

Polarimetry with ZDC scalers

online.star.bnl.gov/scaler/polarimetry

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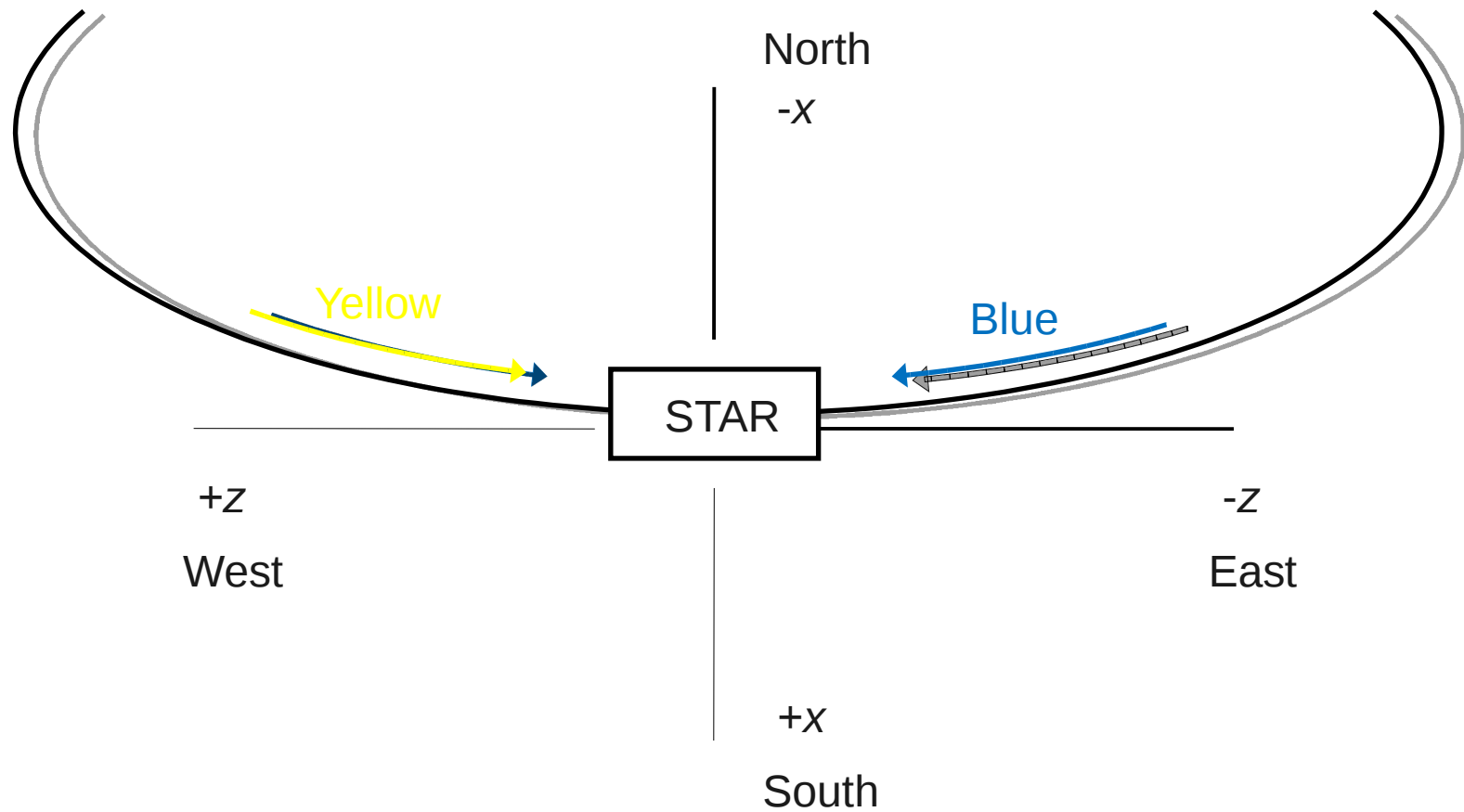
Purpose

- Need to sample full luminosity for each production run
- Need to study the dependence of zero angle asymmetry on the total energy, transverse momentum, and to look for correlation between hits in ZDC and BBC

Mechanics of the ZDC readout

- All ZDC towers are read out by a QT board in the BBQ crate
- All ZDC SMD slats are read out by a QT board in the MXQ crate,
- That QT board writes highest horizontal and highest vertical slats to the two scaler boards, one for East and one for West; a copy is also recorded in the trigger data
- Also present in the scaler boards and used as a trigger: same-side ZDC front and back bits, BBC TAC in window
- Present in the scaler board but not used yet: same-side 3-bit tower sum and 4 BBC small tiles
- Azimuthal distribution of SMD hits is accumulated for each run and for each spin combination
- Differences between Run 9 and Run 11:
new (refurbished from BRAHMS) ZDC towers were installed this summer, gains adjusted to match Run 9
SMD signals are pedestal-subtracted in the QT board this year

STAR Coordinate System



Single-Spin Asymmetry

“Good hit” = intersection of one horizontal and one vertical slat,
each having highest ADC – PED

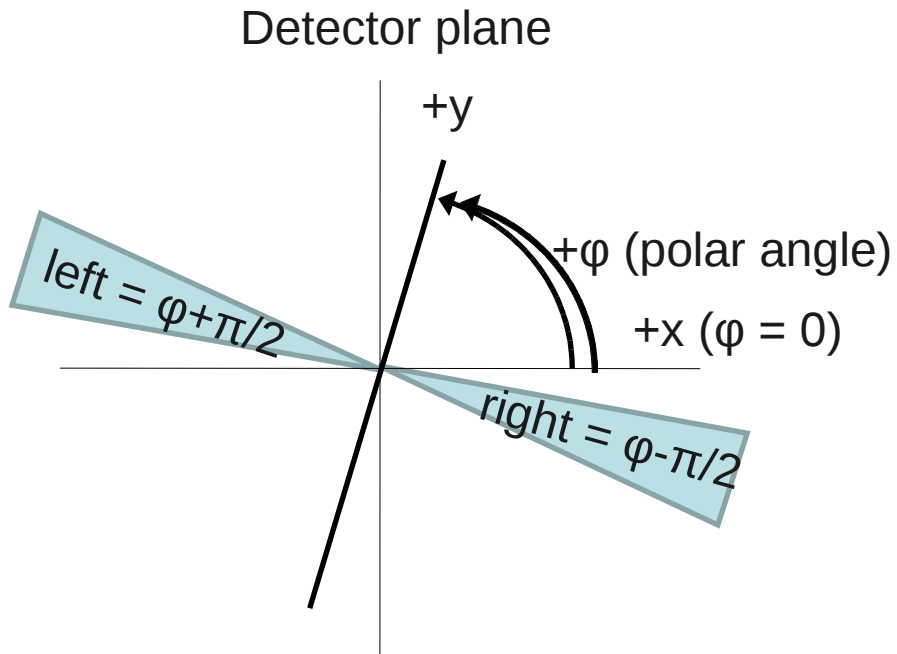
At maximum, one good hit in a detector per event

“Square root formula”

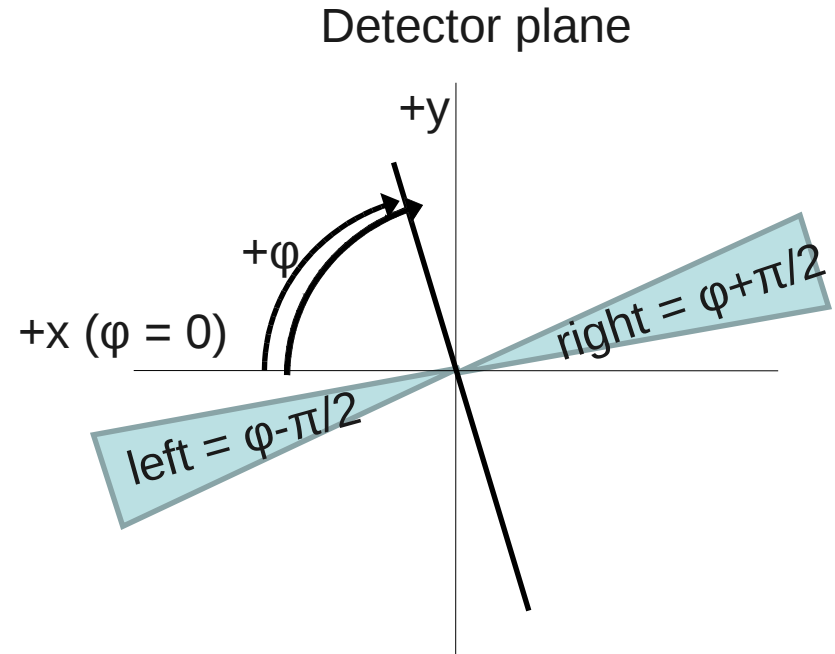
$$\epsilon_{phys} = \frac{\sqrt{N_L^{\uparrow} N_R^{\downarrow}} - \sqrt{N_L^{\downarrow} N_R^{\uparrow}}}{\sqrt{N_L^{\uparrow} N_R^{\downarrow}} + \sqrt{N_L^{\downarrow} N_R^{\uparrow}}}$$

Hit counts are summed over the second beam spin state

Geometry definition



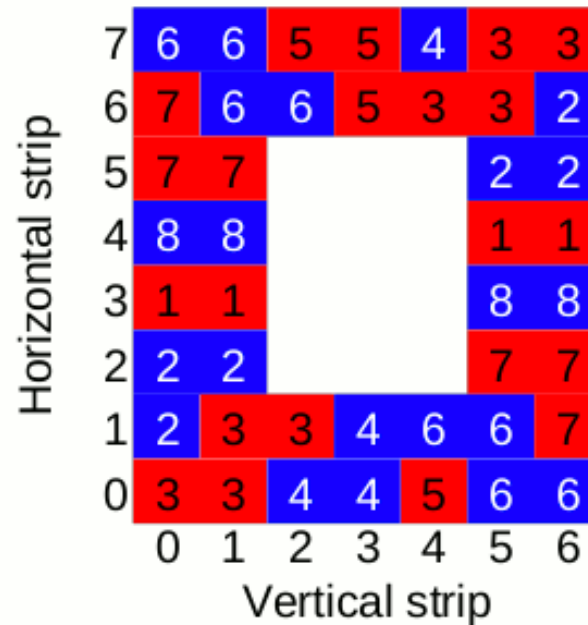
Looking along yellow beam



Looking along blue beam

$\varepsilon_{\text{phys}}$ is a left-right asymmetry
with respect to $\varphi = \text{const}$ plane,
looking along the incident beam

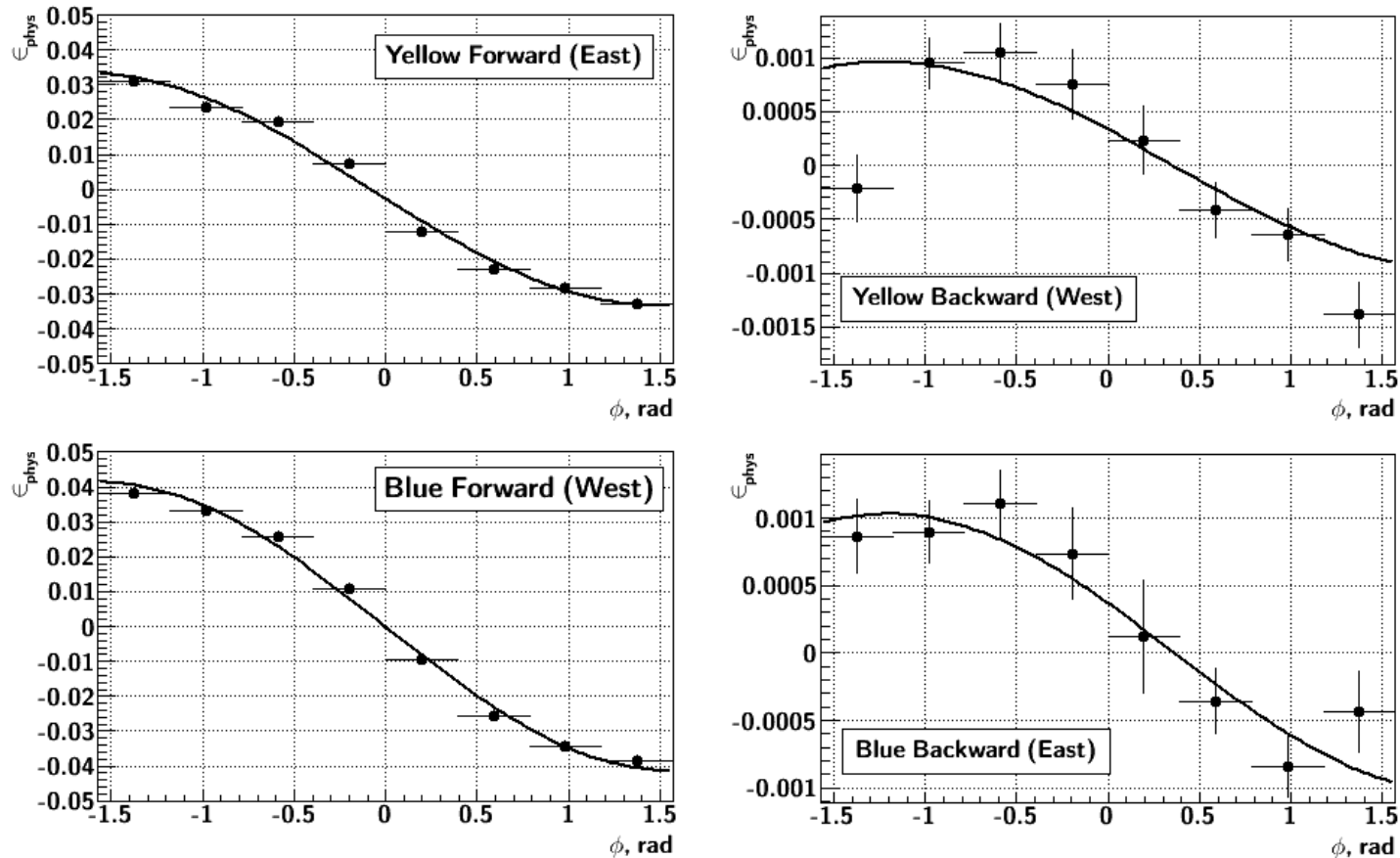
Geometry definition



Each pair of pixels is assigned one of the 8 bins in ϕ ,
determined by the geometrical center
Only the outer 2 slats are used for online analysis,
because inner slats show smaller asymmetry

(bins 4 and 5 are unbalanced, I am working on it)

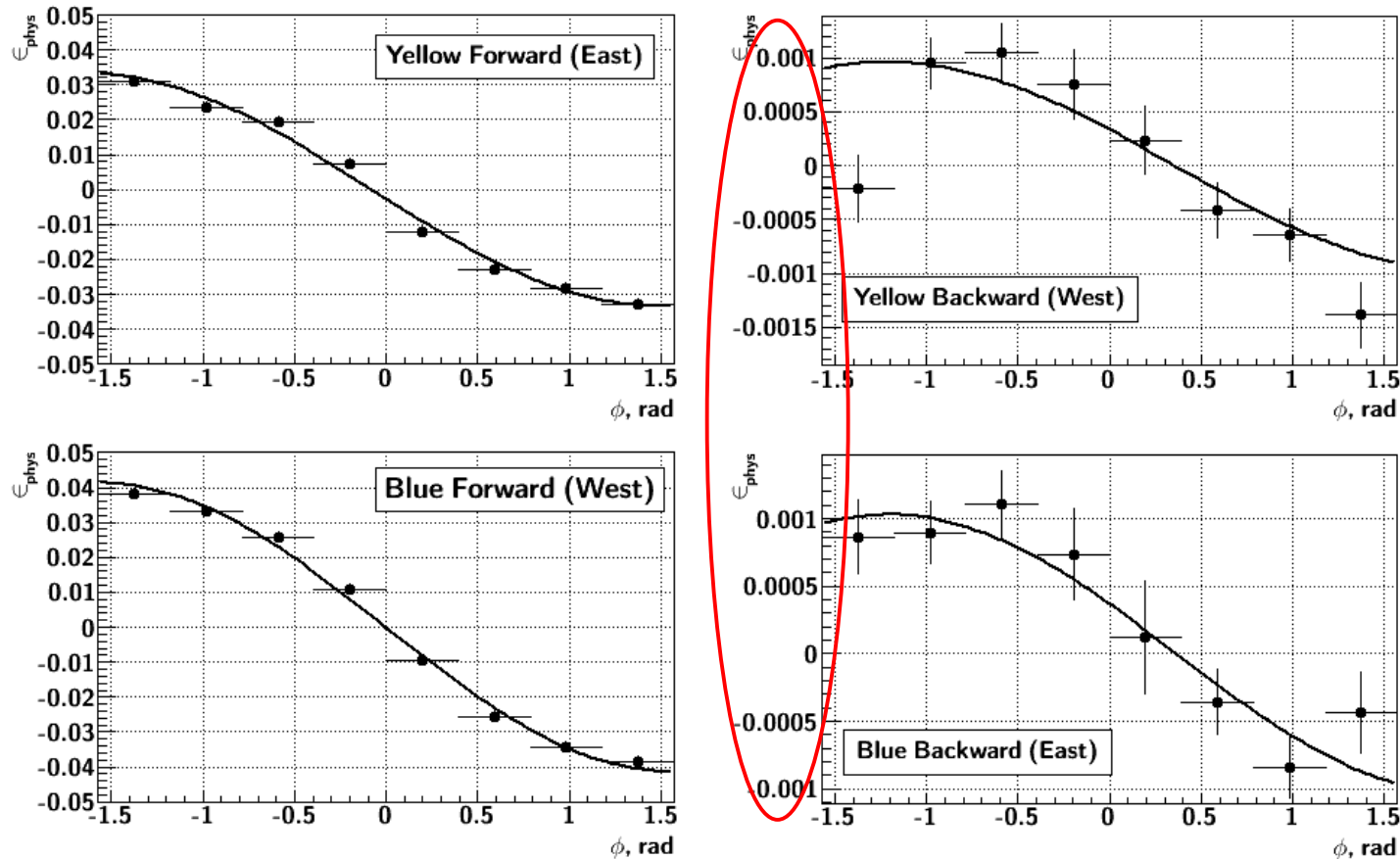
Results for one recent fill



ZDC Single Spin Asymmetry (fill 15170)

With the same trigger as was used in Run 9
and with the same analysis algorithm,
a similar analyzing power of 7-8% is observed

Results for one recent fill

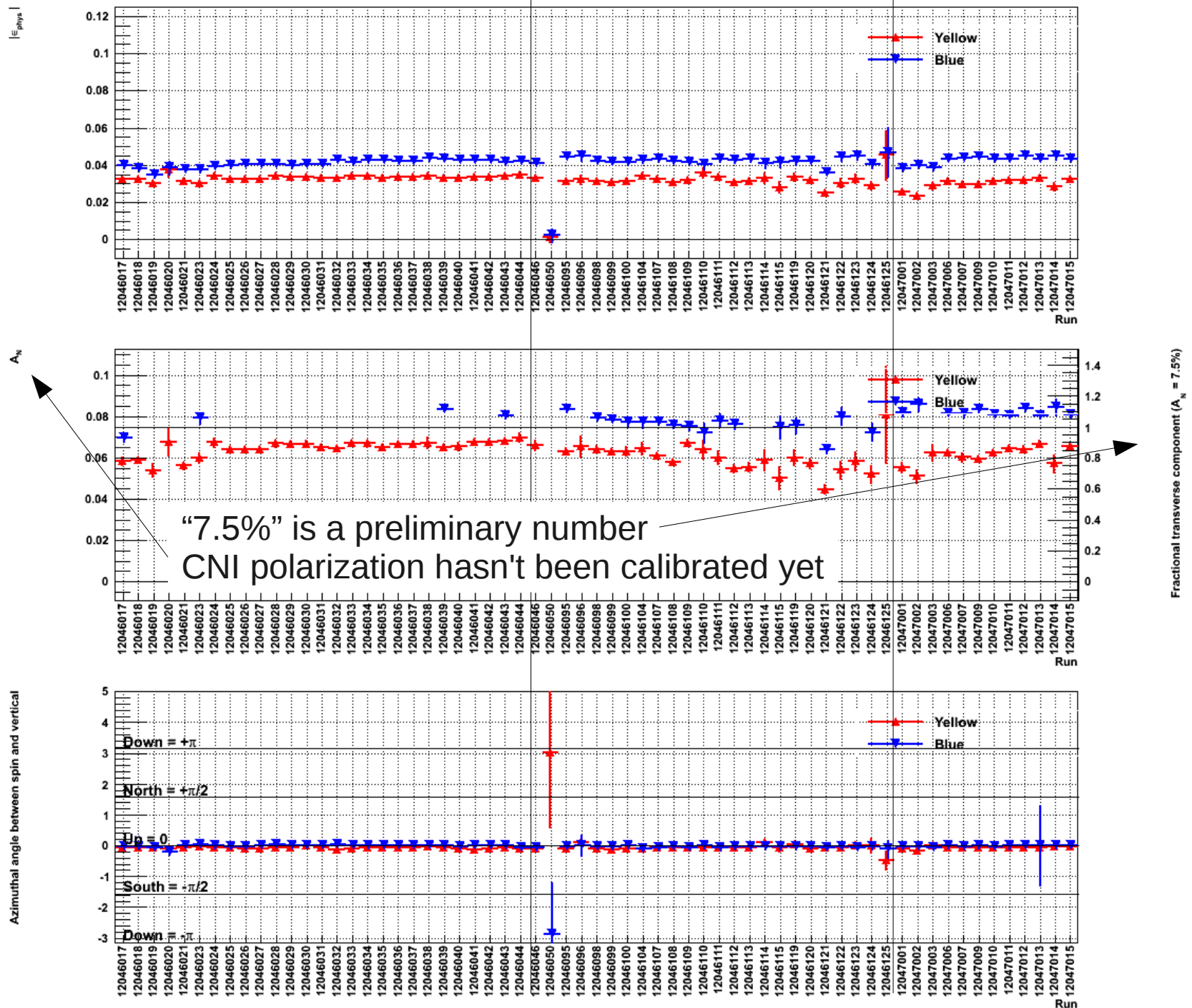


ZDC Single Spin Asymmetry (fill 15170)

Note, the vertical scale is different

With large amount of data we can now see the backward asymmetry, which we couldn't see so clearly before
Is it physics?

Results for 3 recent fills (online)



Summary

- We have commissioned the scaler-based ZDC polarimetry for Run 11
- Recorded statistics per fill is two orders of magnitude larger than what we used to collect in Run 9 in dedicated runs
- We are ready to sample all luminosity during longitudinal running; no need for dedicated “ZDC polarimetry” runs
- Analyzing power is 7-8%, close to the values seen in Run 9
- Scaler boards have information that can be used to further study and optimize the analyzing power: tower energy sum, BBC small tile hits. This is a work in progress...

Acknowledgments

- ZDC towers and SMD commissioning:
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John Nelson, Chris Perkins