An Update on the g_2^p Experiment

Melissa Cummings
The College of William and Mary

Hall A Collaboration Meeting
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Outline

- Theory/Motivation
- Experimental Setup/Run Period
- Status of Analysis

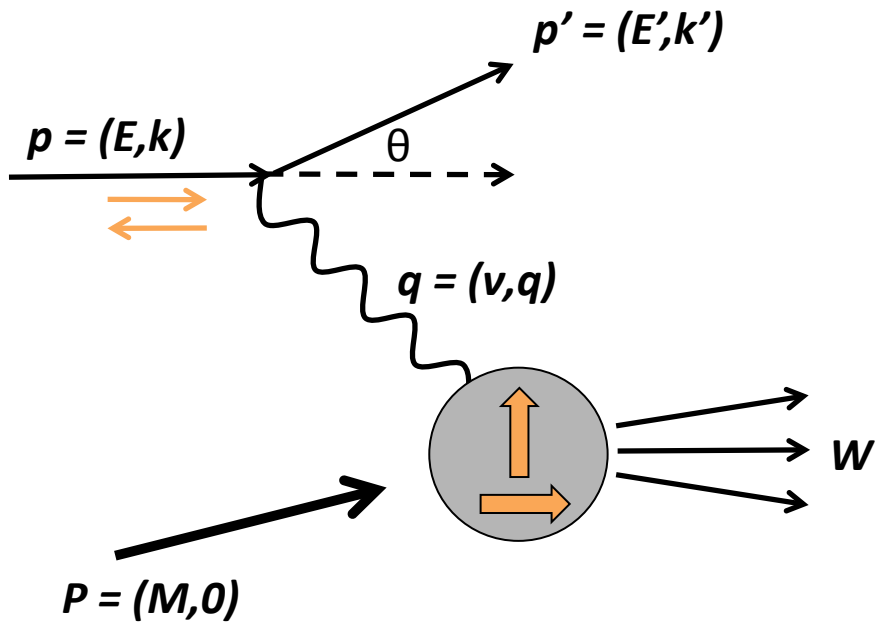
Inclusive Electron Scattering

F_1, F_2: unpolarized structure functions

$$\frac{d^2\sigma}{d\Omega dE'} = \sigma_{Mott}[\frac{1}{\nu}F_2(x,Q^2) + \frac{2}{M}F_1(x,Q^2)\tan^2\frac{\theta}{2}$$

$$+\gamma g_1(x,Q^2) + \delta g_2(x,Q^2)]$$

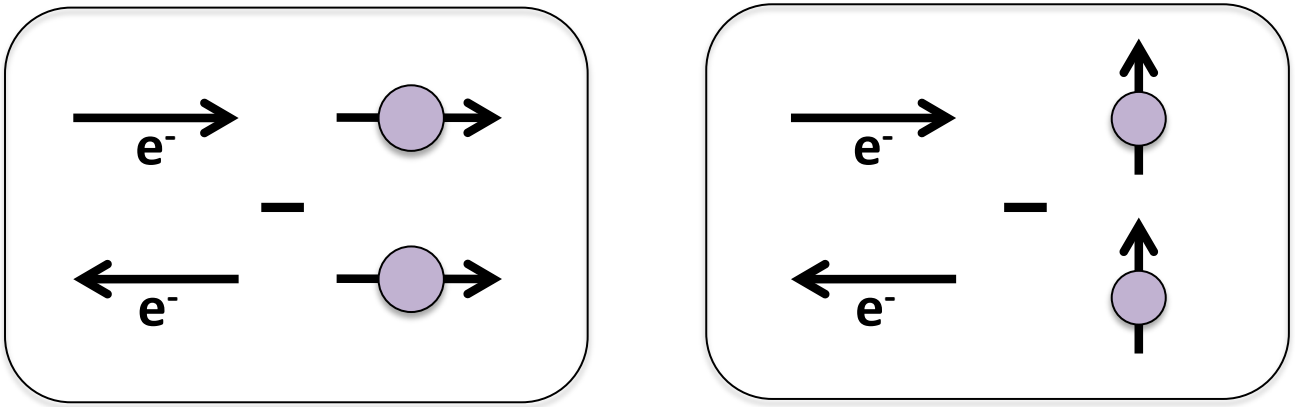
g_1, g_2: polarized structure functions



Motivation

- Measure a fundamental spin observable in region $0.02 < Q^2 < 0.20$ GeV^2 for the first time
- Test the Burkhardt-Cottingham Sum Rule at low Q^2
- Benchmark test X^{PT} with extraction of δ_{LT}
- Hyperfine splitting of hydrogen – contribution from g_2 is one of the leading uncertainties
- Proton Charge radius from μP lamb shift disagrees with eP scattering result

Experimental Technique



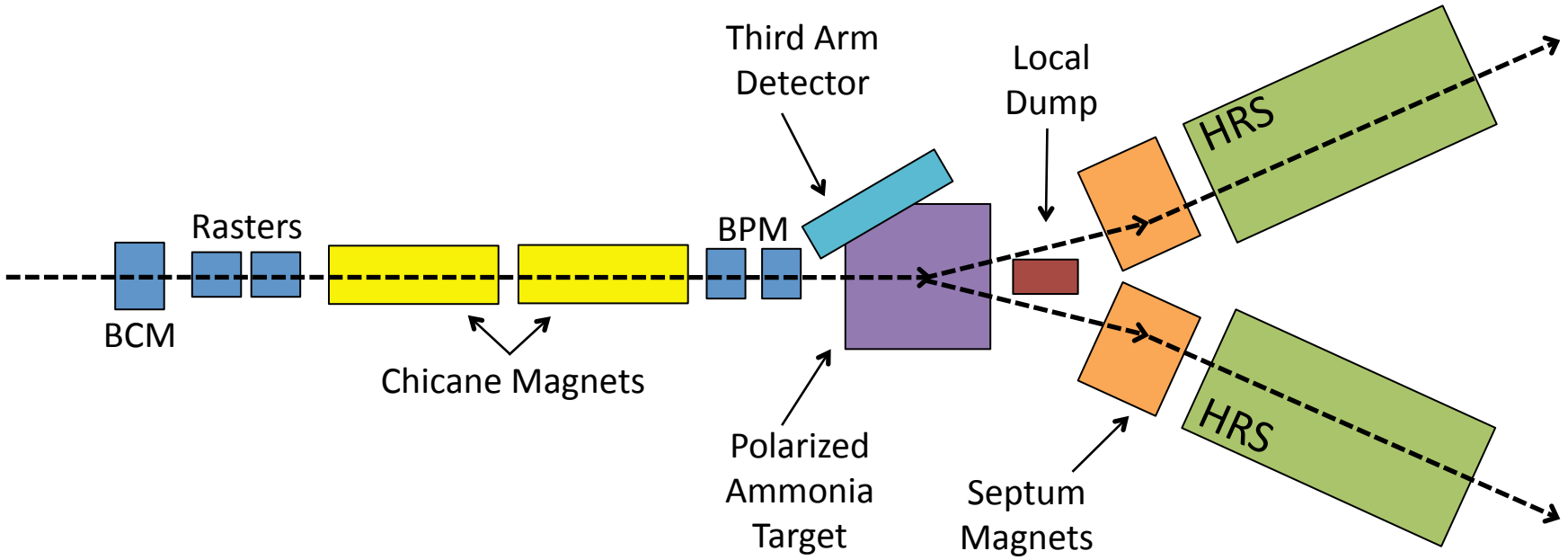
$$\frac{d^2\sigma}{dE'd\Omega}(\downarrow\Uparrow - \uparrow\Uparrow) = \frac{4\alpha^2}{MQ^2}\frac{E'}{\nu E}[(E + E'\cos\theta)g_1(x,Q^2) - \frac{Q^2}{\nu}g_2(x,Q^2)]$$

$\Delta\sigma_{||}$ measured during EG4 experiment in Hall B: extracted g_1^p at low Q^2

$$\frac{d^2\sigma}{dE'd\Omega}(\downarrow\Rightarrow - \uparrow\Rightarrow) = \frac{4\alpha^2\sin\theta}{MQ^2}\frac{E'^2}{\nu^2 E}[\nu g_1(x,Q^2) + 2Eg_2(x,Q^2)]$$

$\Delta\sigma_{\perp}$ obtained from g_2^p experiment and combined with EG4 data to obtain g_2^p

Experimental Setup



New Beamline Diagnostics:

- Rasters
- Beam Position Monitor
- Beam Current Monitor

Summary of Run

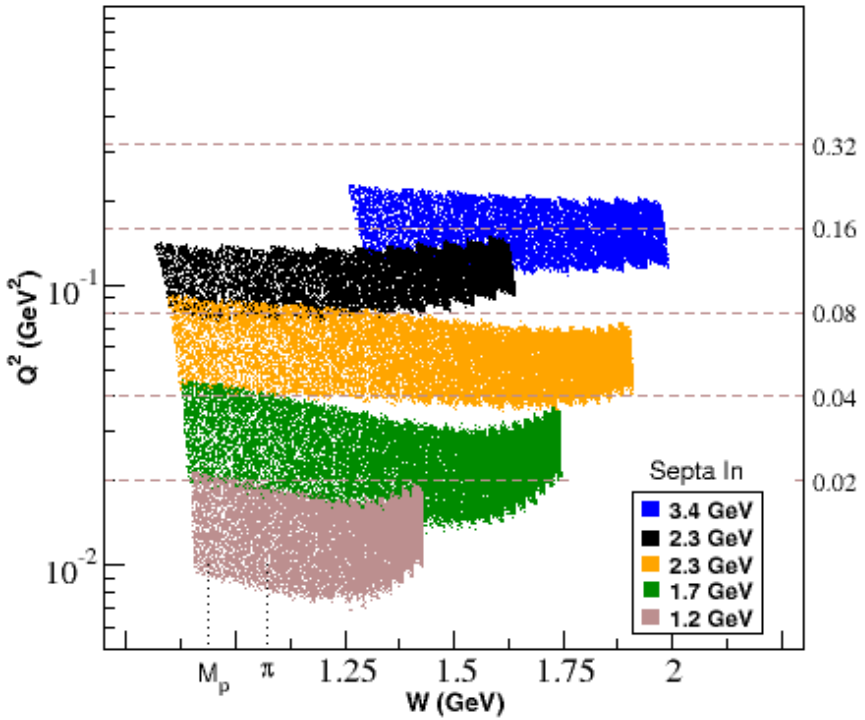
- Ran from 3/2/12 – 5/18/12

  $Mp < W < 2$ GeV

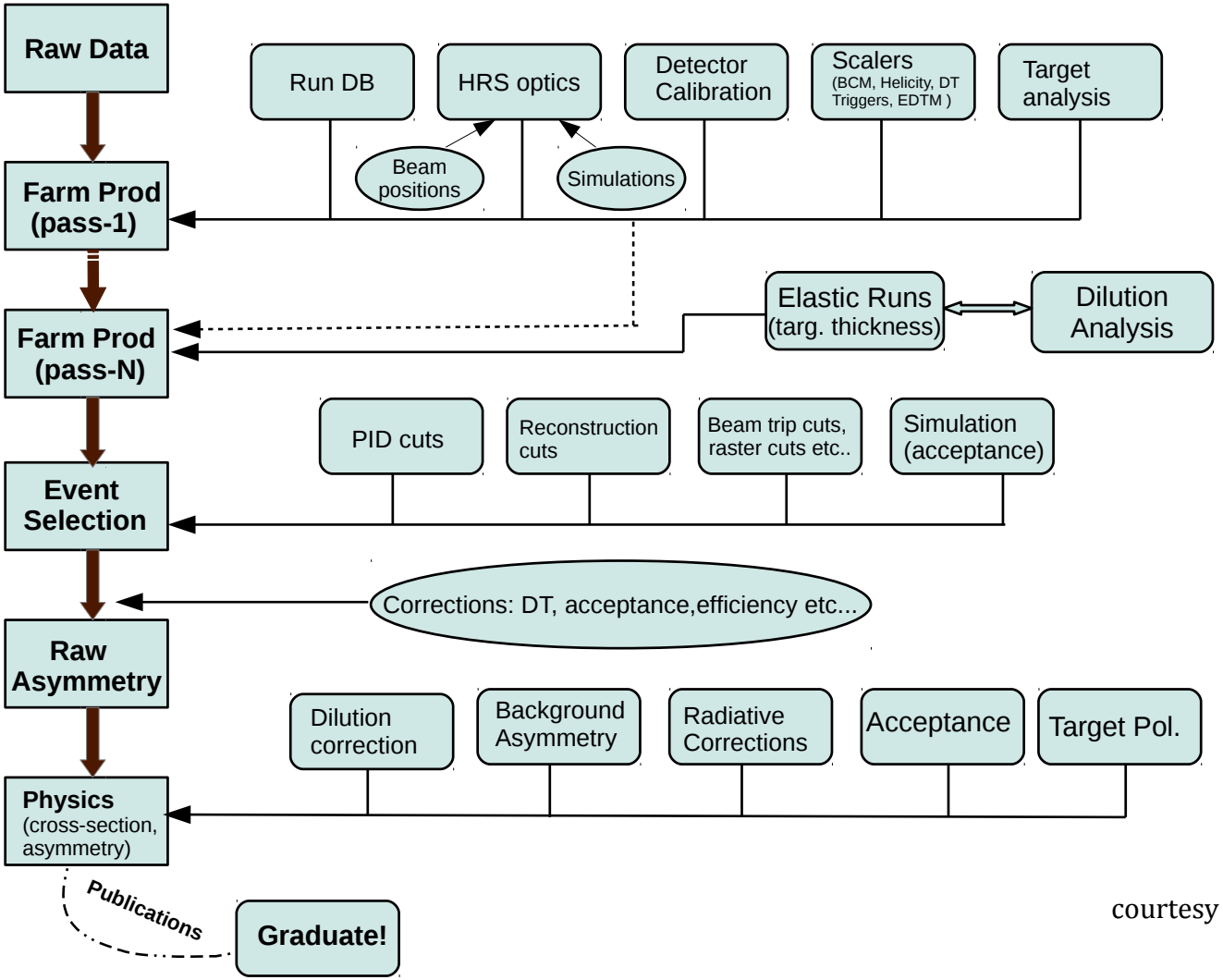
  $0.02 < Q^2 < 0.2$ GeV^2

Statistics		
Beam Energy (GeV)	Target Field (T)	# of Recorded Triggers
2.254	2.5	3.80E+09
1.706	2.5	3.20E+09
1.158	2.5	4.00E+09
2.254	5	7.00E+08
3.352	5	4.00E+08

Reduced Kinematics

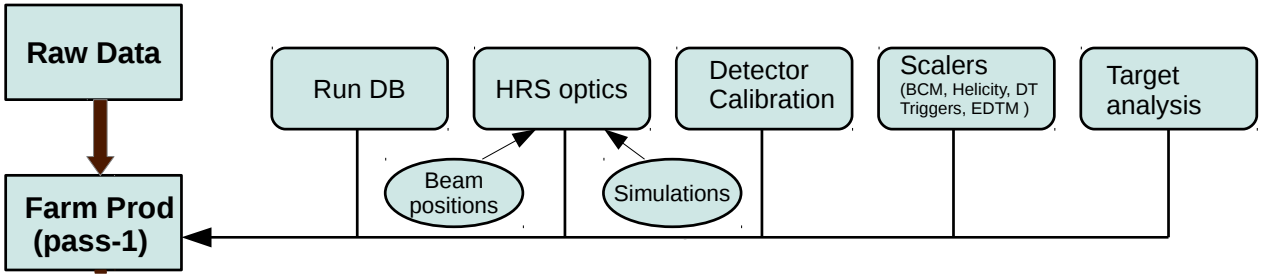


Status of Analysis



courtesy K. Allada

Status of Analysis



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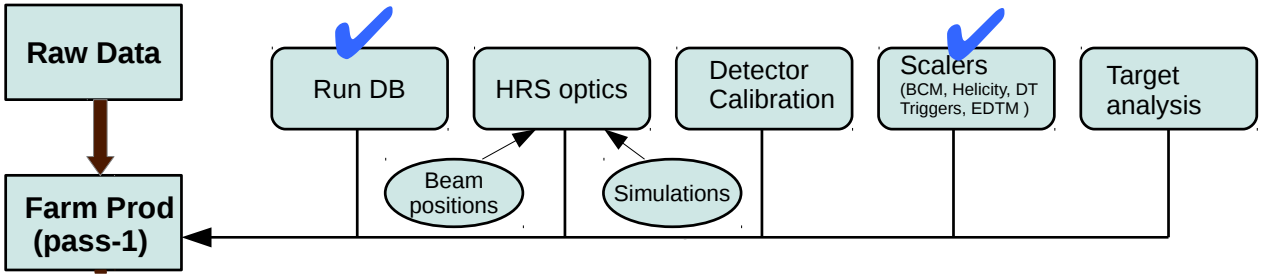
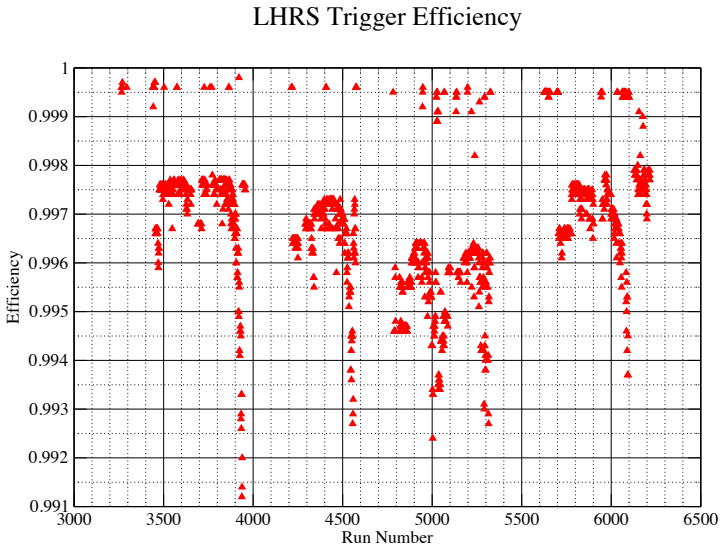


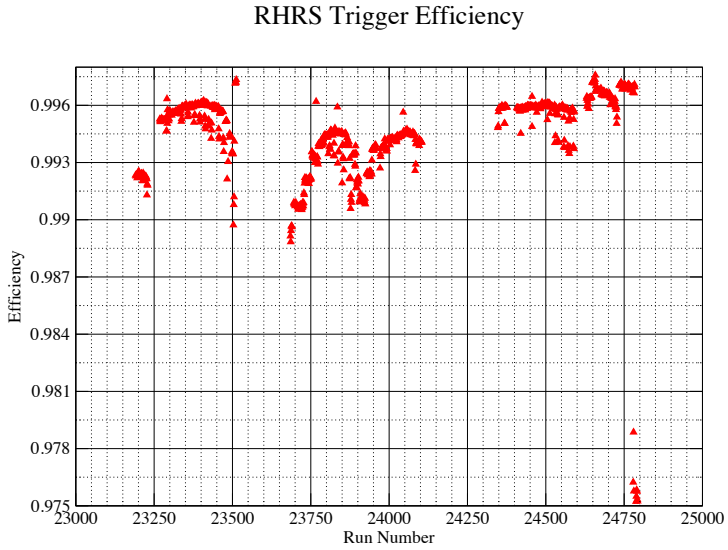
- Run DB is ready!
- BCM calibration complete!
- Helicity decoder finished!

Trigger Efficiencies

- Efficiency for the LHRS [RHRS]defined as: $\frac{T3[T1]}{T3[T1]+T4[T2]}$
  - T1,T3: singles triggers (s1 && s2m)
  - T2,T4: efficiency triggers (s1&&GC)||(s2m&&GC)

- Efficiencies are corrected for deadtime and prescales: $\frac{T_3 * PS_3}{1 - DT_3}$

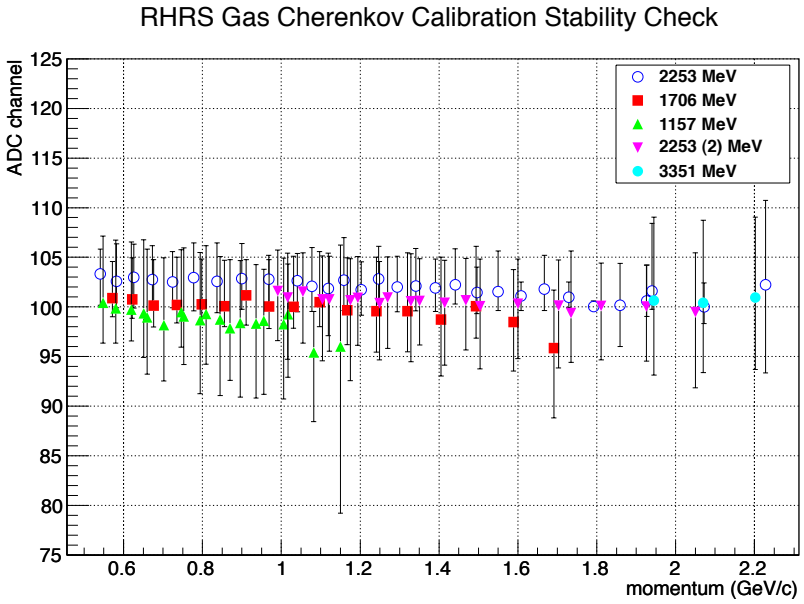


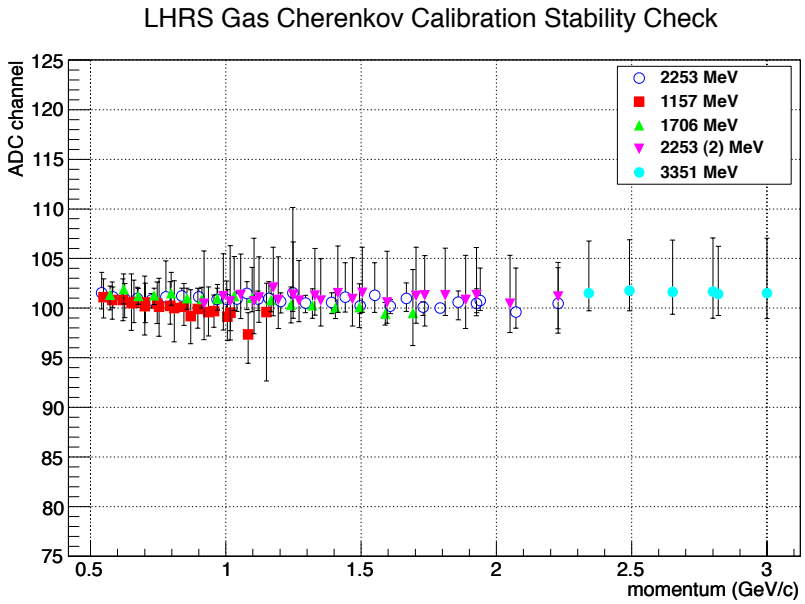


courtesy R. Zielinski

Detector Calibrations

- Gas Cherenkov
  - Isolate single photoelectron peak
  - Align to channel 100

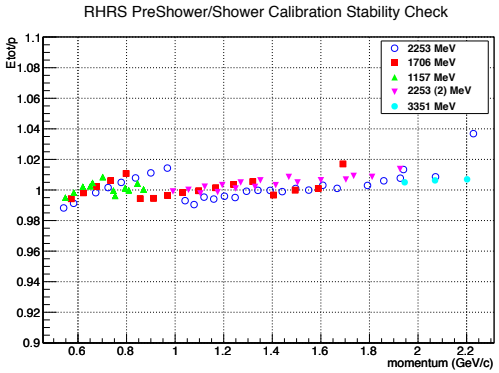


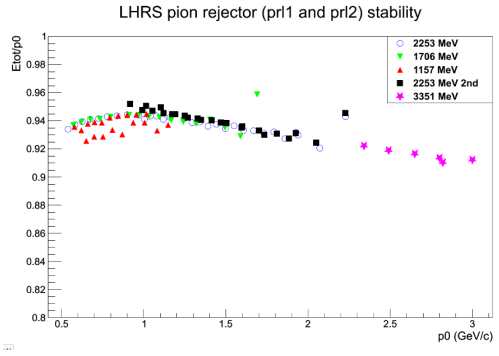


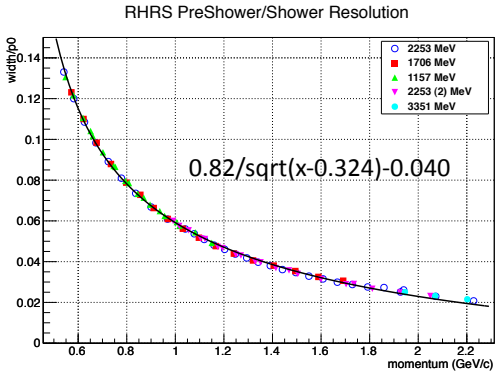
single photoelectron peak location – average of 10 channels

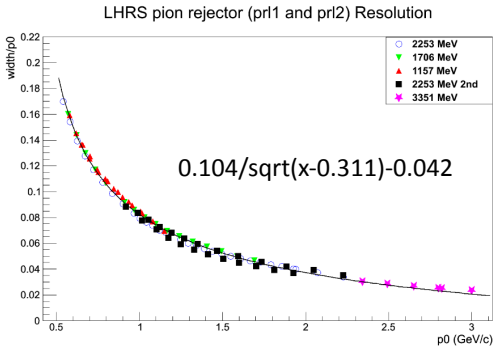
Detector Calibrations

- Lead Glass
  - Optimize calibration coefficients through minimization technique





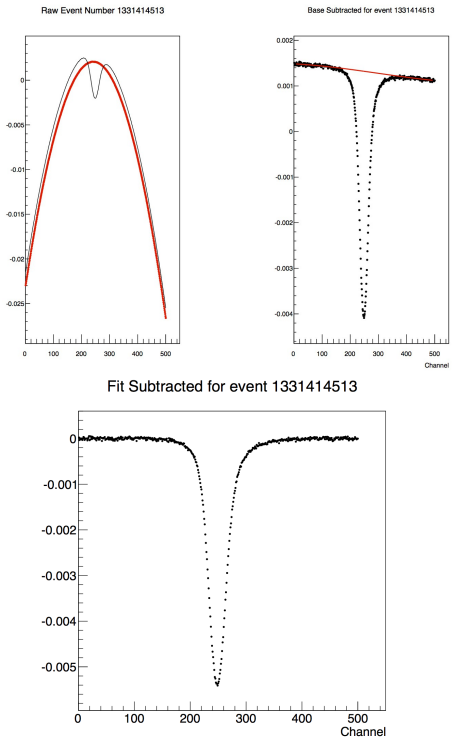


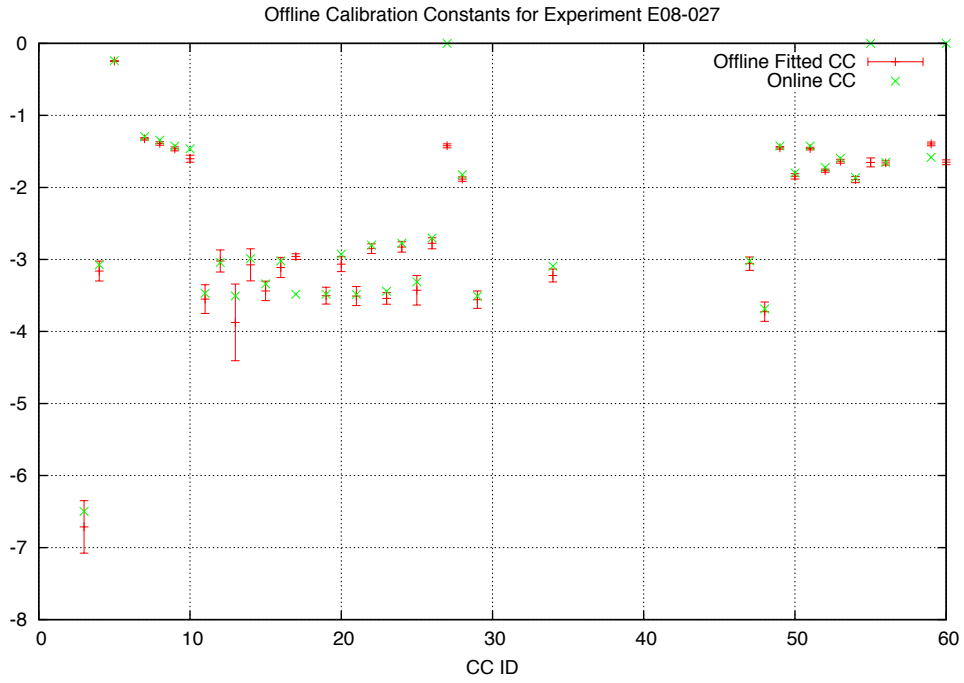


courtesy J. Liu

Target Polarization

- Offline Calibration Constants
  - Baseline subtracted from raw signal, 3rd order polynomial fit to wings

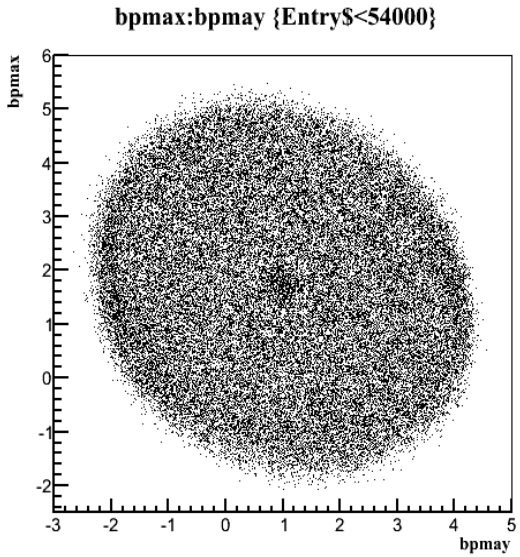


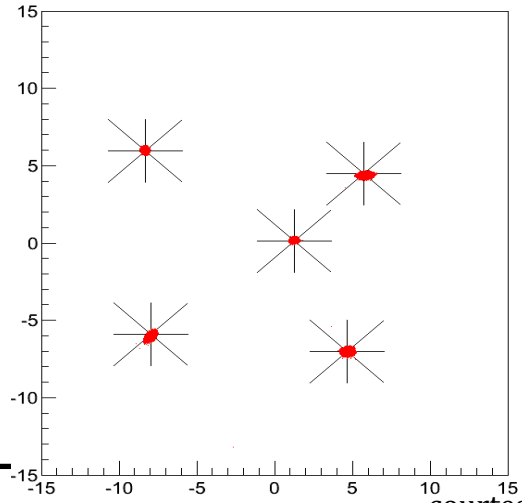


courtesy T. Badman

BPM Calibration

- Straight-thru calibration done!
- New method to calculate beam position from 4 antennas
- Additional transfer function from BPM to target for strong transverse target field (still in progress)
- New independent package for BPM information
- Outstanding Problems
  - Nonlinearity from big raster
  - BPM noise for low current



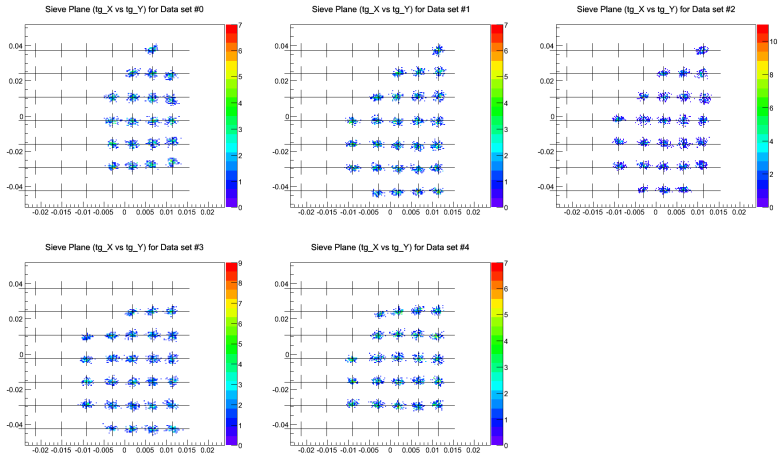


courtesy P. Zhu

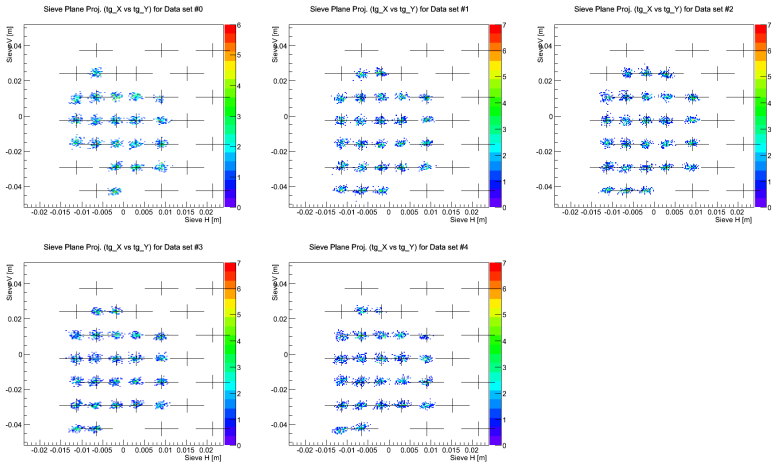
Straight-Thru Optics

- Settings
  - Beam energy 2.253GeV
  - 0T target field at 6 deg, GEP target magnet configuration
  - Good septum: 484816 coils set
- Matrix Angle Calibrations show below

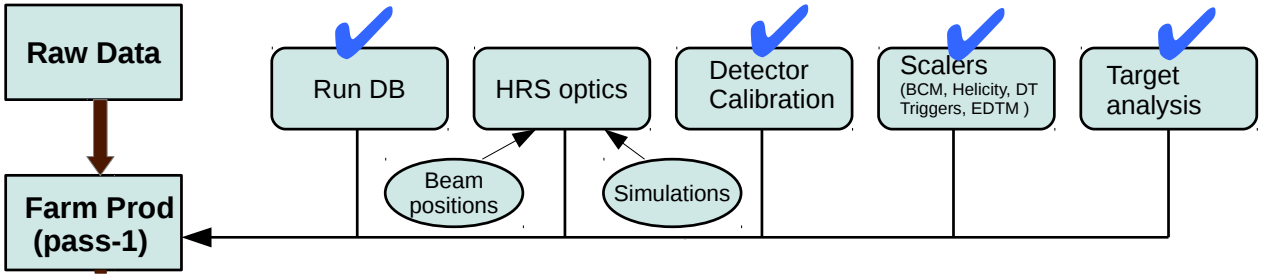
RHRS delta scan: (-3.5%, -1%, 0, 2%, 3.5%)



LHRS delta scan: (-3%, -2%, 0, 2%, 3%)



Up Next



- Optics for non straight-thru – in progress
- BPM calibrations for non straight-thru – in progress
- Preparing for first pass of farm production