

Analysis Progress

for the d_2^n analysis meeting

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- 1 BPM Calibration
 - Coordinate Transformation
 - Comparison: LHRS vs BigBite
- 2 Raster Calibration
- 3 What's Next?

BPM Coordinate Transformation

- The goal: to produce calibration constants for the DB to transform between BPM coordinate system and Hall Coordinate System
- Last time, our results had some mysterious sign discrepancies
- It turns out that this arises from a sign change in two coordinate systems:
 - MCC (used in EPICS variables): $+X$ is to beam right
 - Hall A (also for BPM coordinates): $+X$ is to beam left
- Fixing the sign of the epics BPM X variables gives us results much closer to Transversity's
- Another issue: We have two DAQs
 - Different pedestals, different sources of electronic noise ...
 - We need to calibrate LHRS and BigBite BPM readouts separately

BPM Coordinate Transformations: Results

BPM A

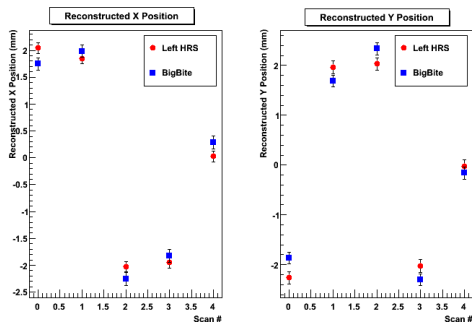
	rot ₁₁	rot ₁₂	rot ₂₁	rot ₂₂	disp ₁	disp ₂
BigBite	-0.614348	0.658442	0.618053	0.669323	-0.00319424	0.000672374
LHRS	-0.676324	0.69569	0.679527	0.706064	-0.000687716	0.000685615
Transv.	-0.682	0.729	0.701	0.717	-0.00112	0.00081

BPM B

	rot ₁₁	rot ₁₂	rot ₂₁	rot ₂₂	disp ₁	disp ₂
BigBite	-0.814325	0.556614	0.814739	0.56004	-0.0061156	0.0078037
LHRS	-0.679278	0.675238	0.684226	0.674596	0.000349452	0.00134201
Transv.	-0.604	0.624	0.65	0.601	7.8e-05	4.25e-05

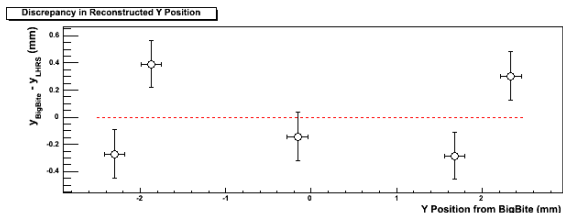
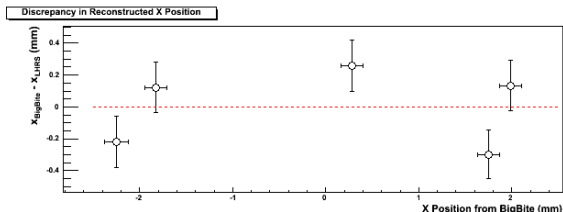
LHRS vs. BigBite BPM Comparison (i)

- Once we've done the calibrations, LHRS and BigBite BPM readings should be consistent
- This plot shows reconstructed x and y at the target location, for both DAQs, during the bull's-eye scans
- x and y are derived from transformed BPMA/B readouts, survey locations



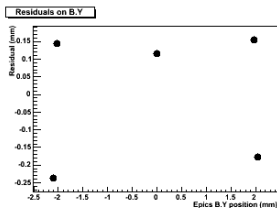
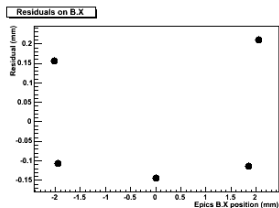
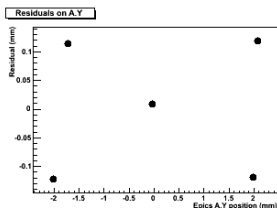
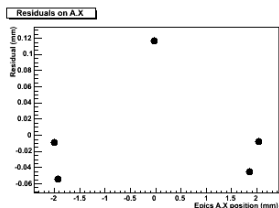
LHRS vs. BigBite BPM Comparison (ii)

- Here we can see the discrepancy between the positions reconstructed from the two DAQs
- At worst, $|x_{BB} - x_{LHRS}| \sim 300\mu\text{m}$ and $|y_{BB} - y_{LHRS}| \sim 400\mu\text{m}$



Size of Discrepancy

- The HALL A NIM paper quotes $\sim 100\mu\text{m}$ as the BPM accuracy
- Our fit isn't exact either. Here are the residuals for BigBite:



Another Coordinate Transformation

- When working with rastered beam, the BPM readouts aren't fast enough to give us real-time x and y positions
- Instead, we can use the raster currents to give us fast beam positions
- We need to transform between ADC readouts of raster current ($raster_x$) and x/y position:

$$x = b_1 + a_{11} \cdot raster_x + a_{12} \cdot raster_y$$

$$y = b_2 + a_{21} \cdot raster_x + a_{22} \cdot raster_y$$

- We can compare average BPM and raster-current readouts over the course of a run to calibrate raster current to beam position
- No special runs are needed
- We can calibrate based on run periods or even run-by-run

What's Next?

- Raster Calibration
 - Test calibrations on a few sample runs
 - Identify run periods with stable beam positions
 - Perform raster calibration for each run period
 - I can roll out partially updated rb and urb DB files now (with new BPM calibrations), or wait until the raster info can be included
- BB Optics
 - We have two runs with BB magnet on and raster off – I can start on those in parallel with raster calibrations
 - Once I've done the raster calibrations for February 10, I can look at runs with rastered beam
- Compton
 - Analyzing power work continues in background
 - Systematics (Cavity State ID)