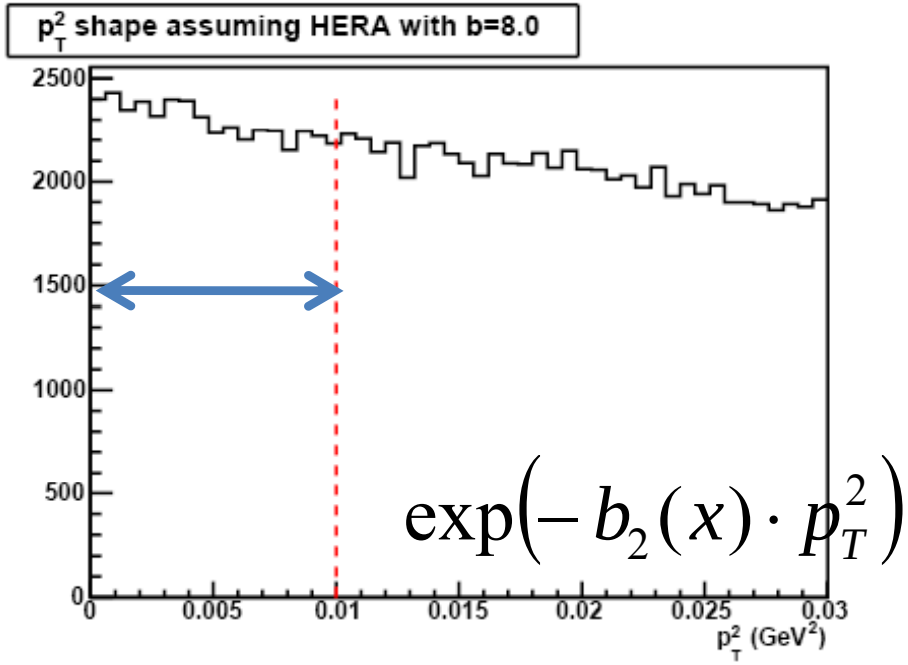
$$\frac{d\sigma}{dx} \approx \frac{\pi}{x}\int_{Acc.} E\frac{d^3\sigma}{dp^3}dp_T^2$$

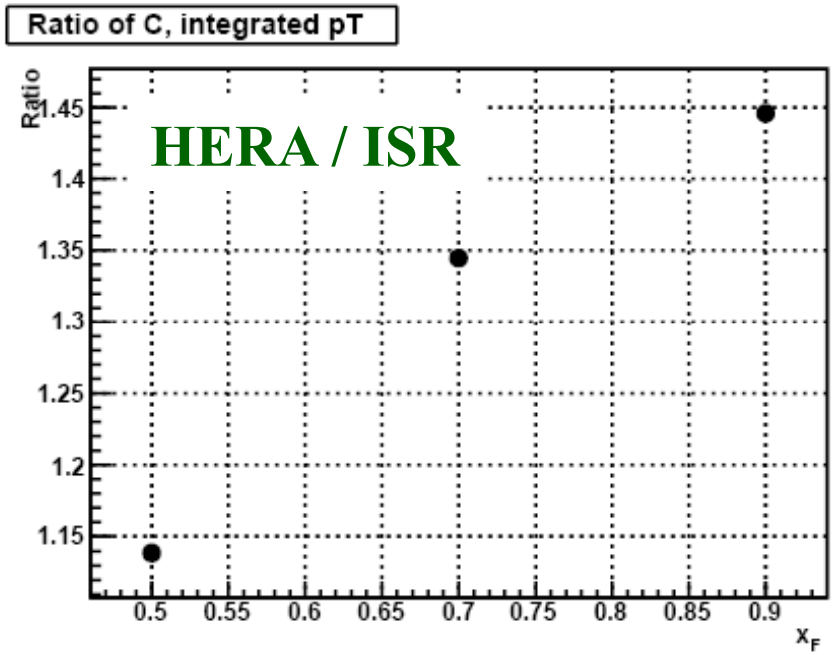
$$\frac{d\sigma}{dx} \approx \frac{\pi}{x}\cdot a(x)\cdot C$$

- Estimation of "C" using each p_T shapes
  - *a(x)* will be invariant cross section at $p_T = 0$ (GeV)
  - Currently *a(x)* for ISR is twice that that for HERA

Comparison







- C for HERA is larger than ISR
  - Depends on x_F region.
    - ~15% @ x_F=0.5
    - ~35% @ x_F=0.7
    - ~45% @ x_F=0.9

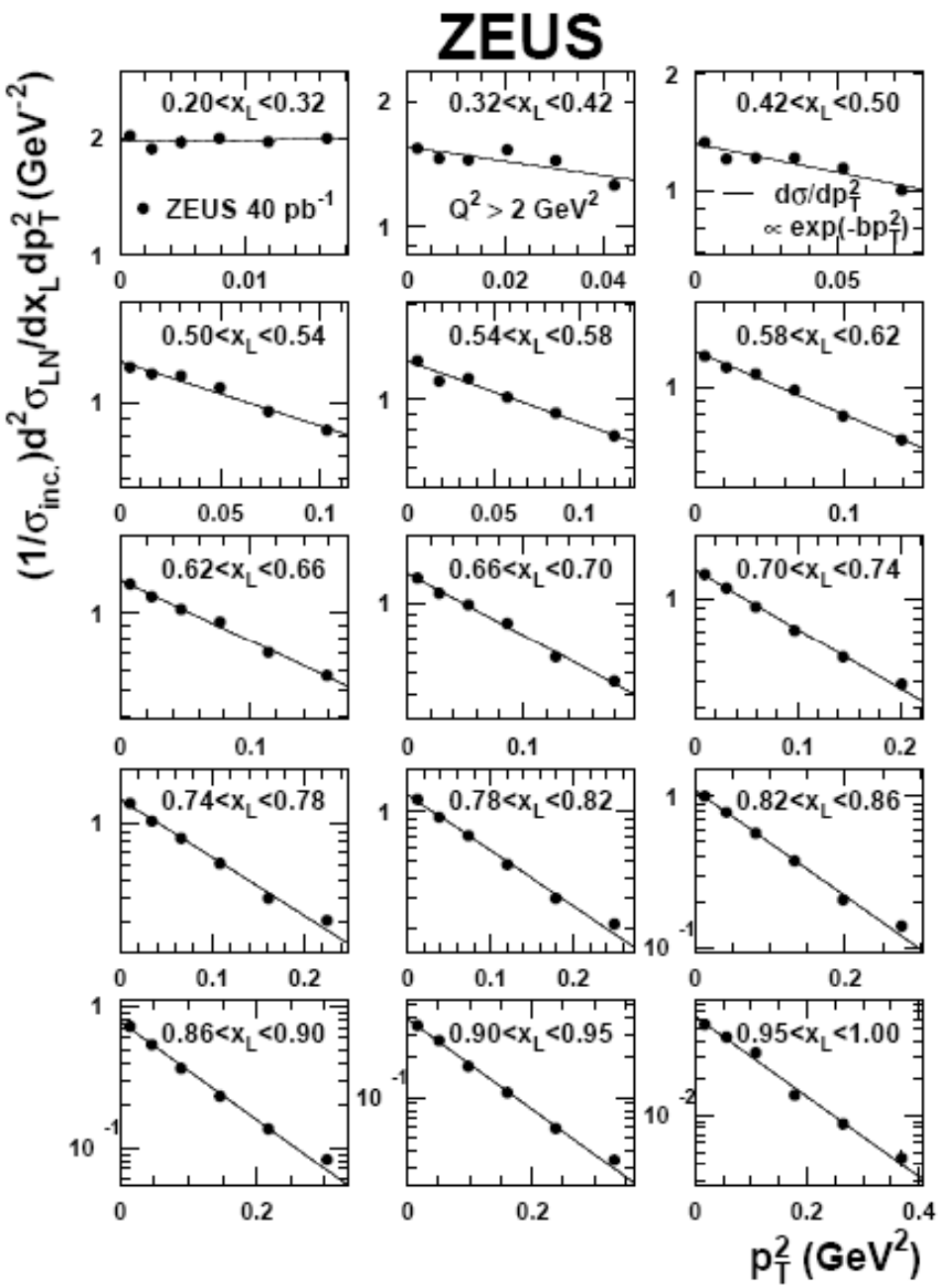
Discussion with p_T resolution (@ x_F=0.5)

- **HERA**
  - Energy resolution ~3% (En = 460 GeV)
    - $\sigma(E)/E = 0.70 / \sqrt{E}$
  - Angle resolution ~ 3%
    - Position resolution is 0.23 cm with FNT (like SMD) and in ~7 cm window (106m from IP)..

  → p_T resolution ~ **4%** (p_T~En*θn)
- **PHENIX**
  - Energy resolution ~24%
    - $\sigma(E)/E = 0.65 / \sqrt{E} + 0.15$
  - Angle resolution ~ 33%
    - Position resolution is about 1 cm (not gaussian. With tail) with SMD in ~3 cm window is ~3 cm (18 m from IP).

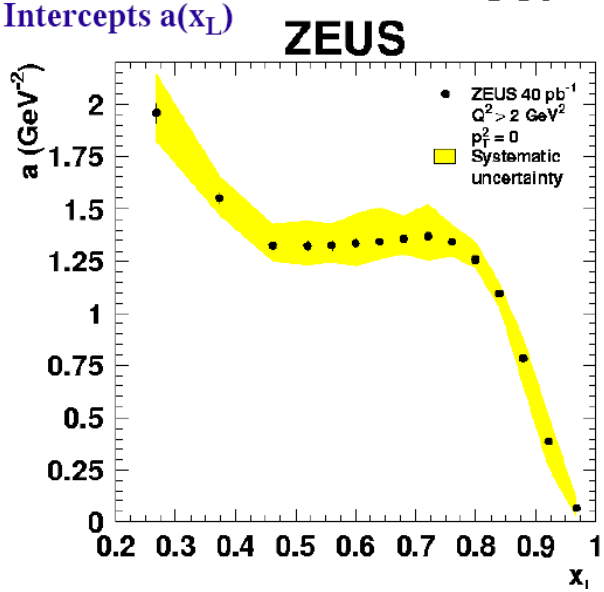
  → p_T resolution ~ **41%**
- **ISR $\sqrt{s}$=62 GeV**
  - Energy resolution ~19% (will be worse at low energy)
  - Angle resolution –
    - No position resolution in ~15 cm window (56 m from IP).

Cross section at HERA



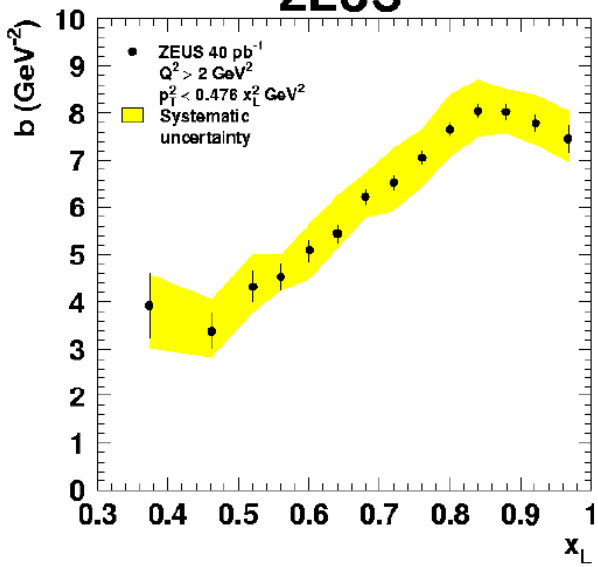
$$\frac{1}{\sigma_{inc}}\frac{d^2\sigma_{LN}}{dx\,dp_T^2} = a(x)\cdot\exp\left(-b_2(x)\cdot p_T^2\right)$$

Intercepts a(x$_L$)



Cross section @ $p_T = 0$ GeV

Slopes b(x$_L$)



Cross section @ $p_T = 0$ (my feeling)

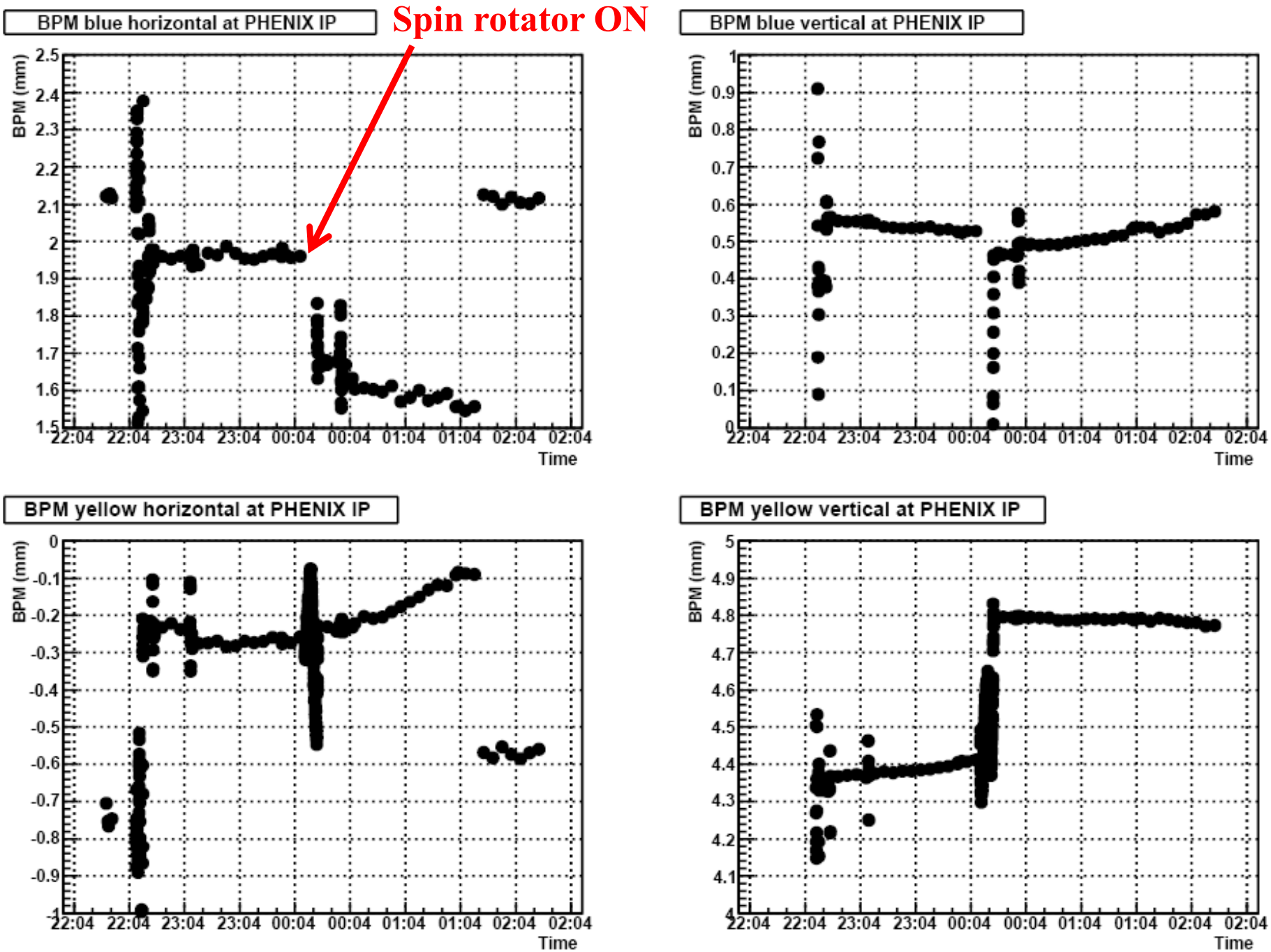
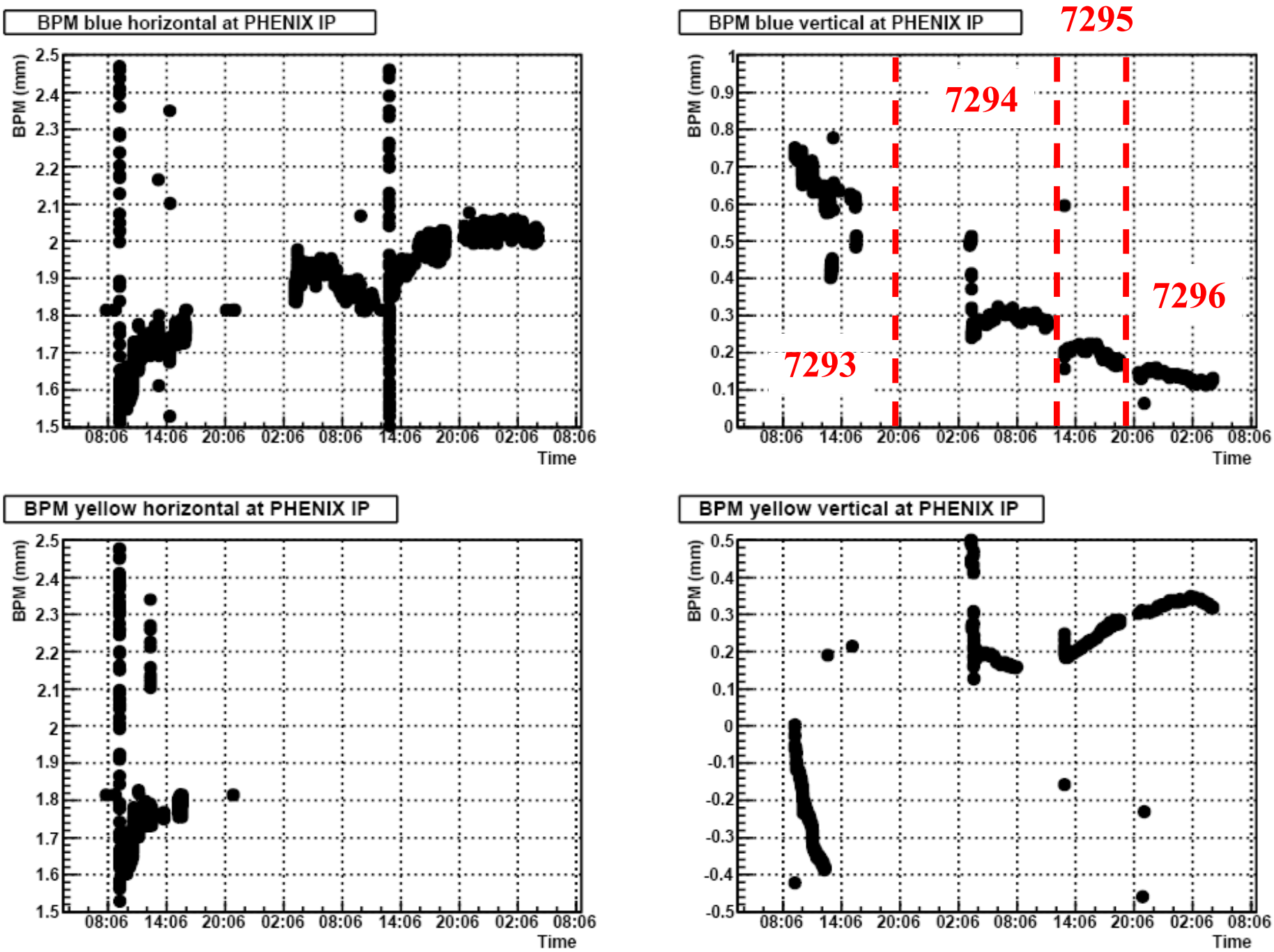
- Only HERA is correct since she can measure p_T precisely.
- Other experiment was dividing dx and dp_T^2 within finite kinematics.
  - ISR and NA49 can not measure neutron position
  - Just divided by these are (square measure in x and p_T^2) or using p_T spectrum extrapolating from low p_T?
    - In NA49 case, they are using p_T shape of proton assuming with isospin symmetry.

→ needs to know detail method to calculate invariant cross section at ISR for more discussion.

BPM information

- I got DX BPM information for following fills
  - Fill#6931, 7293, 7294, 7295, 7296
  - I calculate the beam position @ PHENIX IP as (BPM@7 + BPM@8)/2
- Not well calibrated
  - Offset uncertainty has 1 mm at least. (maybe more)
- Within these uncertainty, it does not exceed 1 cm.
  - 1.1 cm is the shift in vertical estimated by center search using luminosity formula.

BPM Fill#6931



BPM Fill#7293-7296