

# Update on the RHIC Polarization Analysis

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7/29/2002 RSC meeting

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Contents

- Bunch-by-bunch polarization study

# Reminder

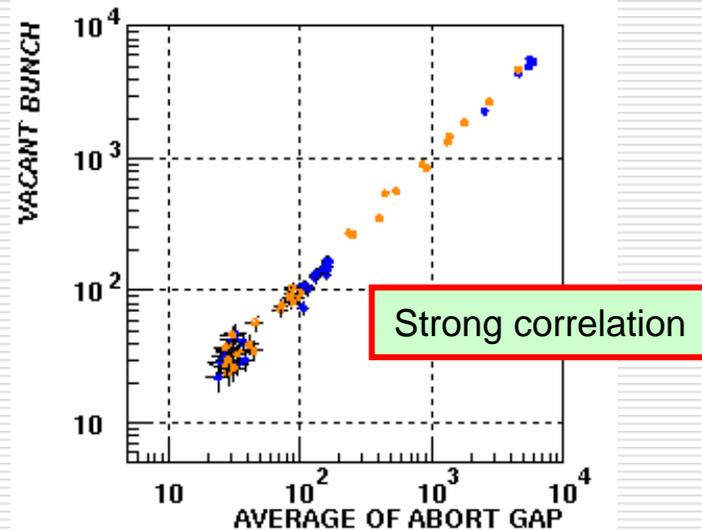
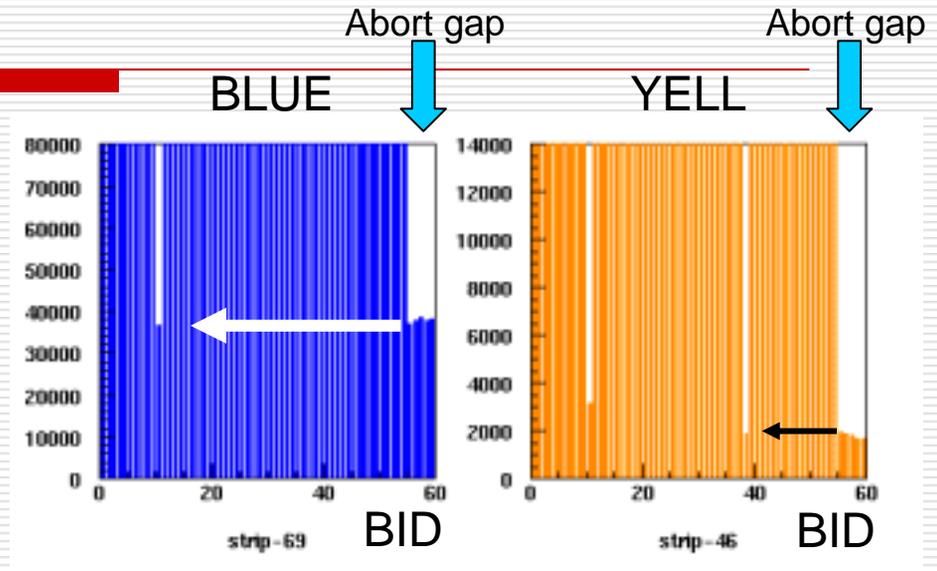
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- *From my last presentation,*
  1. *1<sup>st</sup> 0-pol bunch behaves strange*
    - *use 2<sup>nd</sup> and 3<sup>rd</sup> 0-pol bunches*
  2. *Low populated bunches create unphysical counts ratio between 6-Si detectors*
    - *Fitting  $\chi^2$  for the ratio distribution can be a criteria for choosing good bunches*
- *Other concerns*
  - *Robust strip selections will create large acceptance asymmetries*
  - *systematic effects (Asymmetry of Up (down) spin bit went up (down))*

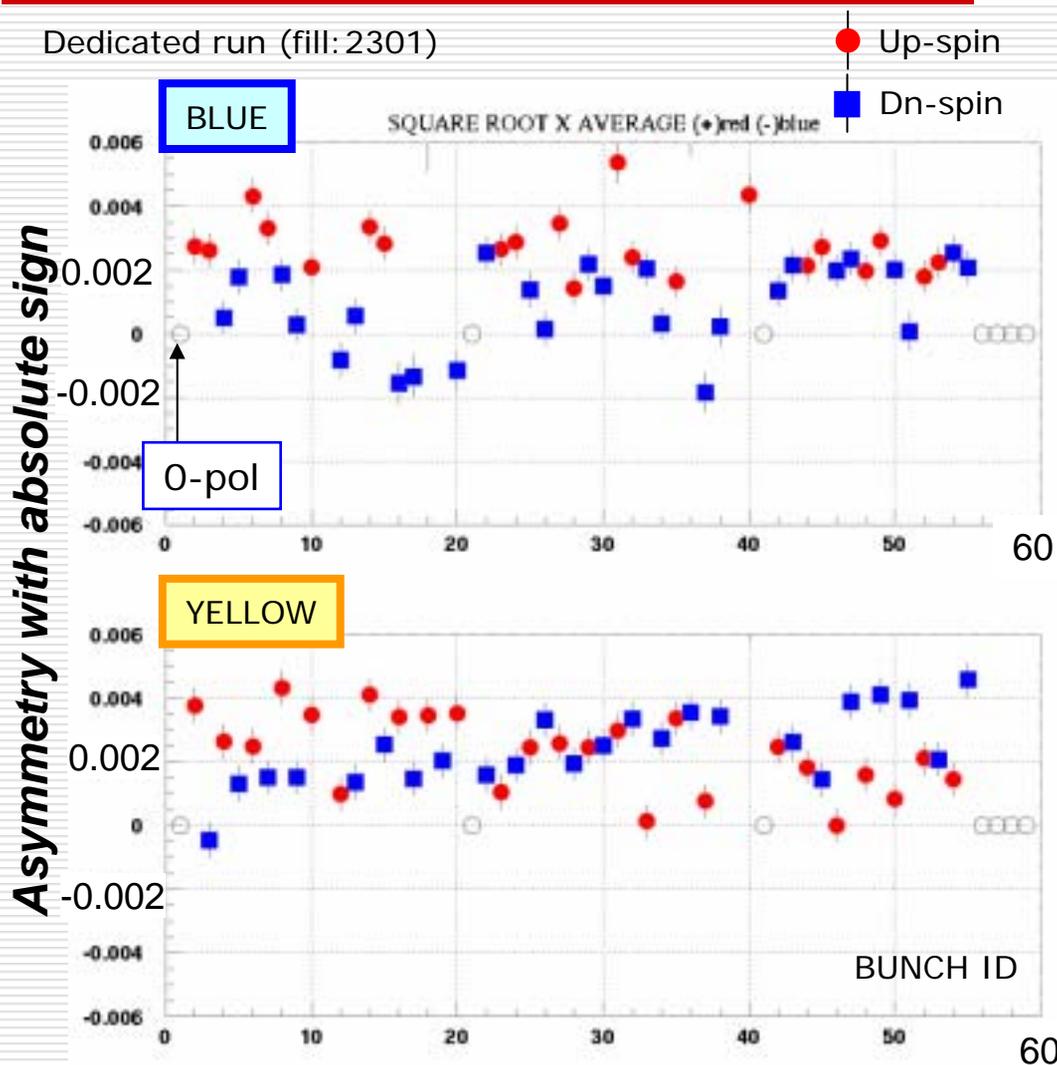
# Strip selections

Use Dedicated run (fill:2301)

- *In order to avoid the acceptance asymmetry distortion, the noisy strips are going to be used in the analysis*
- *Background level for each strip is estimated with the number of counts in the abort gap*
- *Assuming that the backgrounds are flat with respect to the bunch distribution, average of the number of counts in abort gap is subtracted for each strip*



# Bunch by bunch asymmetry



- Taking bunch-by-bunch asymmetries with background subtraction
- 1<sup>st</sup> 0-pol bunch is not used

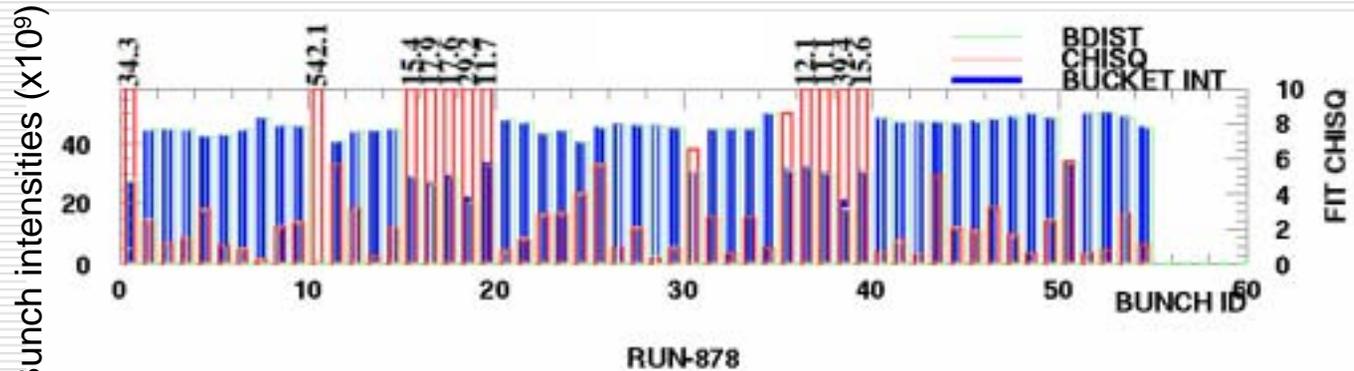
## 1. For BLUE

- Large gaps are due to the unphysical detector ratio
- Some criteria to discard those runs are needed

## 2. For YELLOW

- Down spin bit is going up
- Up spin bit is going down

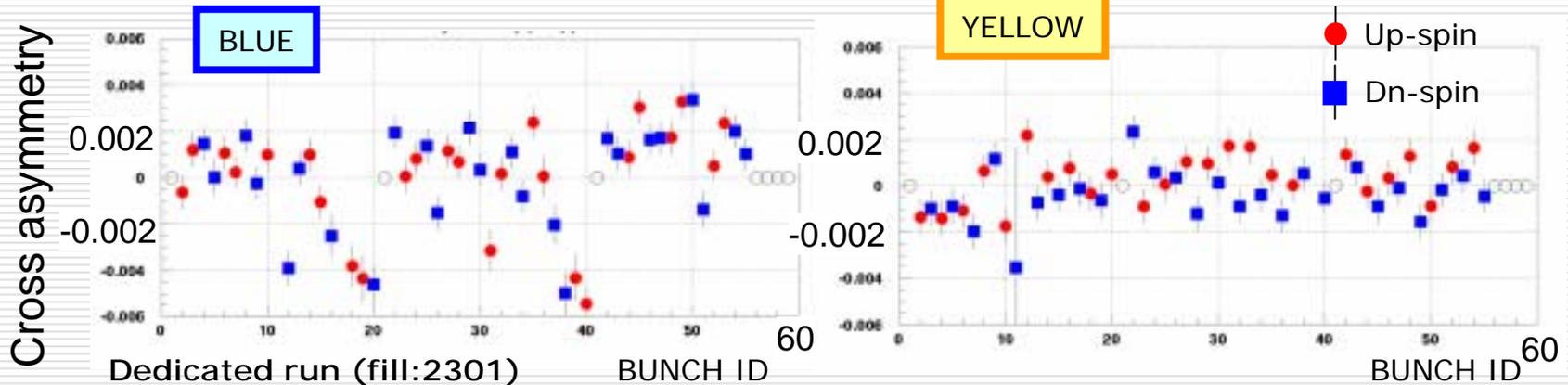
# Fit $\chi^2$ as a bunch selection criteria



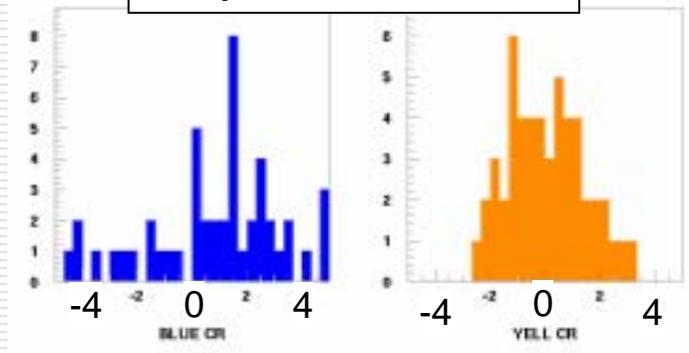
The earlier run which was in the same fill as dedicated run

- ❑ *The luminosity ratio with respect to the 0-pol bunch for each detector is fitted with  $\sin\phi$  function ( $\phi$  dependence of  $A_N$ )*
- ❑ *Fit  $\chi^2$  is obtained for every bunches*
- ❑ *Fit  $\chi^2$  surely indicates the bad bunches, however it is hard to determine the criteria line ( $\chi^2=2,3,?$ )*
- ❑ *The normal bunches can easily get the higher fitting  $\chi^2$*

# Cross (forbidden) asymmetry as a criteria parameter



Projection to Y-axis

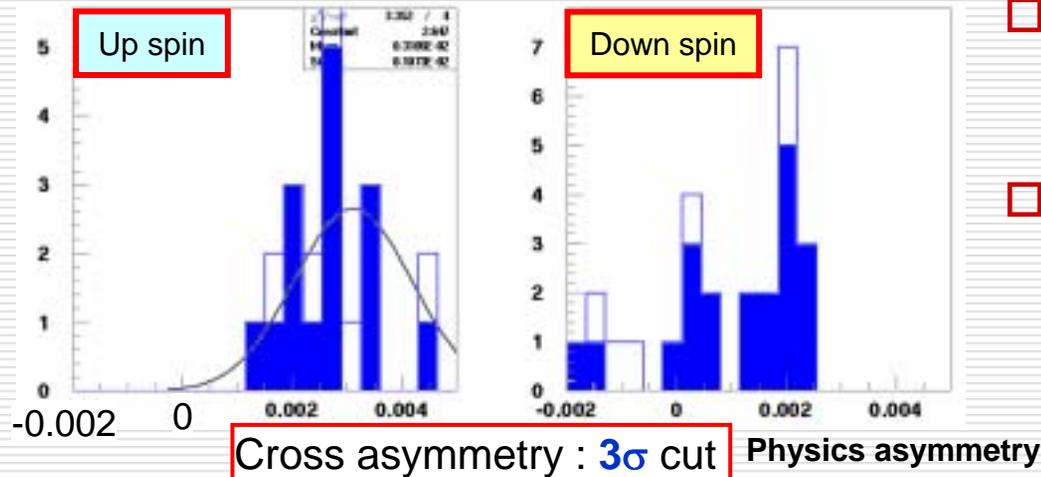


Significance plot  
[Asymmetry/ $\sigma_{\text{stat.}}$ ]

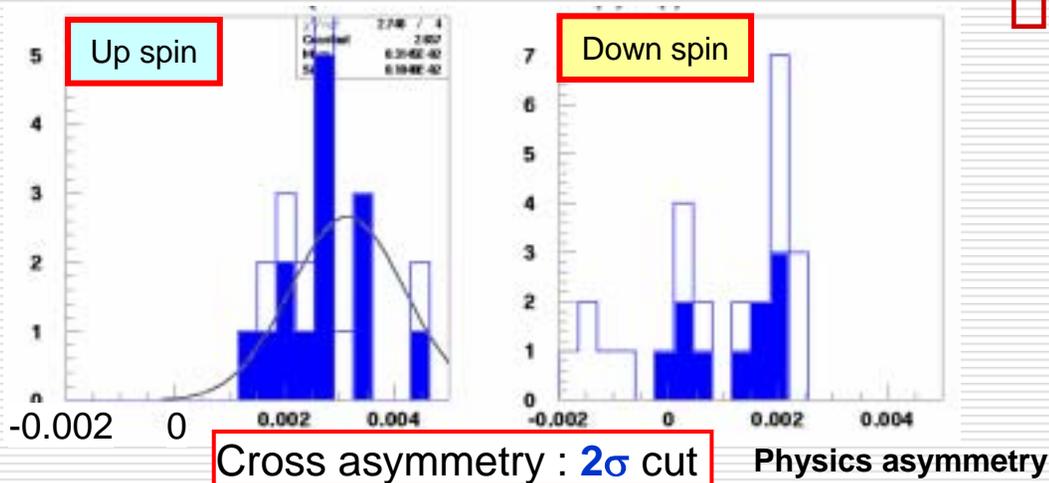
- Cross asymmetry is taken btw  $i$ -th bunch and 0-pol bunch
- 45 degree detectors are used forbidden combination (1x4-2x5)
- Basically the cross asymmetry corresponds to the fit  $\chi^2$
- Criteria is determined by significance

# Blue: physics asymmetry after bunch selection

Dedicated run (fill:2301)

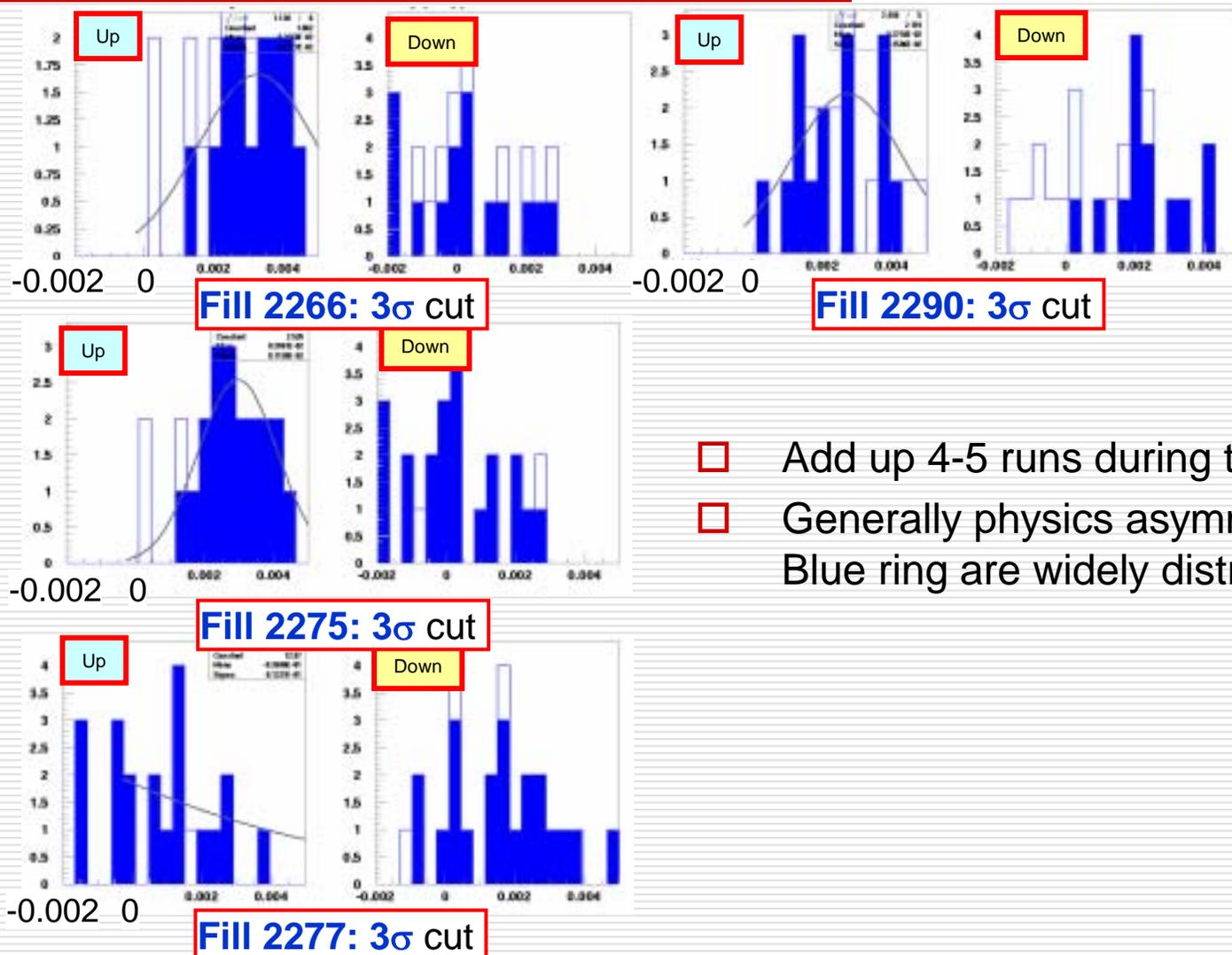


- *Up spins are rather stable with wide distribution (35% fluctuation)*
- *Down spins are unstable with strong dependence on cut condition*



- *It would be better to take a look at other fills*

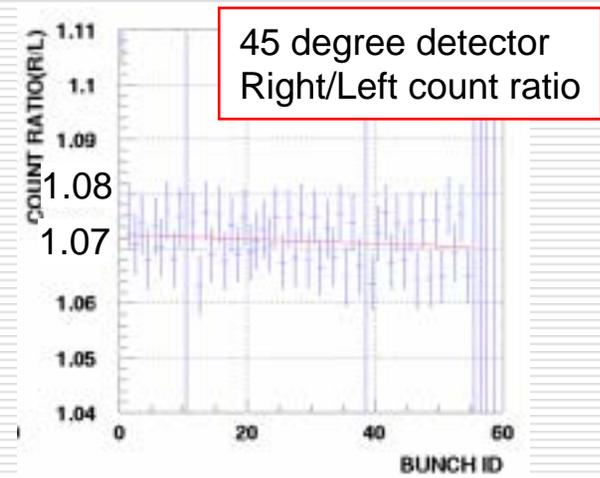
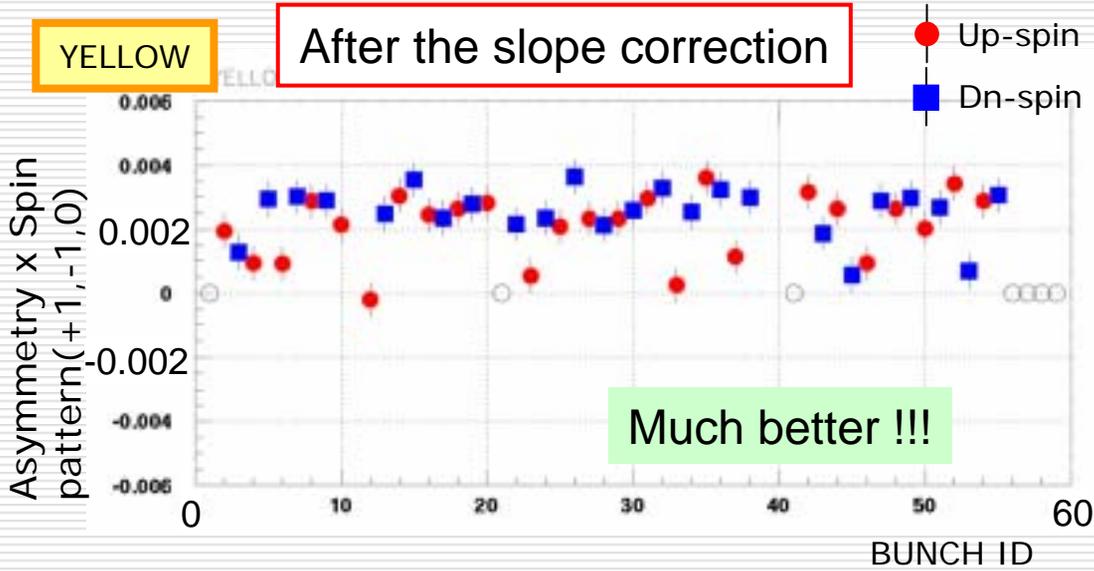
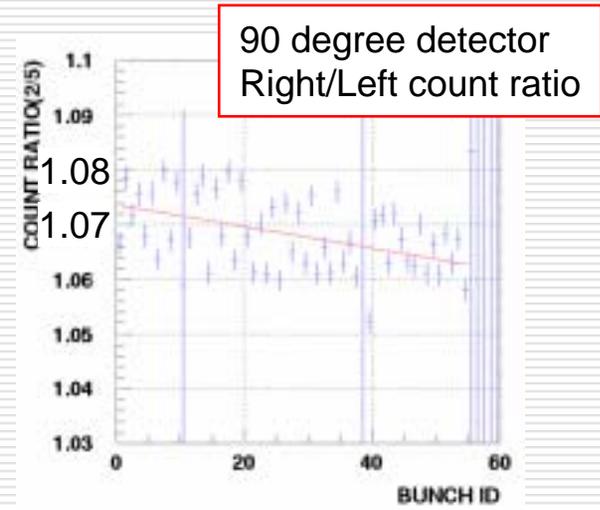
# Other fills (for Blue)



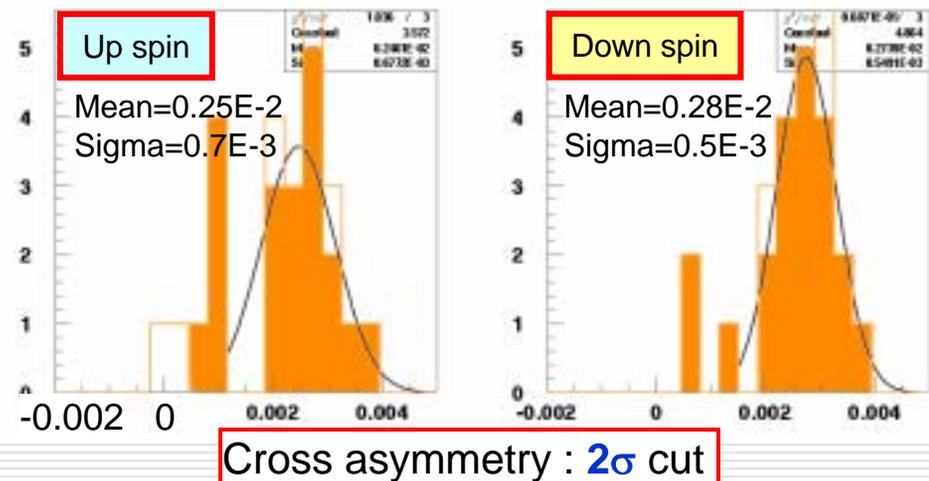
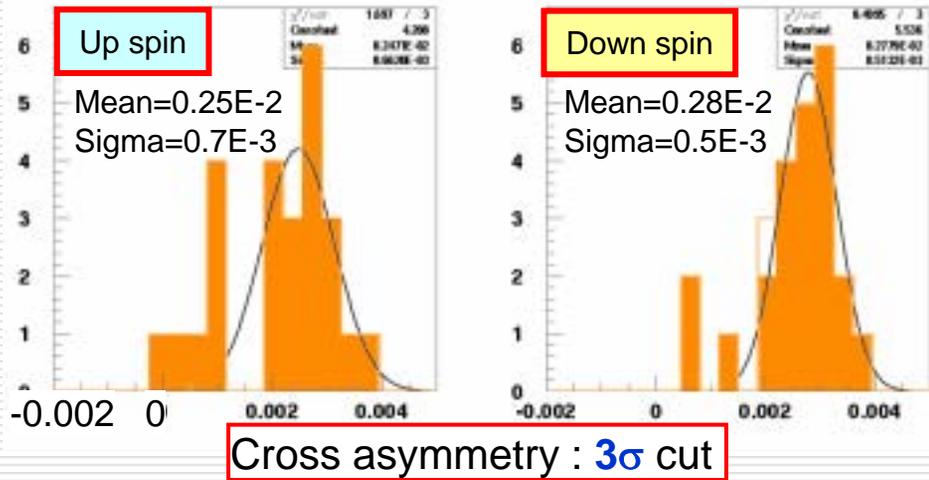
- Add up 4-5 runs during the same fill
- Generally physics asymmetries for Blue ring are widely distributed

# (Yellow) Shifting of the counts (left → right)

- Absolute asymmetry values for yellow is shifting towards minus on both spin signs
- The ratio Right/Left is decreasing linearly as a function of bunch ID
- Although the reason for the behavior is *unknown*, the slope correction is possible



# Yellow: physics asymmetry after bunch selection

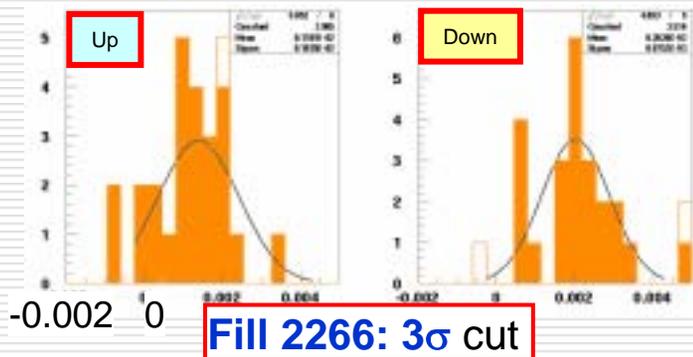
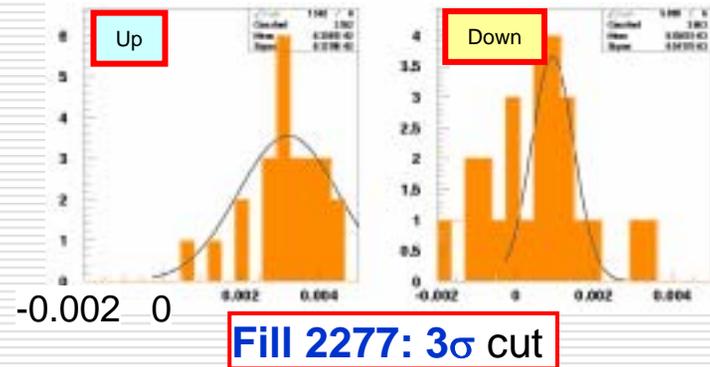
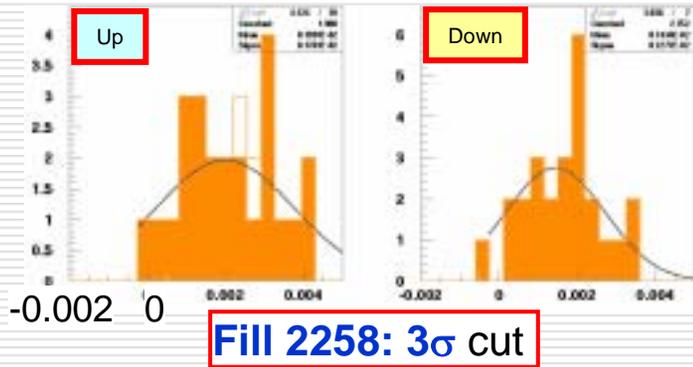


- Both spins are stable with variation of cut condition
- Distribution widths are relatively 20~30% for both rings
- Expected statistical fluctuation is

$$\frac{1}{\sqrt{200M/55}} = 0.53 \times 10^{-3}$$

- The outliers are found around zero even after the cross asymmetry cut, indicating some of the bunches lose polarization(?)

# Other fills (for Yellow)



- 4-5 runs (20M events each) are added up
- Estimated error is  $\sim 0.8E-3$
- Some fills are stable both in up and down spin
- Some fills show up-down separation
- Some fills need slope correction

