

# **Brendan, Flemming, Bob, and Hank Crawford (STAR)**

## **BRAHMS Collaboration Meeting (June, 2003)**

### **Outline**

- Why measure relative luminosity?
- Setup of bunch-sorted scalers.
- First look at bunch-sorted scaler data.
- Plans for further studies.

$$A_N(\pi) = \left( \frac{1}{\vec{p}_b} \right) \cdot \frac{\frac{N_\pi^\uparrow}{\mathcal{L}^\uparrow} - \frac{N_\pi^\downarrow}{\mathcal{L}^\downarrow}}{\frac{N_\pi^\uparrow}{\mathcal{L}^\uparrow} + \frac{N_\pi^\downarrow}{\mathcal{L}^\downarrow}} = \left( \frac{1}{\vec{p}_b} \right) \cdot \frac{N_\pi^\uparrow - R \times N_\pi^\downarrow}{N_\pi^\uparrow + R \times N_\pi^\downarrow}$$

where  $R = \mathcal{L}^\uparrow / \mathcal{L}^\downarrow$  ... need to measure R well to keep systematic errors under control.

What is the module?

- Histogramming memory w/24-bit address space and 40-bit data words.
- Developed by Hank Crawford (LBL) for STAR, debugged at STAR in Run-02.

How do we use it?

- Trigger signals setup address, increment data word with RHIC clock.
- Use V124 module to convert bunch number to 6-bit address to bunch sort 18 trigger signals.
- Put DAQ\_BUSY into one input to count dead/live separately.

6 & 7	as yet unused
8	ZDC wide
9	ZDC narrow (didn't work for this run)
10	Bunch 1 signal
11	BBC $\geq 1$
12	INRL-narrow
13	INRL-wide
14	INL-singles
15	INR-singles
16	FFS trigger
17	Yellow Beam Gas (off-time INRL coin.)
18	Blue Beam Gas (off-time INRL coin.)
19	BRAHMS Trigger
20	MRS Trigger
21	FS Trigger (after Run 8986)
22	as yet unused
23	DAQ_BUSY (separate live & dead counts)
24	RHIC clock (the strobe)

- setup ready by May 13 (Run 8949)
- mostly working from May 17th (Run 8986) to EOR

- Compare counter A against counter B, i.e.: compute  $R_i^{AB} = N_i^A / N_i^B$  for each bunch  $i$ .
- Fit  $R_i^{AB}$  with constant:
  - Ignores residual spin effects.
  - Remove bad (low intensity) bunches:
    - I dropped bunches 0, 10, 30, both veto gaps.
  - $\chi_{\text{fit}}^2/\text{d.o.f.}$  shows systematic error.
- Precision:  $\Delta R = \text{fit error} \times \sqrt{\chi_{\text{fit}}^2/\text{d.o.f.}}$ .
- Compare  $R_i^{AB}$  with  $R_i^{A'B'}$  to find trends.

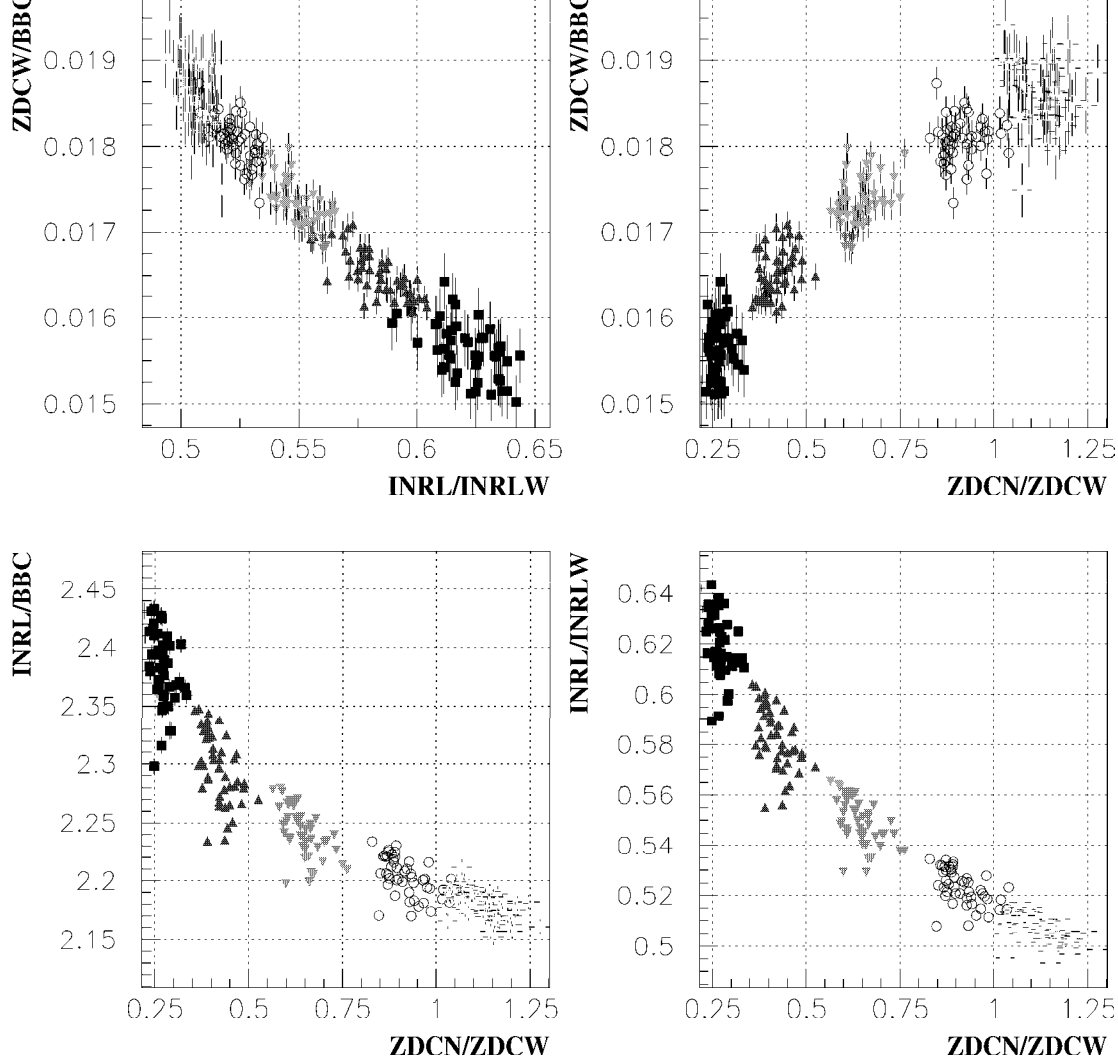
... Here, I have looked at ...

- 1 : A=INRL B=BBC
- 2 : A=ZDCW B=INRL
- 3 : A=ZDCW B=BBC

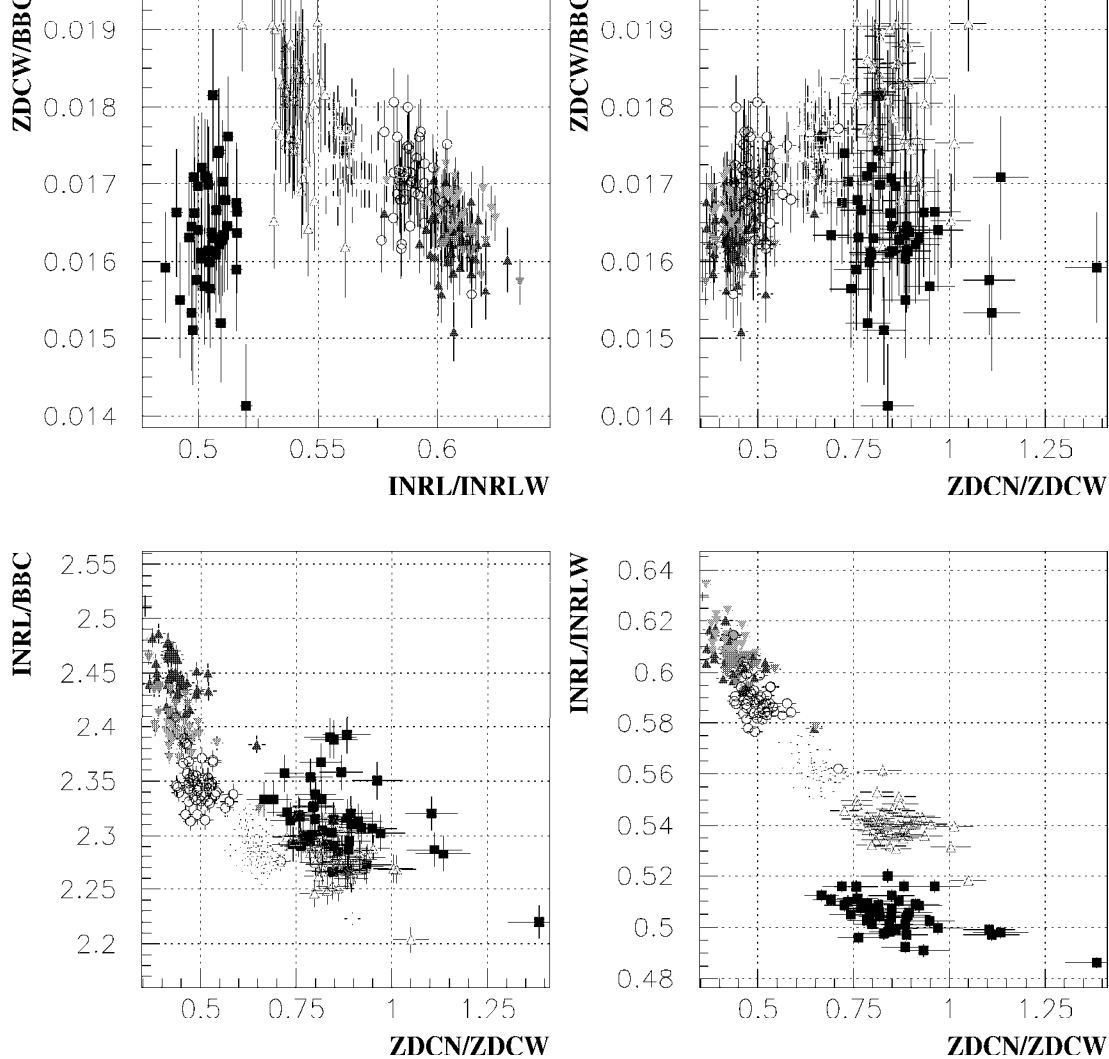
... Other items to study on bunch-by-bunch basis ...

- beam gas contamination.
- vertex width differences (narrow -vs- wide rates).
- accidental coincidences (inelastic singles rates).

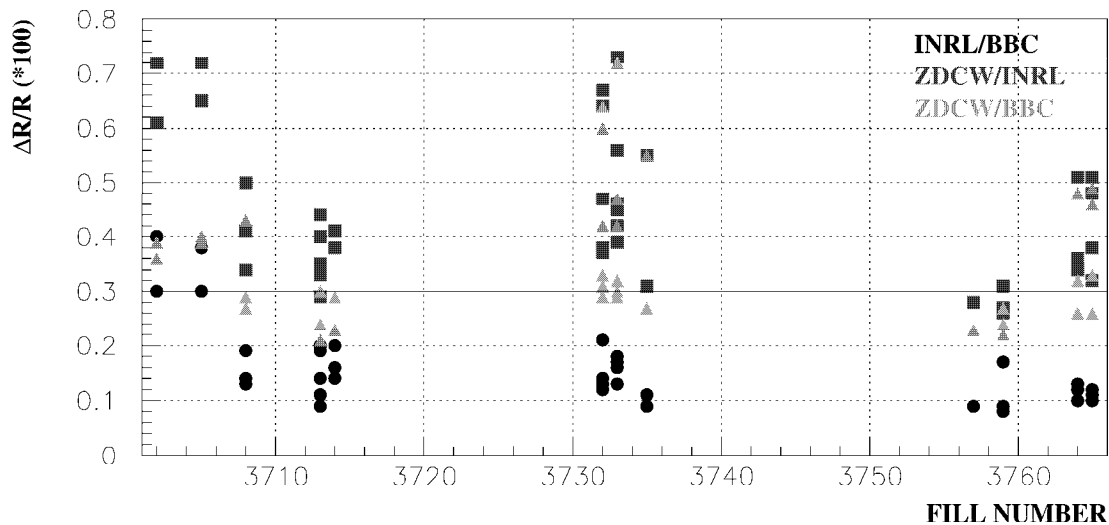
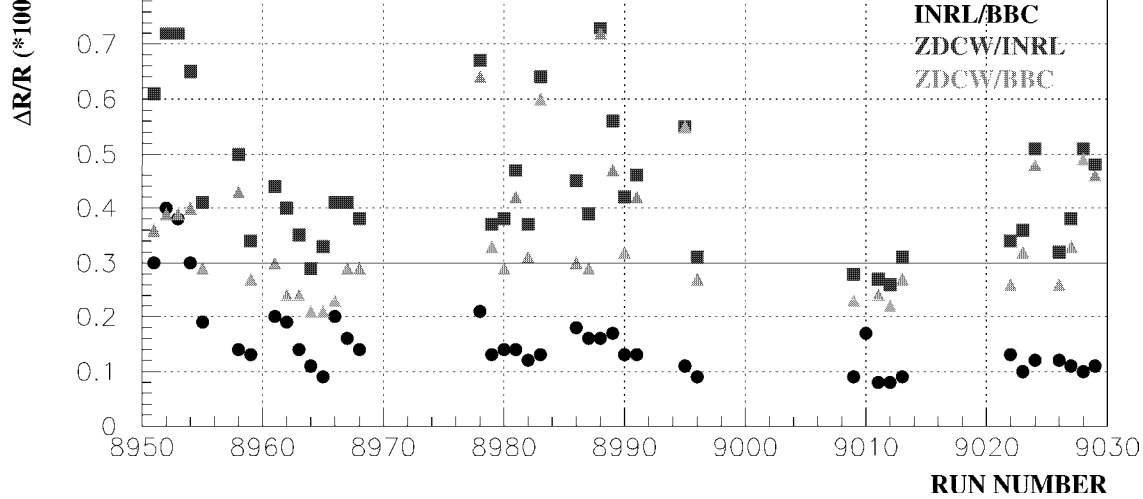
... if appropriate.



- ZDCN=RC .AND. ZDC\_YELLOW (due to mistake)
- Time in Fill is shown with COLOR ...  
BLACK, RED, GREEN, BLUE,
- 1st run in fill - no background issues (not typical)
- Panel Left/Top - clear trend with vertex width?



- ZDCN=RC .AND. ZDC\_YELLOW (due to mistake)
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BLACK, RED, GREEN, BLUE, MAGENTA
- 1st run in fill - background issues (not atypical)
- Panel Left/Top - trend with vertex width?



- For  $A_N \sim 1\%$ , need  $\Delta R/R < 0.3 \times 10^{-2}$  since  $\vec{p}_b \sim 30\%$ .
- See changes w/in fill, e.g., INRL/BBC at Run  $\sim 8960$ .
- Measurement w/ZDC limited by statistics.
- BBC & INRL look good,  $\Delta R/R < 0.3\%$ .
- Bunch-by-bunch correction for vertex widths ... improve? ... match FS acceptance? ... to do!

- Bunch-by-bunch vertex width from data ... how correlated?
- Use Beam-Gas counters to look at background.
- Use Beam Current Measurements to look at spec. luminosity.