GDH Analysis

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Pol. ^{3}He Collaboration Meeting

April 10^{th}, 2006

- Analysis Software: Analyzer
- BCM Offsets
- Scaler Analysis
- Acceptance
- Summary

Analysis Software: Analyzer

Recent Updates:

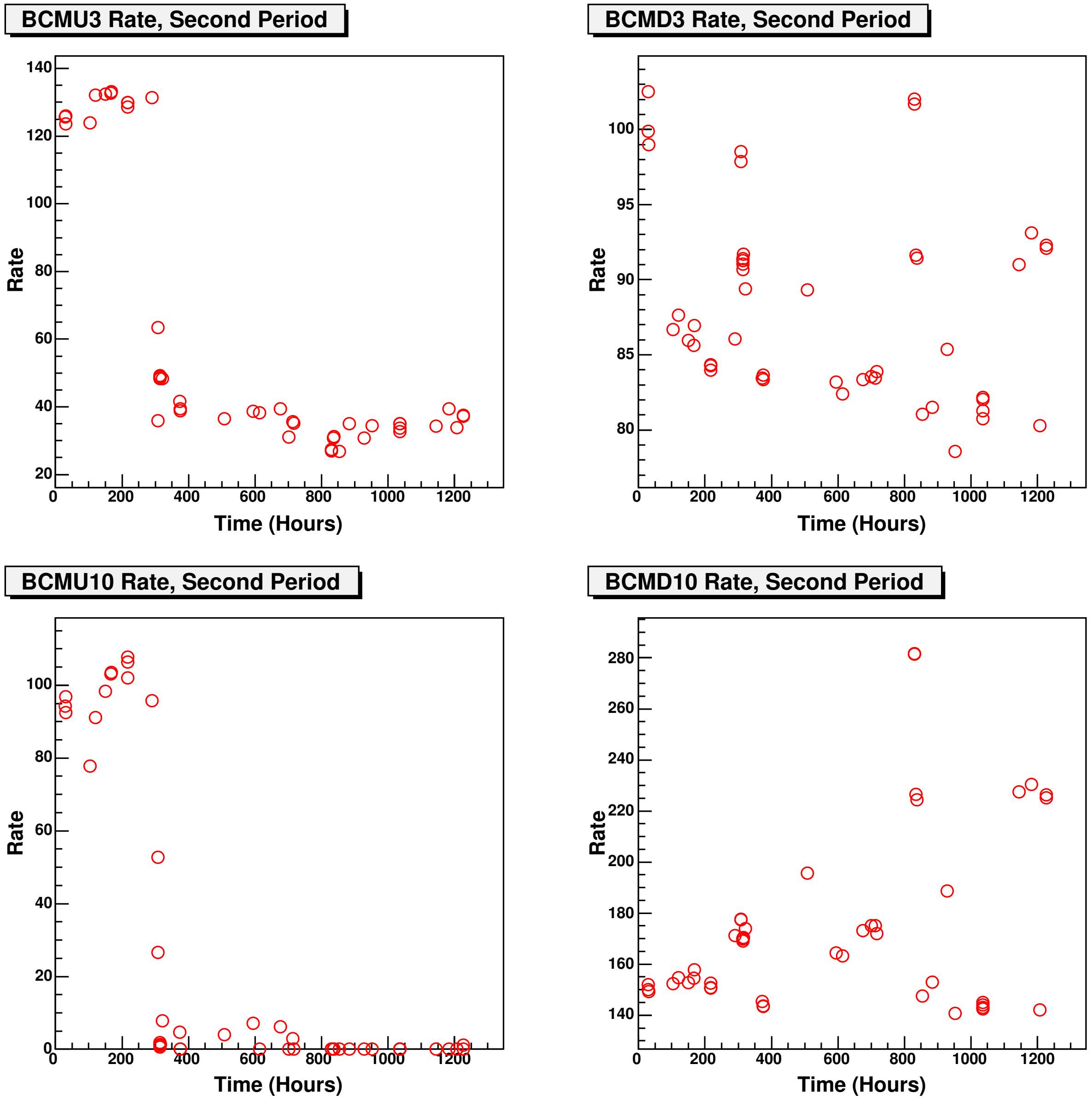
- Fixed problem with helicity gated scaler rates.
- Bug found and fixed with helicity decoding after deadtime burps (R. Holmes).
- New helicity module
  - Allows one to switch the helicity mode (G0 delayed or in-time).
  - Includes helicity variables for debugging.
  - Helicity from new module agrees with original module for in-time and delayed modes.
- Version 1.4.0 ready for use.

Helicity from the Analyzer

- Used G0 delayed mode for first period.
- High dead time runs have numerous zero helicity events.
  - Seonho fixed this in ESPACE by using T9 events.
  - Rob Feuerbach has agreed to work on this in the Analyzer.
- Wrote a new ring buffer module for the Analyzer.
  - Helicity decoding of the ring buffer looks good even when physics events have deadtime burps.
  - Replay for entire runs needs to be checked.
  - Needs to be checked versus Bob's scaler code.
  - Ring buffer could be used to analyze the first period data.

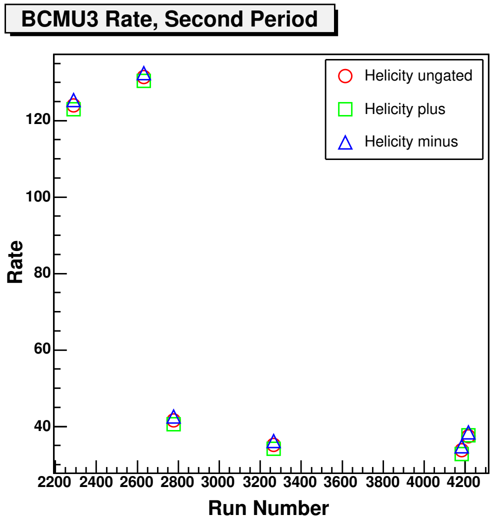
BCM Offsets

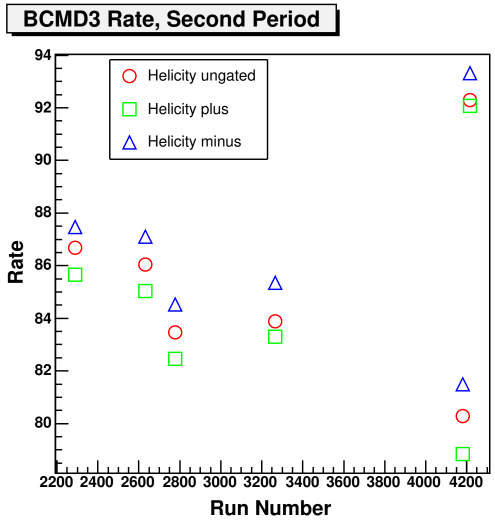
- Replayed second period cosmic runs to obtain the BCM offsets.
- Drop in U3, U10 and D1 shortly before Penelope ruptured.
  - Affects about 50 runs, 40 before and 10 after the drop.
  - Appears to happen over a few runs.
  - Used linear interpolation for the runs in the drop period.
  - At 0.1 μA , systematic of 1% for U10.
- The D10 offset fluctuates between 140 to 280.
- Otherwise the offsets are reasonably stable.

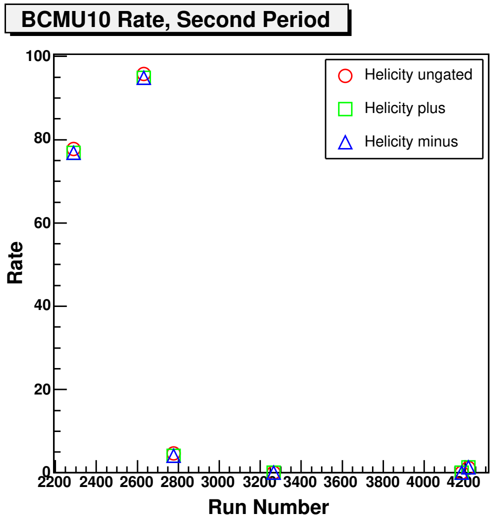

BCMU3 Rate, Second Period
Rate
Time (Hours)
BCMD3 Rate, Second Period
Rate
Time (Hours)
BCMU10 Rate, Second Period
Rate
Time (Hours)
BCMD10 Rate, Second Period
Rate
Time (Hours)

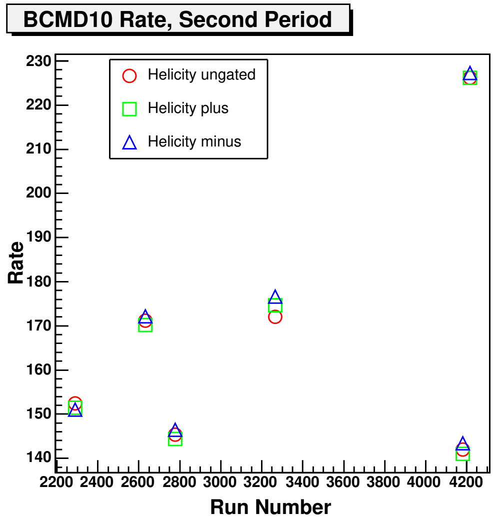
BCM	Offset	Uncertainty	Range (Run #)
u3	129.1	1.0	2284 - 2632
u3	63.7 - 132.1	28.3	2643 - 2685
u3	37.7	1.1	2686 - 4217
d3	88.2	0.9	2284 - 4217
u10	97.6	2.4	2284 - 2632
u10	52.6 - 93.4	17.9	2643 - 2685
u10	1.25 - 26.9	5.2	2686 - 2697
u10	1.3	0.4	2698 - 4217
d10	152.0 - 171.3	2.0	2284 - 3265
d10	225.4	1.1	3485 - 3486
d10	150.6	5.6	3486 - 3854
d10	210.3	19.5	4073 - 4217

Circles: ungated, Squares: helicity plus, Triangles: helicity minus.







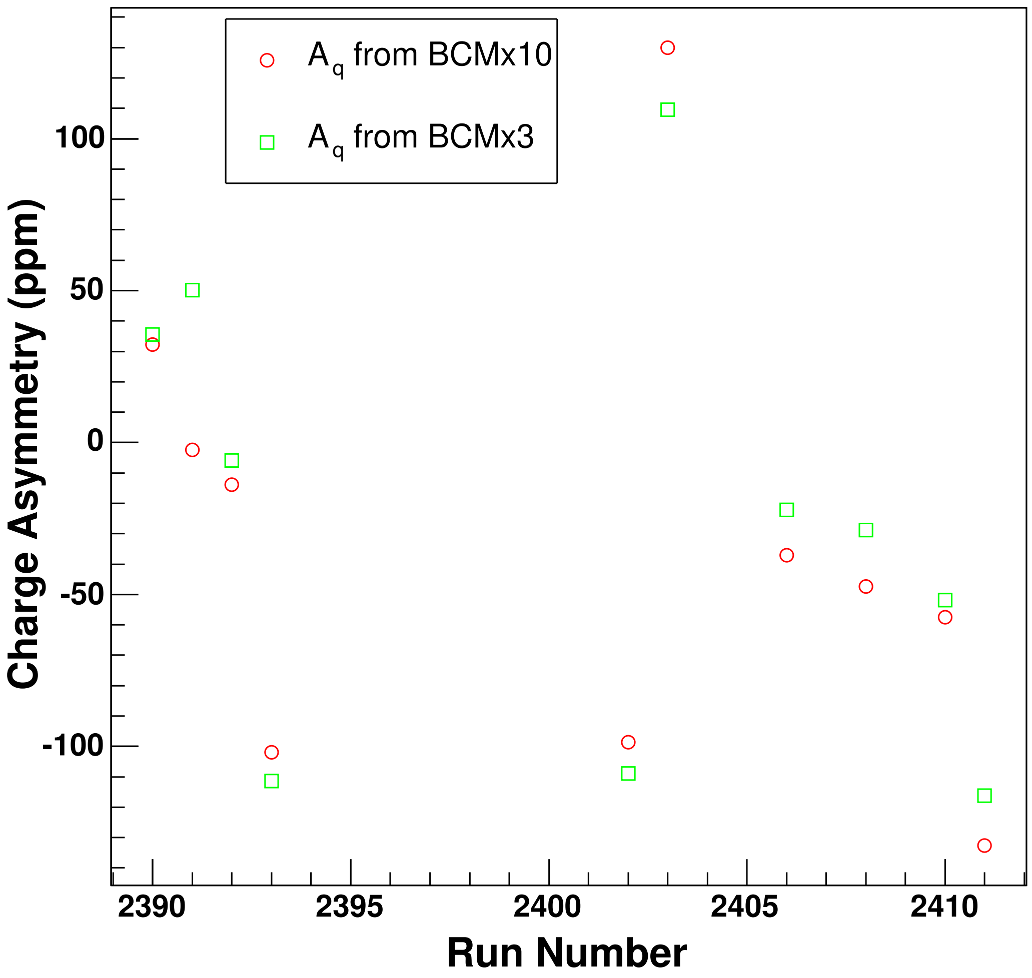


Scaler Overview

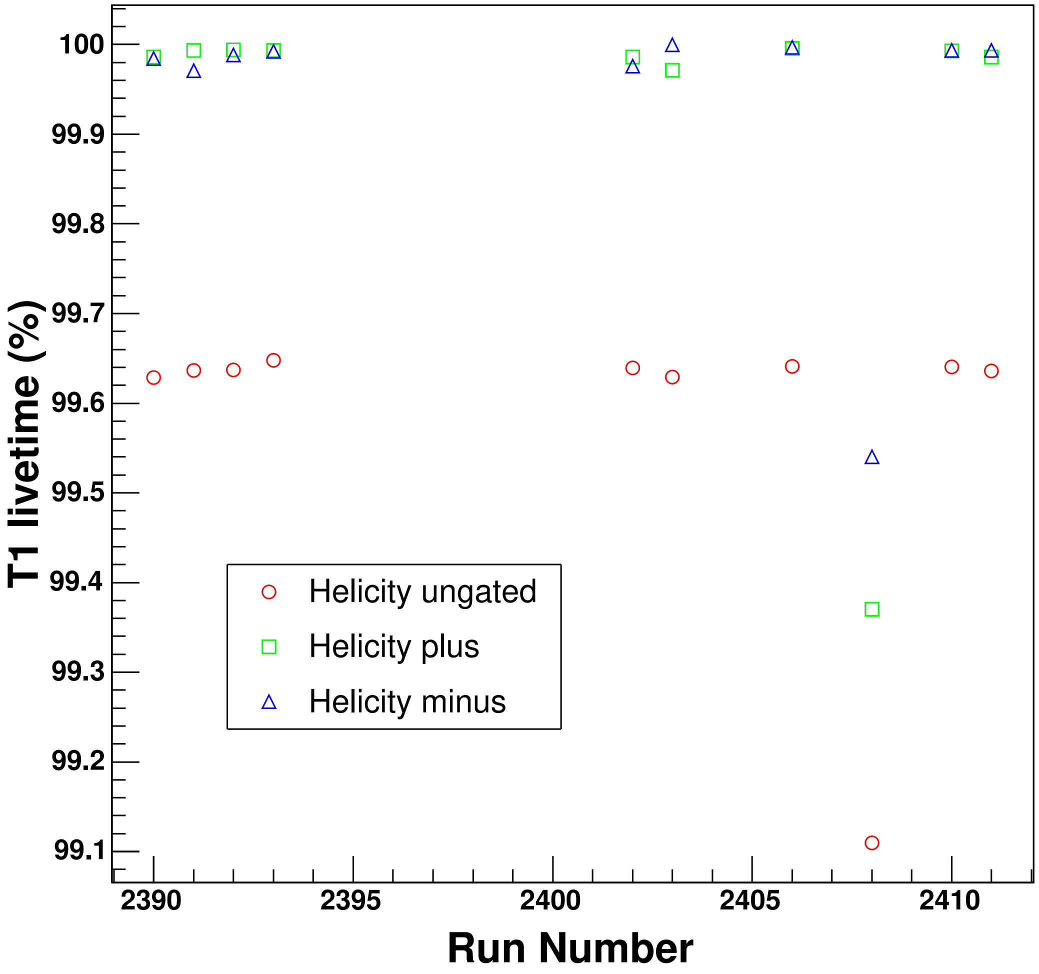
- Asynchronous scalers (T140) are available in the Analyzer.
- Synchronous scalers and ring buffer (ROC10/11) also available.
  - These scalers are missing the final reading at the end of the run.
  - Final scaler reading from ROC 10 exists as event type 100.
  - Code does not exist to extract this event.
- TS2 scalers exists, but not currently supported in the Analyzer.

Scaler Analysis

- Analyzed 10 acceptance runs for 2.134 GeV, 6° data.
  - Extracted charge and livetime from event 140.
  - Scalers from data agree with end-of-run file.
  - One run disagreed, but the HALOG is wrong (B. Michaels).
- Analyzed large charge asymmetry run (2418).
  - A_{q}(BCMx3) = -3.33%, A_{q}(BCMx10) = -3 .36%
  - A_{q}(Moller) = 3.37% (HALOG # 106475)
  - Raw Asymmetry: A_{raw} = 3.50%, sign already corrected!
  - From Alexandre's online analysis A_{raw} = 3.52% (included PID cuts).
- Tim will finish the scaler analysis.



A_q from BCMx10
A_q from BCMx3
100
50
0
-50
-100
Charge Asymmetry (ppm)
2390
2395
2400
2405
2410
Run Number



100
99.9
99.8
99.7
99.6
99.5
99.4
99.3
99.2
99.1
T1 livetime (%)
2390
2395
2400
2405
2410
Run Number
Helicity ungated
Helicity plus
Helicity minus

Acceptance for saGDH

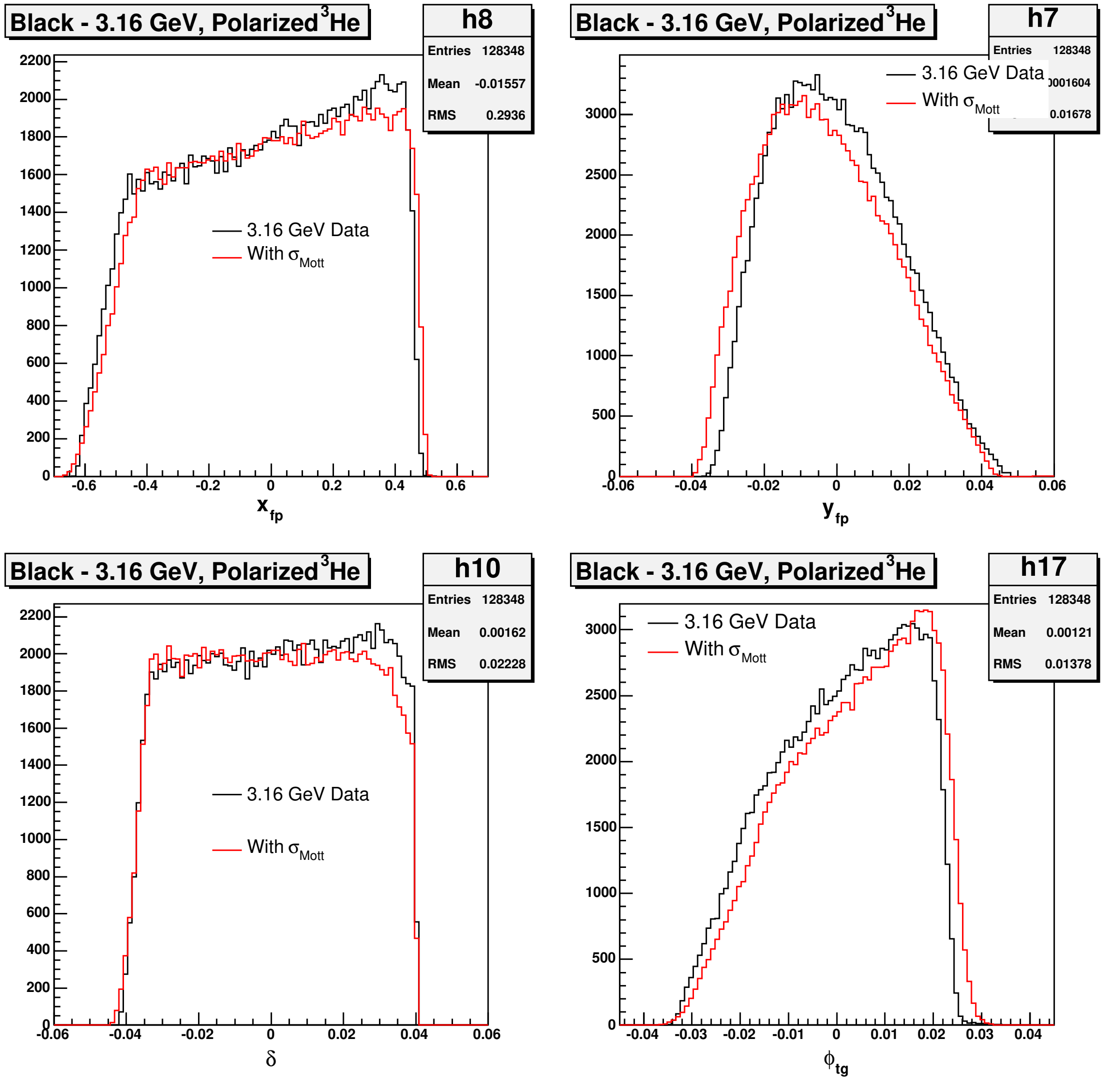
Inelastic ^{3}He data at 6°:

- Useful exercise in looking at the target collimators.
  - Cuts now based on collimator position from the 6° spectrometer line.
  - Calculate $y_{\rm coll}$ (similar to $y_{\rm sieve}$), which is zero on the 6° line.
  - Z is the location of the collimator along the beamline..

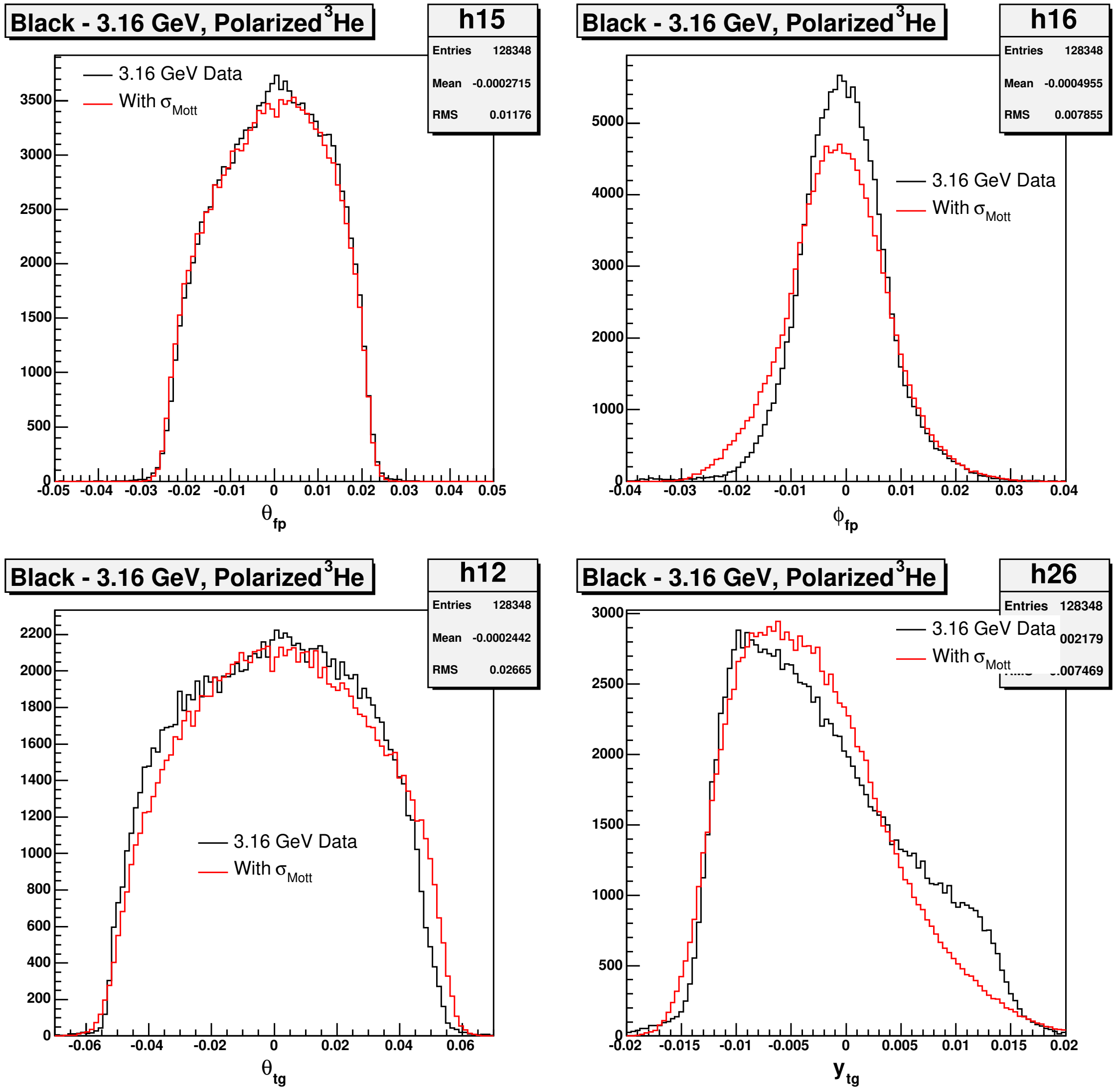
$$L_{\rm coll} = Z' = \frac{Z}{\cos\theta_0} \tag{1}$$

$$y_{\rm coll} = y_{\rm tg} + L_{\rm coll} \tan\phi_{\rm tg} \tag{2}$$

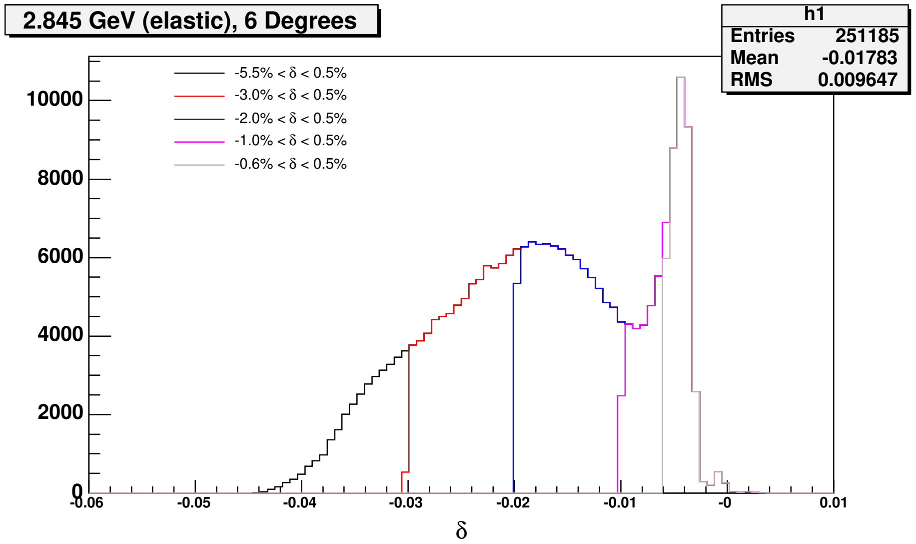
Black: data, red: simulation.

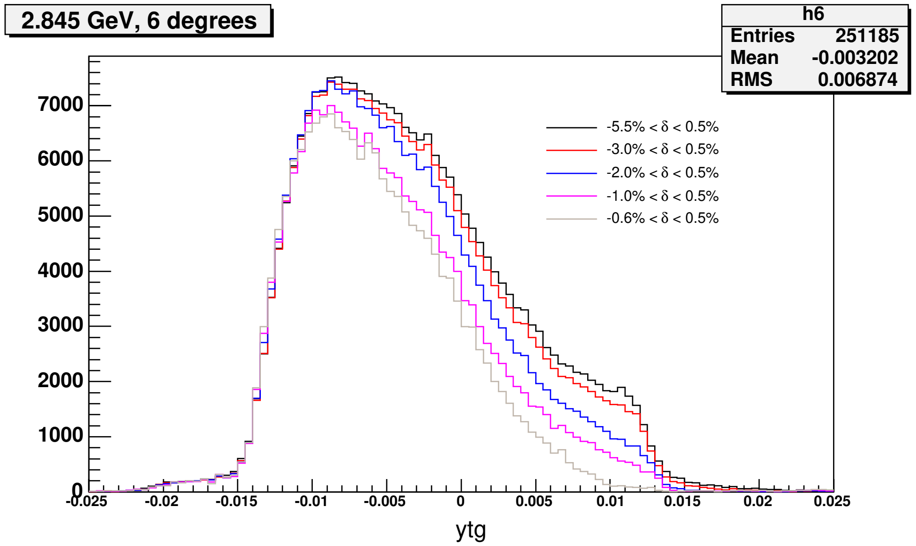


Contamination from collimator punch-throughs in y_{tg}.

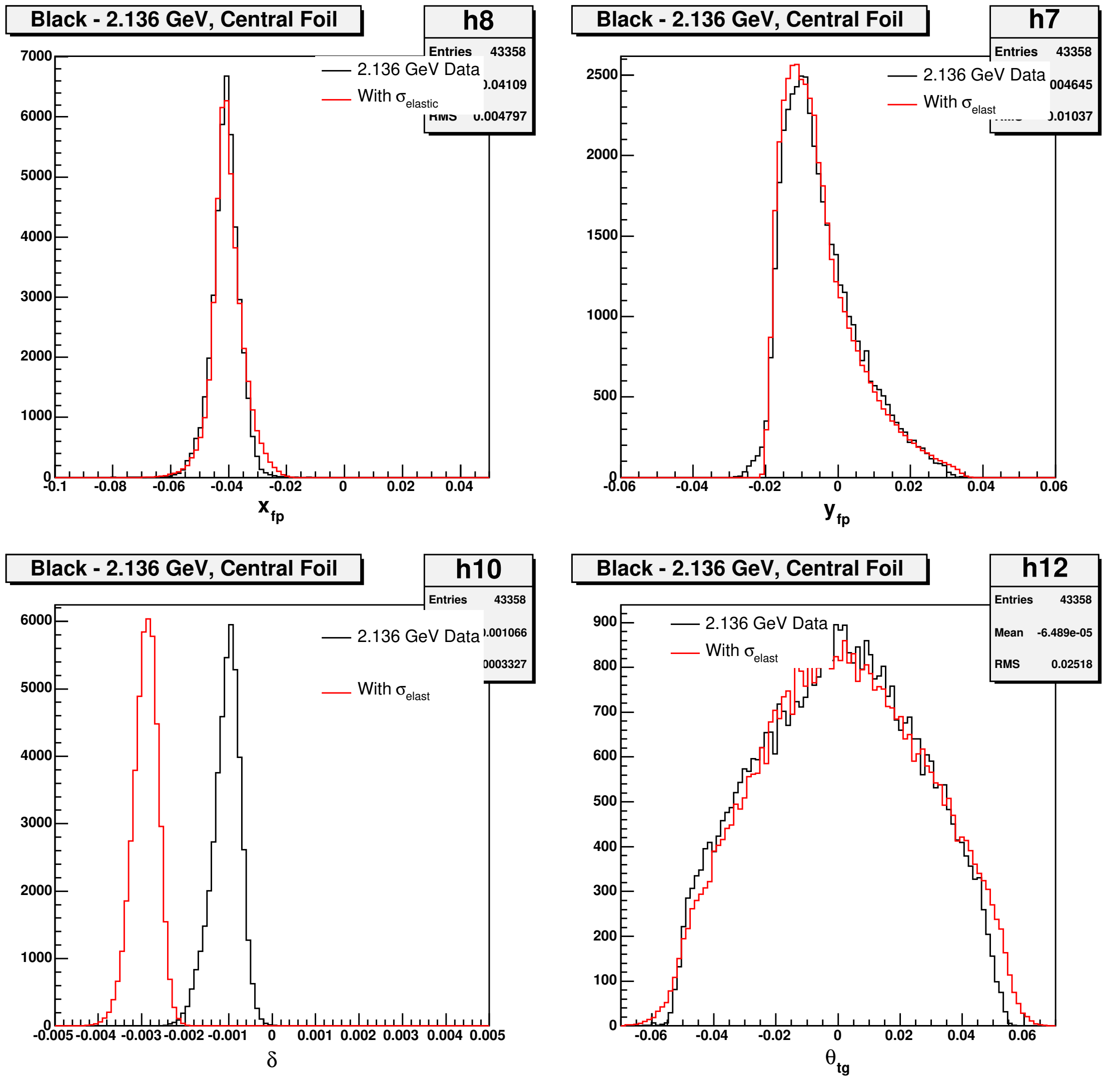


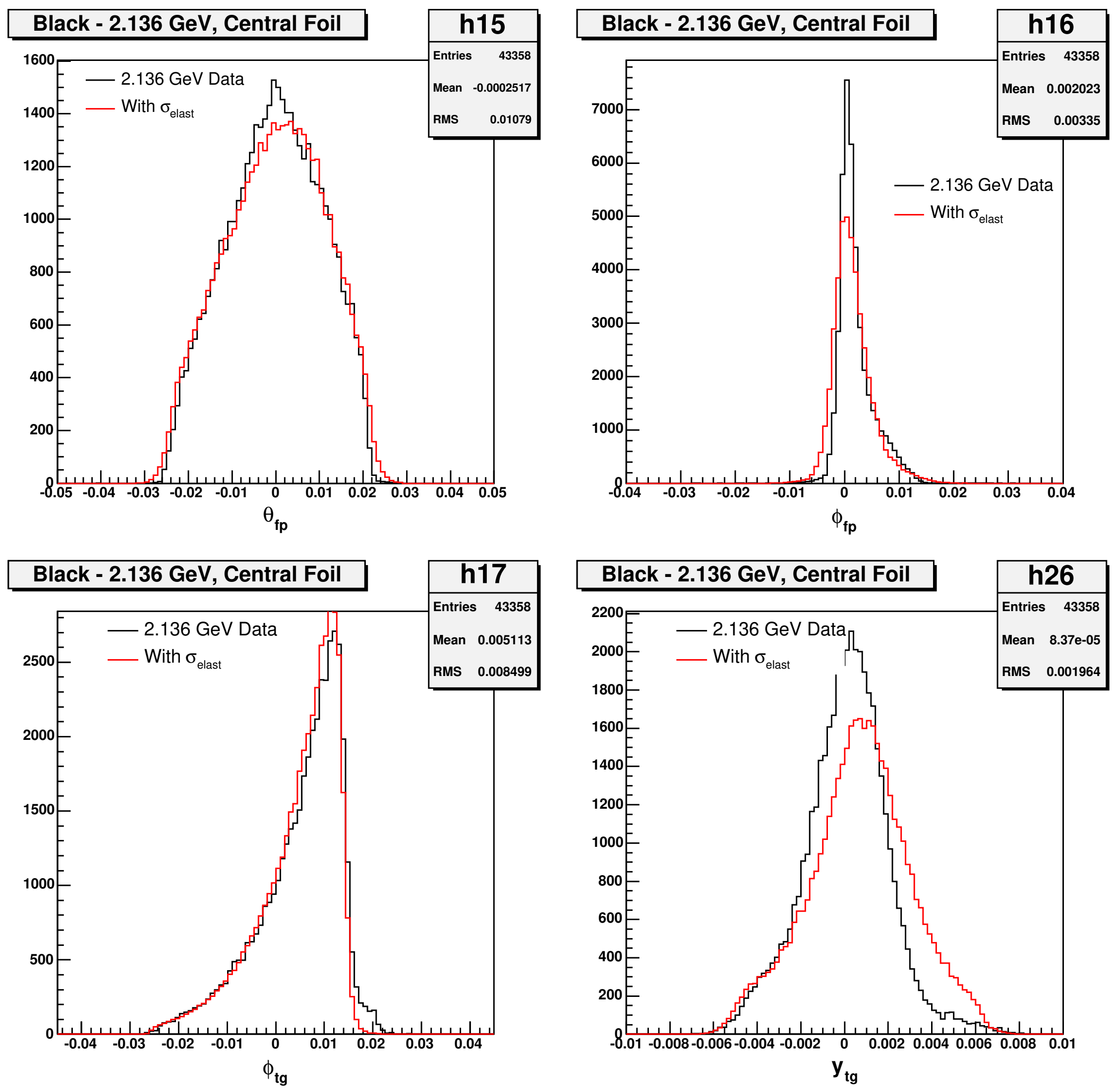
Punch-throughs can be removed with an elastic cut.





Elastic ^{12}C Foil Comparison. Black: data, red: simulation.





Black - 2.136 GeV, Central Foil
h15
Entries 43358
Mean -0.0002517
RMS 0.01079
2.136 GeV Data
With σ_{elast}
θ_{fp}
Black - 2.136 GeV, Central Foil
h16
Entries 43358
Mean 0.002023
RMS 0.00335
2.136 GeV Data
With σ_{elast}
ϕ_{fp}
Black - 2.136 GeV, Central Foil
h17
Entries 43358
Mean 0.005113
RMS 0.008499
2.136 GeV Data
With σ_{elast}
ϕ_{tg}
Black - 2.136 GeV, Central Foil
h26
Entries 43358
Mean 8.37e-05
RMS 0.001964
2.136 GeV Data
With σ_{elast}
y_{tg}

Simulation for Carbon Elastic

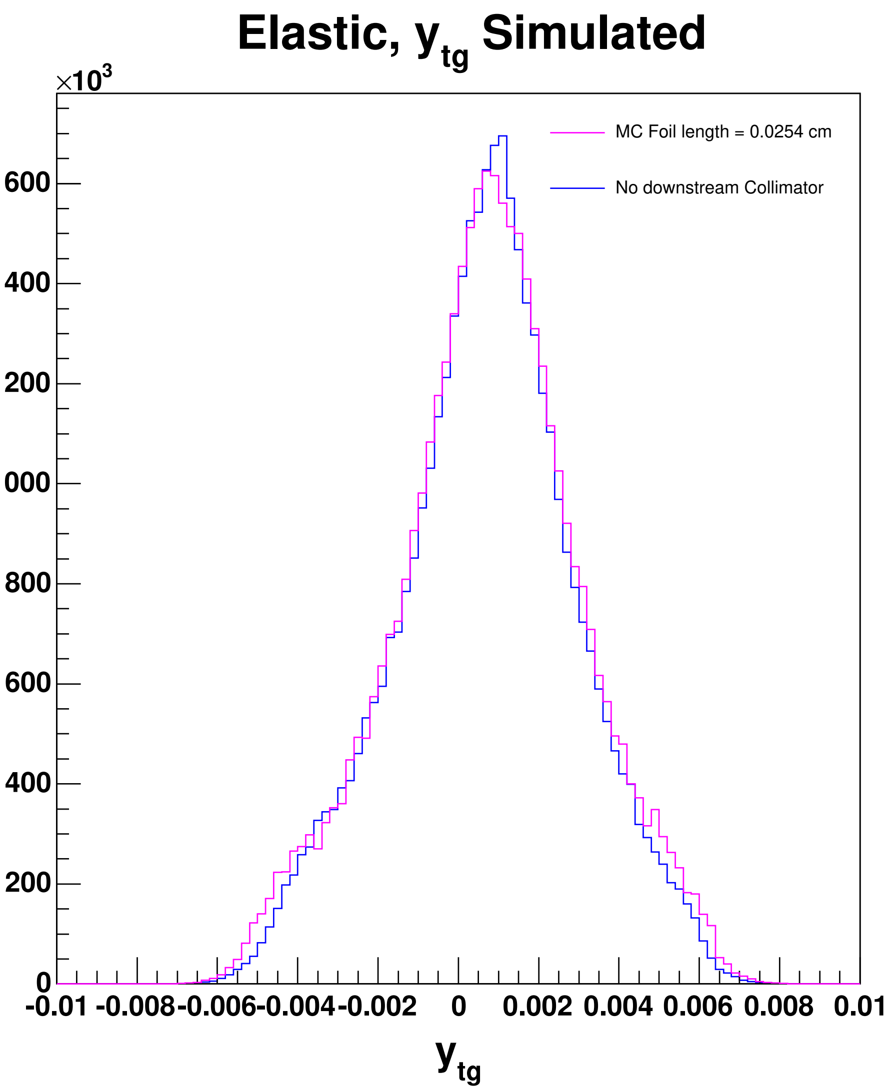
- ϕ_{fp} distribution.
  - Problem with transfer function.
  - Probably not a major issue.
- y_{tg} distribution.
  - Problem with transfer function?

    Probably not (See ^{3}He elastic).
  - Problem with collimator cut?

    ϕ_{tg} and y_{fp} look fine.
  - Problem with skewed optics?

    Most likely source of asymmetric shape in the data.

Magenta: with collimator cut, Blue: without collimator cut.



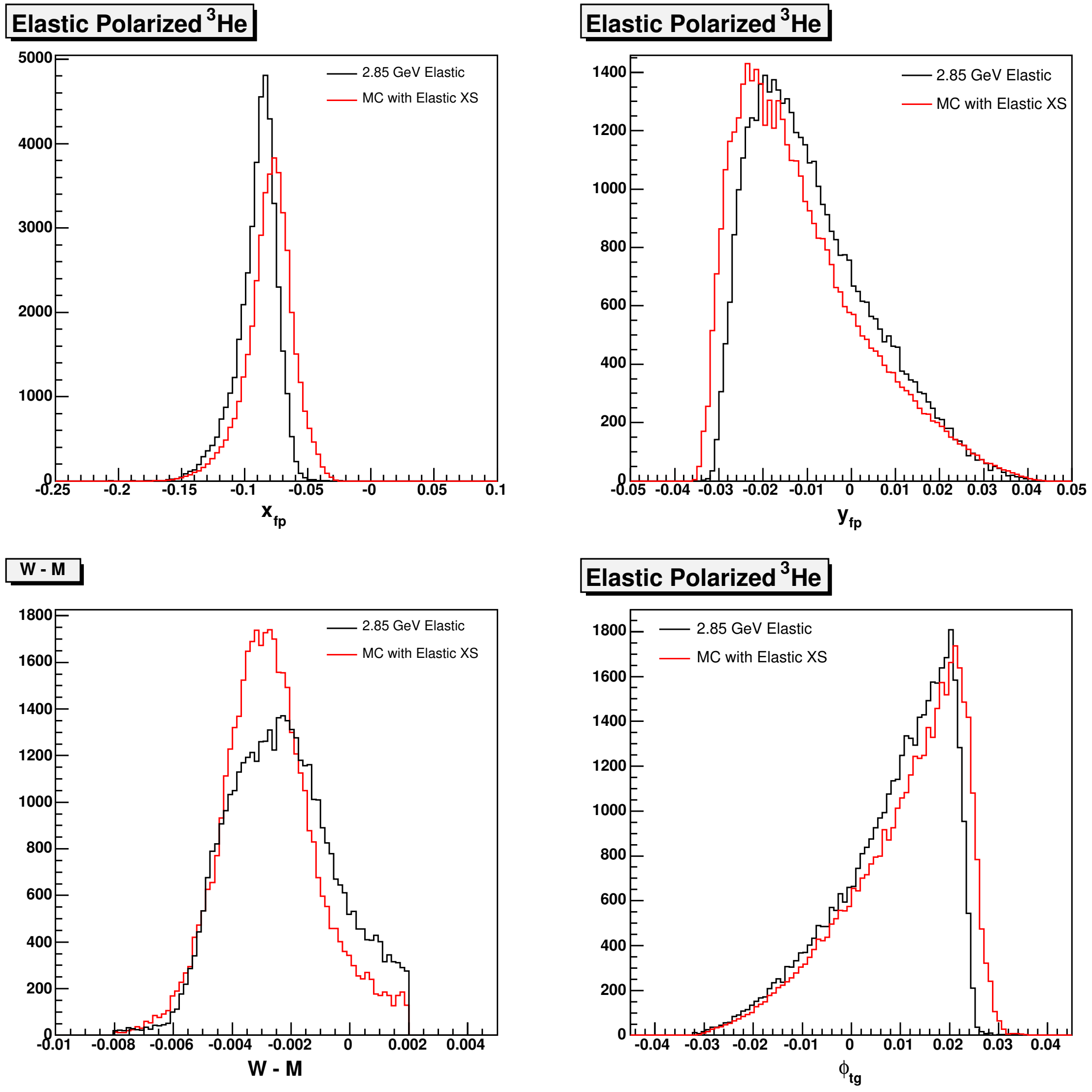
Carbon Elastic Cross Section

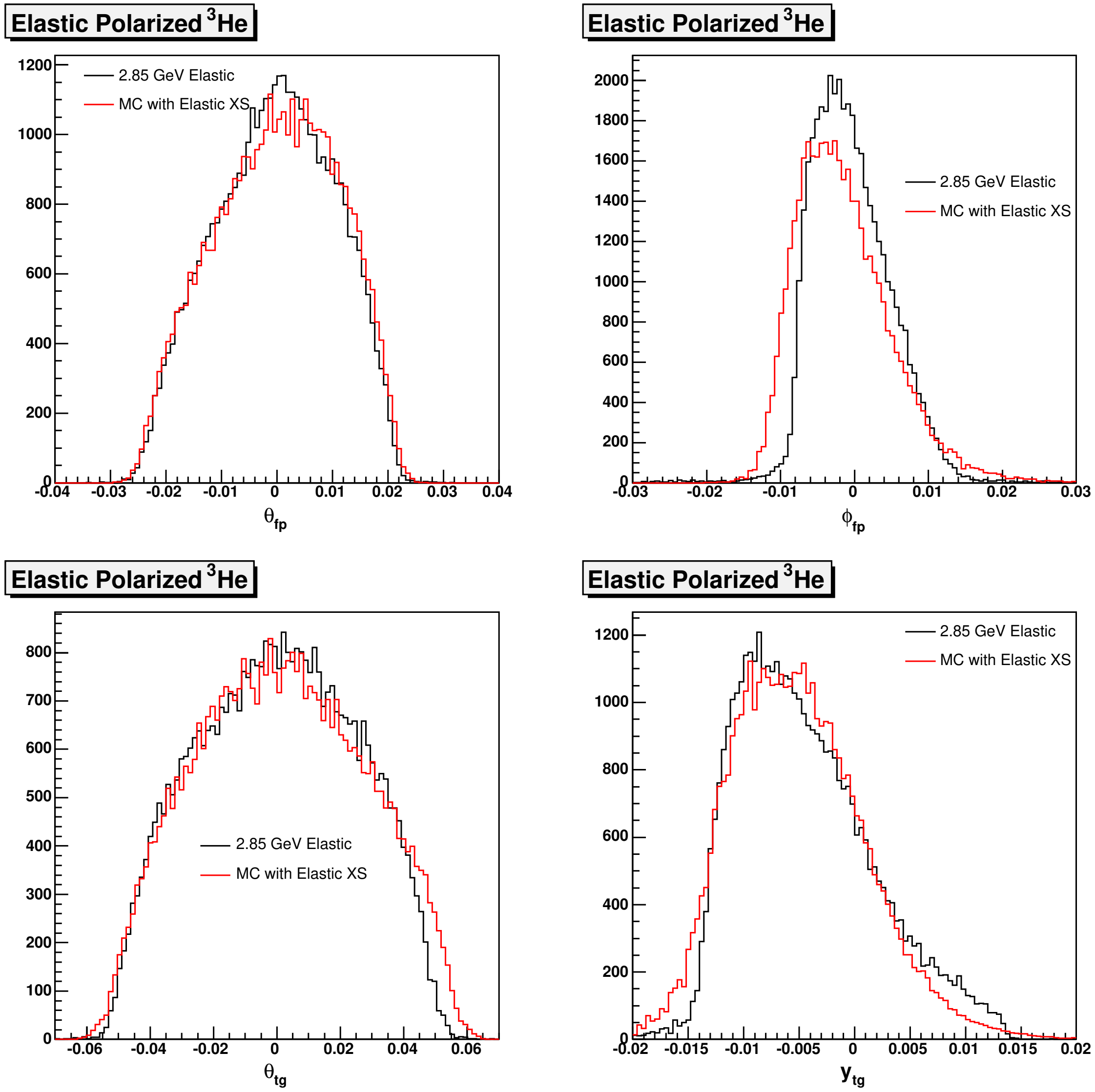
- Preliminary cross section results:
  - Using final lifetime and charge.
  - 50 mg cm^{-2} foil density?
  - Cross section between data and simulation agree at 1% level.
- To Finish ^{12}C elastic cross section:
  - Finalize a couple radiation lenths in MC.
  - Obtain correct density of foils (Nilanga).
  - Acceptance cut study.
  - Compare all delta settings.
  - Calculate errors and uncertainties.

Simulation for ^{3}He Elastic

- Ran MC for elastic ^{3}He data at 2.845 GeV, 6°.
- Check y_{tg} for the extended target distribution without collimator contamination.
- Preliminary results show good agreement for the extended y_{tg} target spectra for elastic data.
- Need to update radiation lengths and optimize cuts.

Black: data, red: simulation.




Elastic Polarized ³He
2.85 GeV Elastic
MC with Elastic XS
θ_fp
Elastic Polarized ³He
2.85 GeV Elastic
MC with Elastic XS
ϕ_fp
Elastic Polarized ³He
2.85 GeV Elastic
MC with Elastic XS
θ_tg
Elastic Polarized ³He
2.85 GeV Elastic
MC with Elastic XS
y_tg

Remaining Issues and Tasks

- Check carbon data for source of $y_{\rm tg}$ asymmetric shape?
- Finish ^{12}C elastic cross sections.
- Study acceptance cut dependency.
- ^{3}He elastic asymmetries and cross sections.
- ^{3}He inelastic:
  - Looks reasonable.
  - Need a model to subtract collimator background.
- Check data with simulation at 9°.
- Generate new transfer functions for 9°.

Summary

- New modules to check helicity for both periods.
- Helicity for high deadtime runs needs to be recovered, first period.
- Determined BCM pedestals for the second run period.
- Began scaler analysis, which Tim will finish.
- Acceptance
  - Comparisons with ^{12}C and ^{3}He elastic data look good at 6°.
  - Comparisons with inelastic ^{3}He data are reasonable at 6°.
  - Preliminary ^{12}C cross section looks fine.
  - $y_{\rm tg}$ for foil data has an asymmetric shape.
  - Inelastic data have background from the target collimators.

Still To Do

- Calculate ^{12}C and ^{3}He elastic cross sections.
- Acceptance study at 9°.
- Raster calibration.
- Calculate unpolarized cross sections.
- Calculate asymmtries and polarized cross sections.
- Finish technote for Duality target analysis.
- Write up gradient studies for saGDH.