

GDH Analysis

Vincent Sulkosky

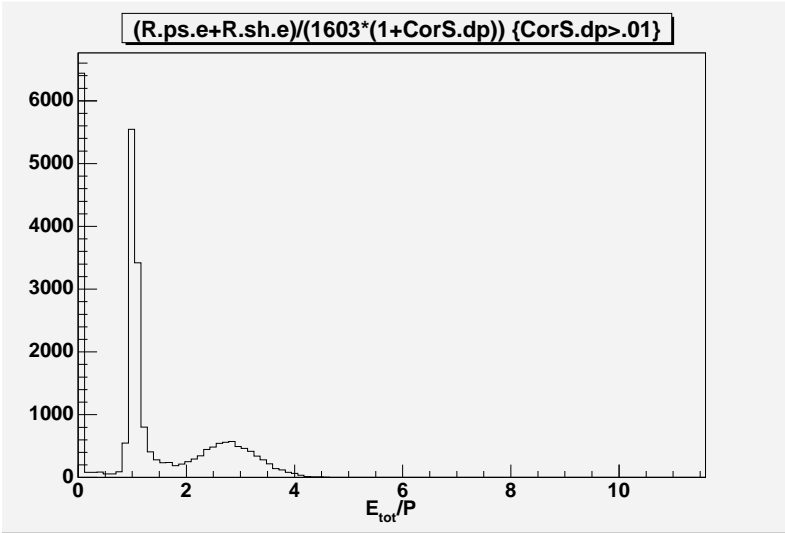
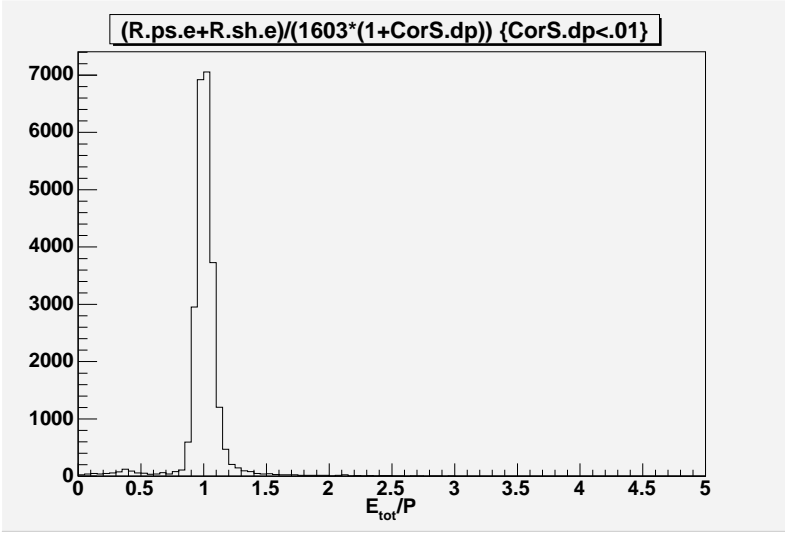
Pol. ^3He Collaboration Meeting

June 21st, 2006

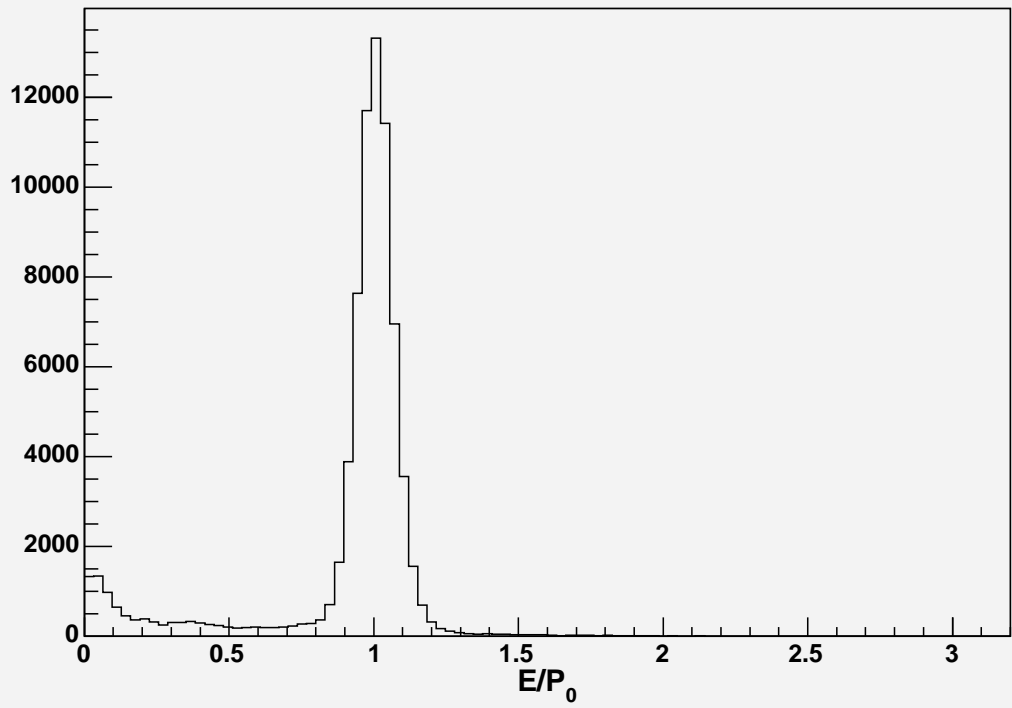
- Shower Calibration at 2 GeV
- Acceptance
- Carbon Elastic Cross Section
- Summary

Shower Calibration at 2 GeV

- For 2.134 GeV 6° data, **two peaks in shower calorimeter**.
- Localized to delta's between 1% and 3%.
- Shower distribution looked **fine for elastic data**.
- Temporarily adjusted constants for blocks 42-44.
- Hai-jiang provided **new calibration constants** for this energy.



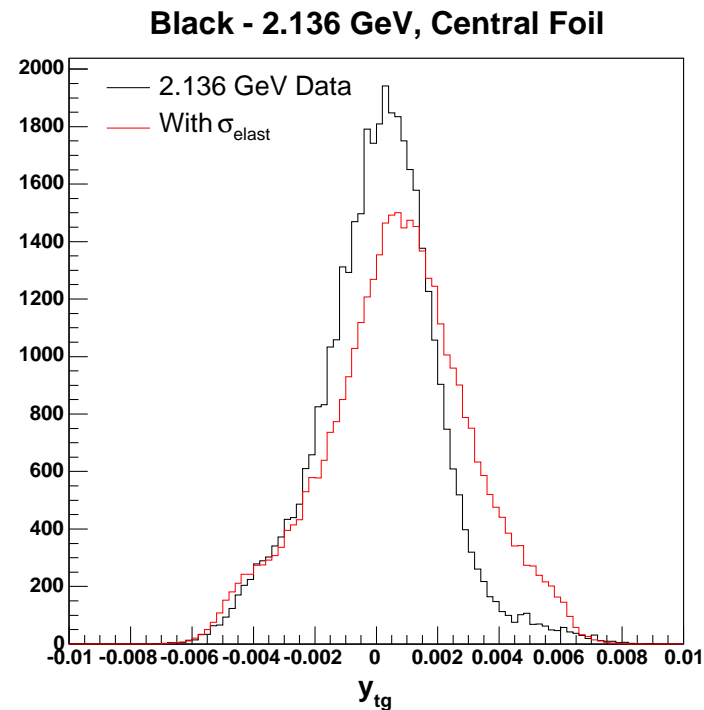
With New Constants



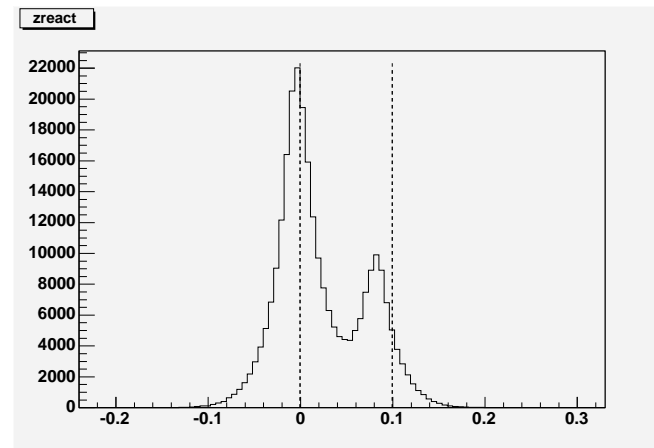
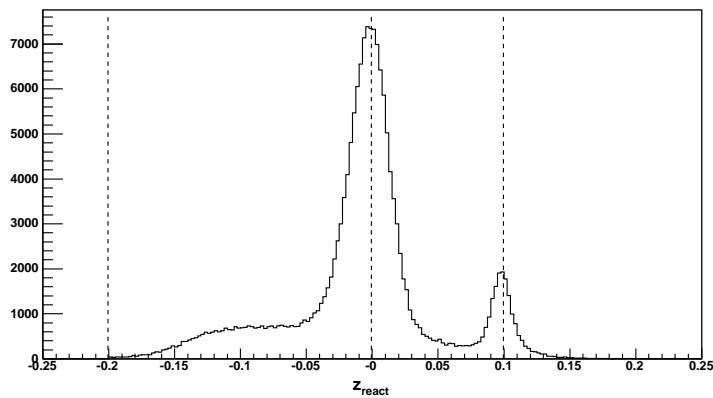
Acceptance for saGDH

y_{tg} Discrepancy (Foil Target):

- Asymmetric shape partially due to optics.
- Collimator cuts the kink region in ϕ_{tg} .



- Added the downstream foil to the simulation.
- Apparent there were two problems:
 - Foil resolution was poor in MC.
 - Downstream foil position was off.



y_{tg} Resolution:

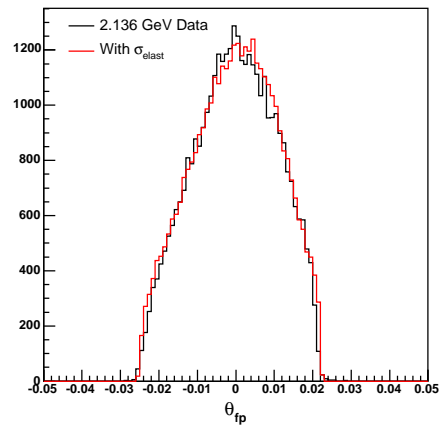
- Sensitive to the multiple scattering effect, especially the titanium window.
- MS formula dependent on the charge of the incident particle.
- Simulation used charge of the material passed through, (Ti, $Z = 22$).
- Afterwards the resolution was too good for the central foil.
- Downstream foil resolution was fine.

y_{tg} Position:

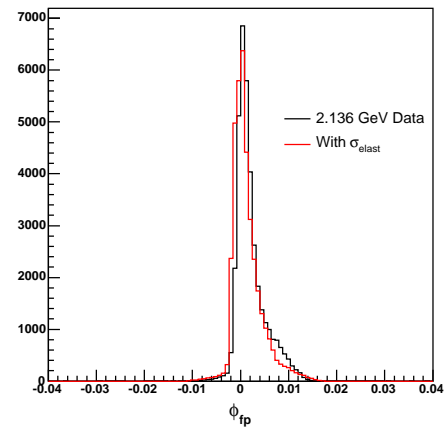
- Fixed by using exact equation for z_{react} for y_{tg} input.
- Foil positions within collimator cuts agree well with data.

Elastic ^{12}C Foil Comparison.

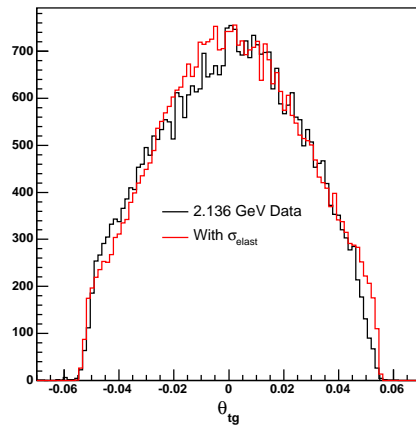
Black - 2.136 GeV, Central Foil



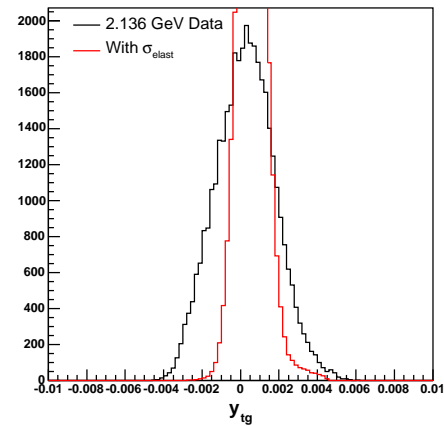
Black - 2.136 GeV, Central Foil



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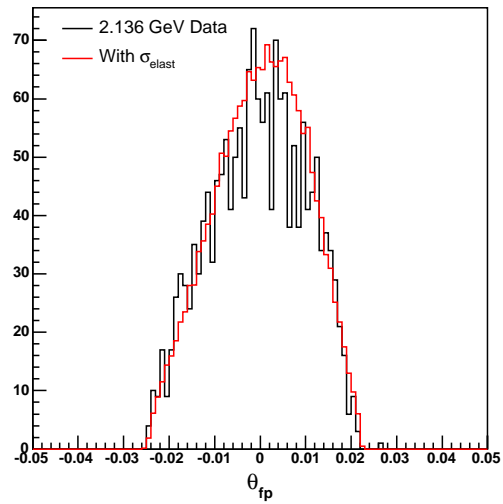


Black - 2.136 GeV, Central Foil

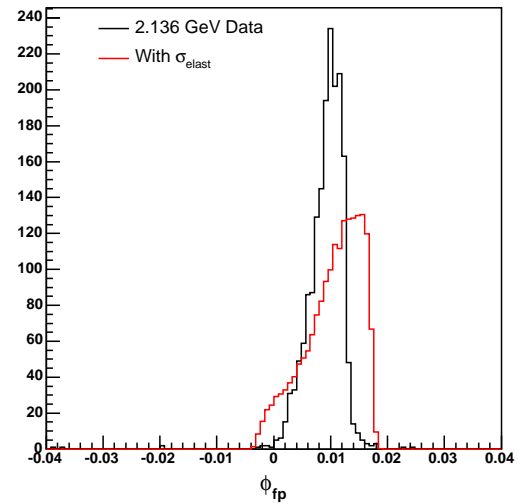


Black: data, red: simulation.

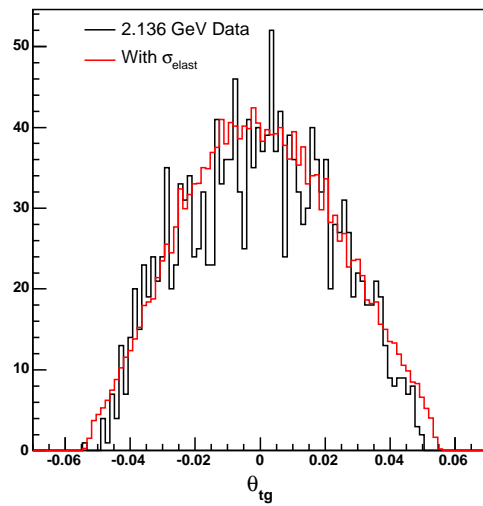
Black - 2.136 GeV, Downstream Foil



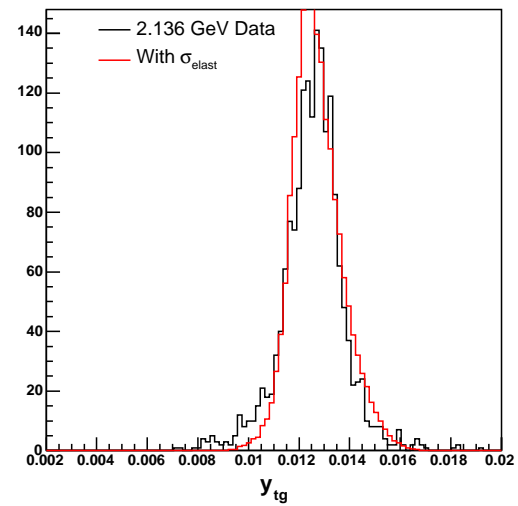
Black - 2.136 GeV, Downstream Foil



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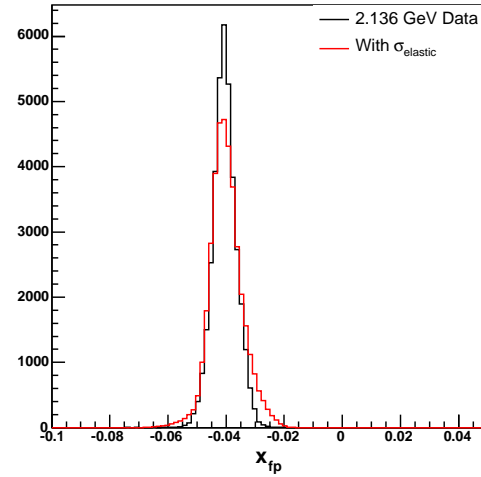


Foil Resolution Revisited

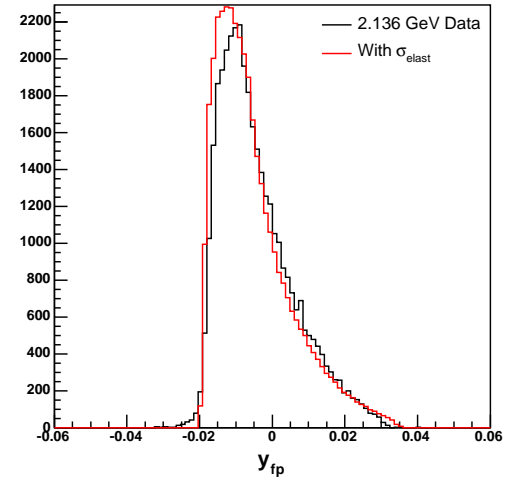
- Difference in foil resolution due to a y_{tg} optimization problem.
- Simulation uses two different resolutions for the two foils.
- Effect needs to be checked for the extended target.

Black: Data, Red: simulation.

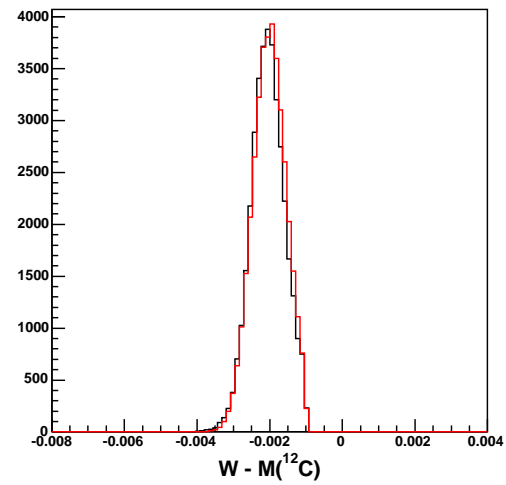
Black - 2.136 GeV, Central Foil



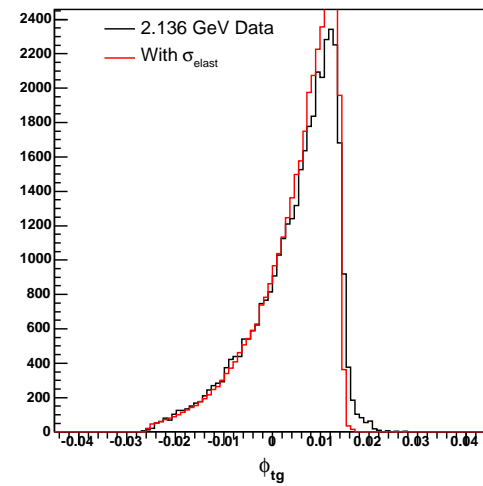
Black - 2.136 GeV, Central Foil



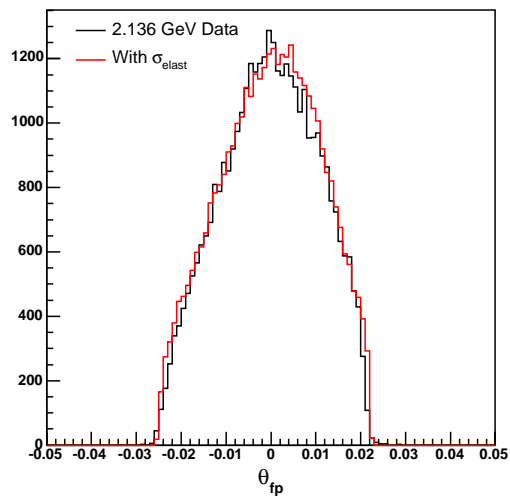
W - M



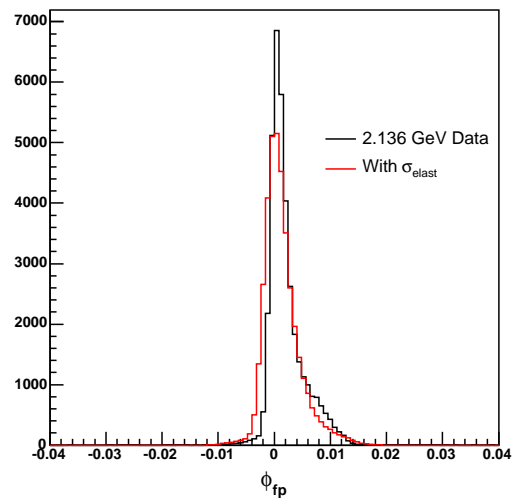
Black - 2.136 GeV, Central Foil



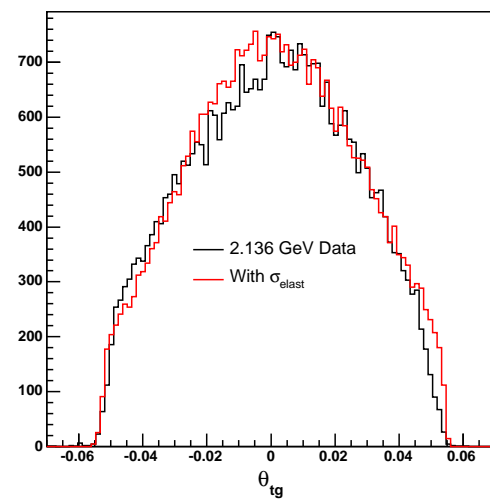
Black - 2.136 GeV, Central Foil



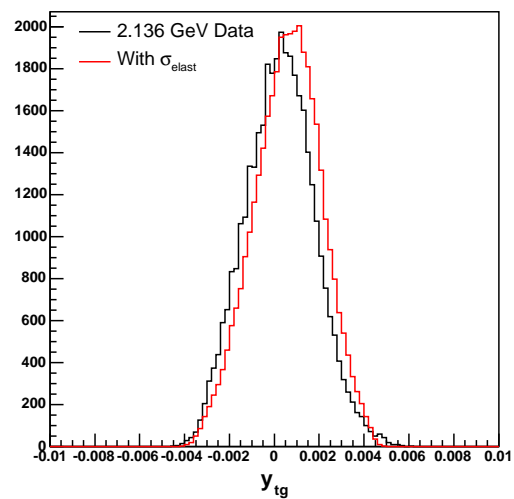
Black - 2.136 GeV, Central Foil



Black - 2.136 GeV, Central Foil



Black - 2.136 GeV, Central Foil



Remaining Issues

- Difference in foil resolution.
- Small shifts in ϕ_{fp} and y_{tg} .
- Downstream foil ϕ_{fp} becomes distorted with collimator cuts.
- This effect on the transfer functions is known by J. LeRose.

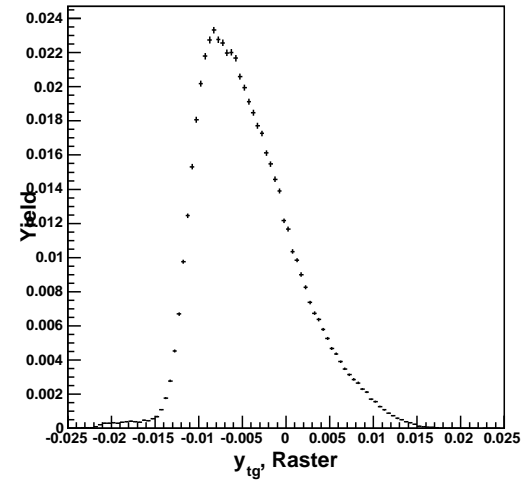
Carbon Elastic Cross Section

“No Target” Background Subtraction:

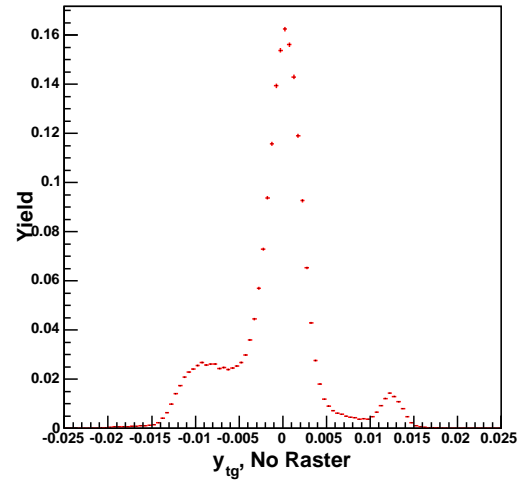
- Analyzed empty (no target) runs for 2.13 GeV.
- Calculated yields for empty and carbon runs.
- Empty runs only **exist with raster at -2% and -4%**.
 - Requires **scaling the empty yields** at +2% and 0%.
 - ϕ_{tg} and y_{tg} **distributions need to be shifted**.
 - Upper limit on the effect is a **2% uncertainty for the foil yields**.
- At 1 GeV, a complete set of runs exist.

$$\text{Yield} = \frac{PS}{LT\epsilon_{\text{det}}Q/e} N_{\text{acc}}$$

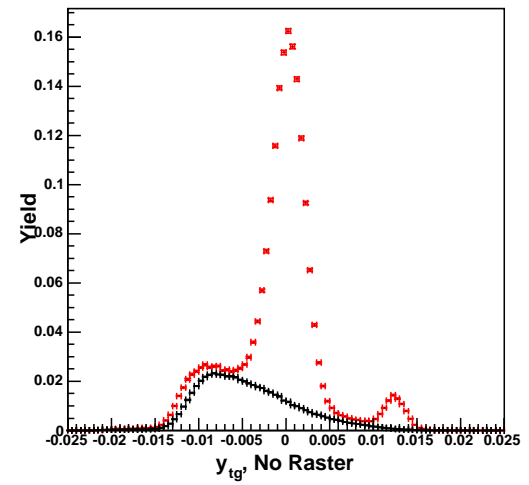
-2%, No Target (Helium-4)



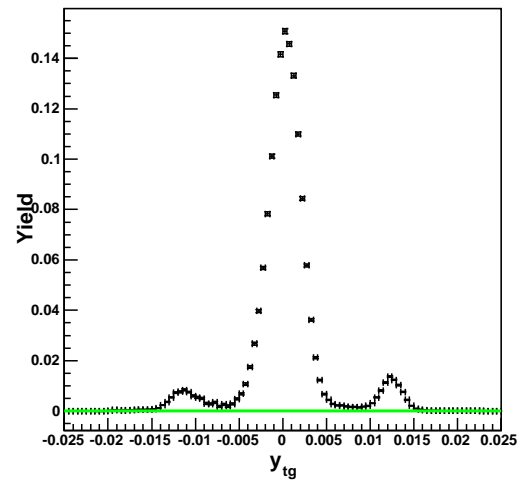
0%, Multi-Foil Carbon

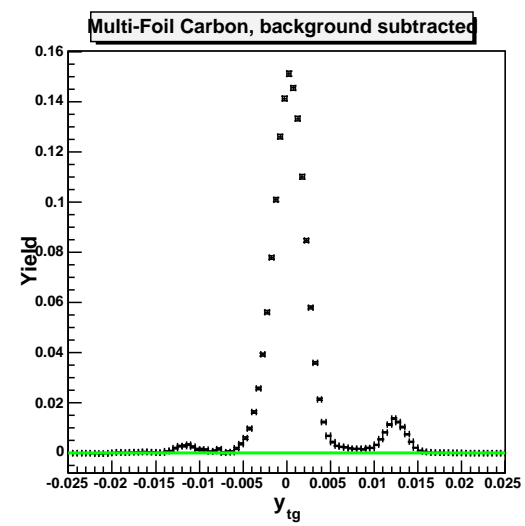
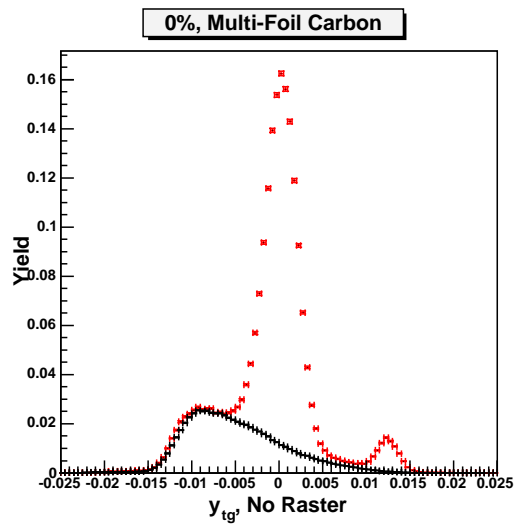
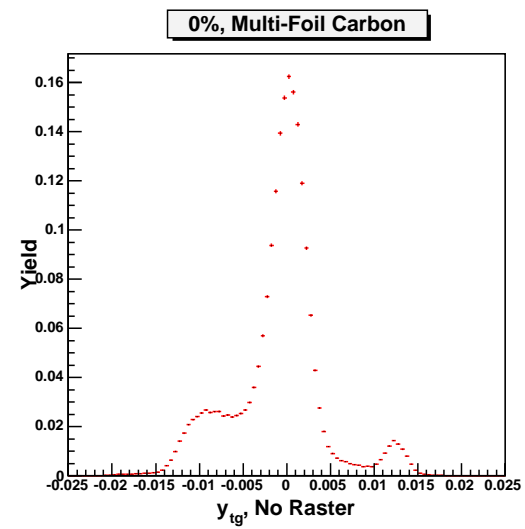
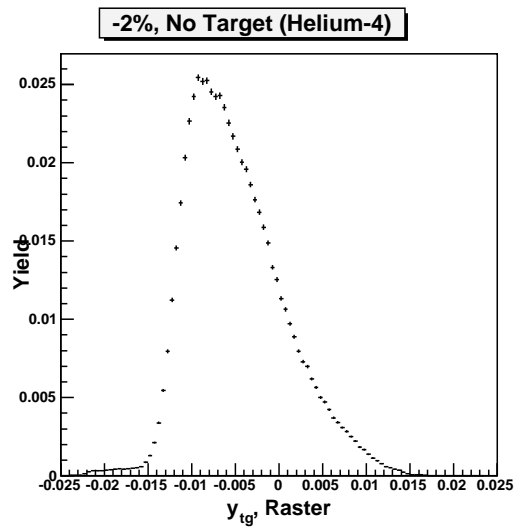


0%, Multi-Foil Carbon



Multi-Foil Carbon, background subtracted



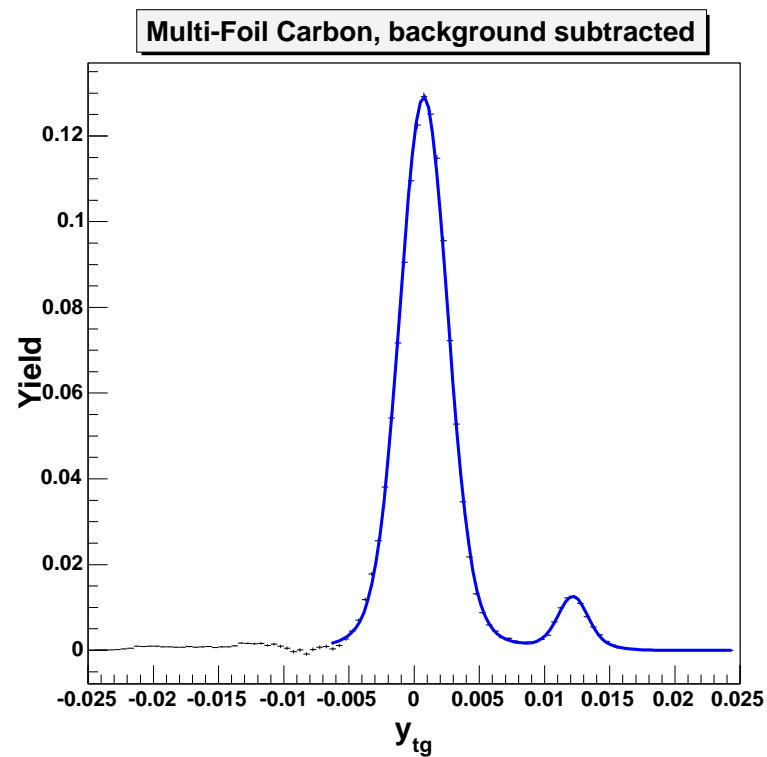


Detector Efficiencies: ($\epsilon_{pid} = 0.984$)

Target	Run	η_{VDC}	η_{Scint}	PS1	PS2
Carbon	2391	0.9457	0.9991	14	300
Carbon	2392	0.9534	0.9992	14	300
Carbon	2393	0.9562	0.9996	14	300
Carbon	2394	0.9552	0.9994	14	300
Carbon	2401	0.9095	0.9993	30	300
Carbon	2402	0.9117	0.9994	30	300
Carbon	2403	0.9141	0.9993	30	300
Empty	2408	0.9697	0.9996	10	300
Carbon	2410	0.9078	0.9993	30	300
Carbon	2411	0.9086	0.9993	30	300
Empty	2412	0.9687	0.9996	10	300

Foil Cut Separation:

- Fit two foil peaks to calculate the cross section for each peak.
- Fit uses a double Gaussian, since the wings are non-Gaussian.

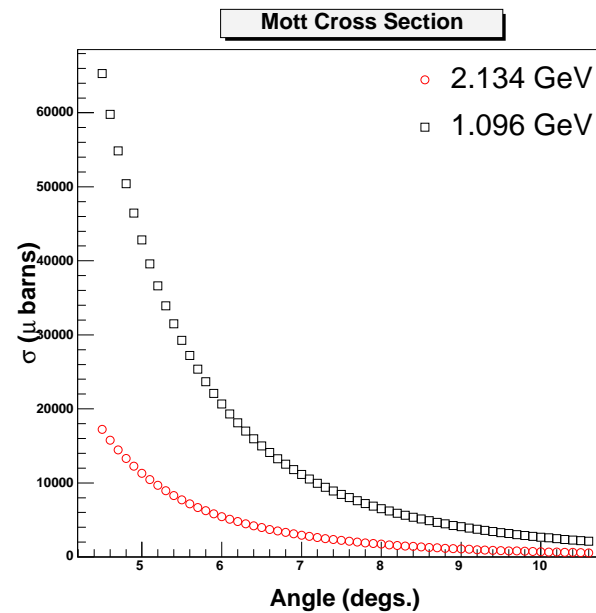
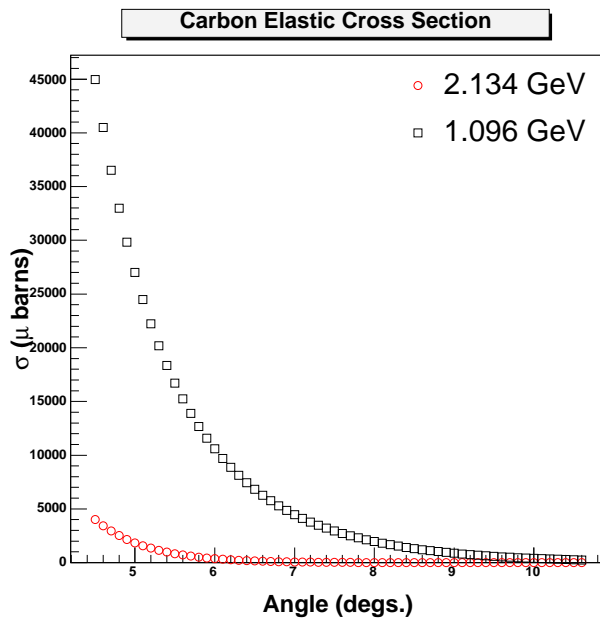


Run	Central Foil	Downstream Foil	Cut (cm)
2391	1.0044	0.9157	1.01
2392	1.0003	0.9936	0.94
2393	1.0048	0.9153	1.03
2394	1.0054	0.9111	0.98
2401	1.0006	0.9906	0.86
2402	1.0002	0.9972	0.87
2403	1.0008	0.9863	0.93
2410	1.0080	0.8783	0.80
2411	1.0064	0.8994	0.86

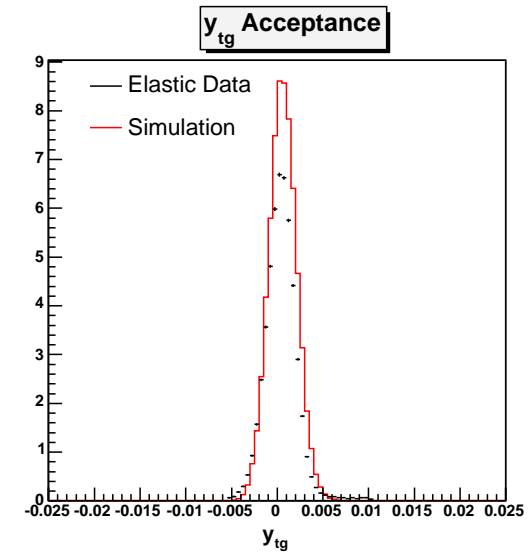
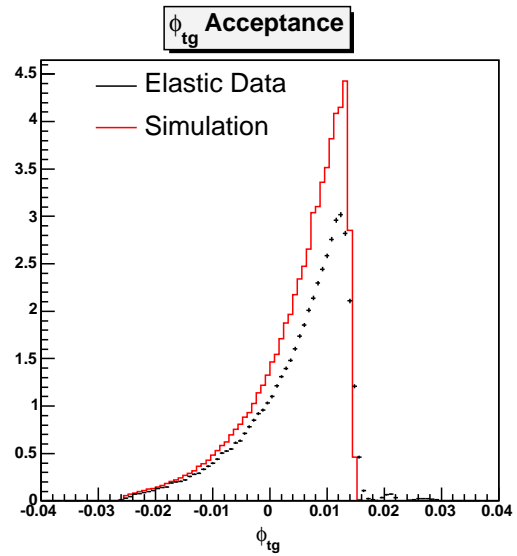
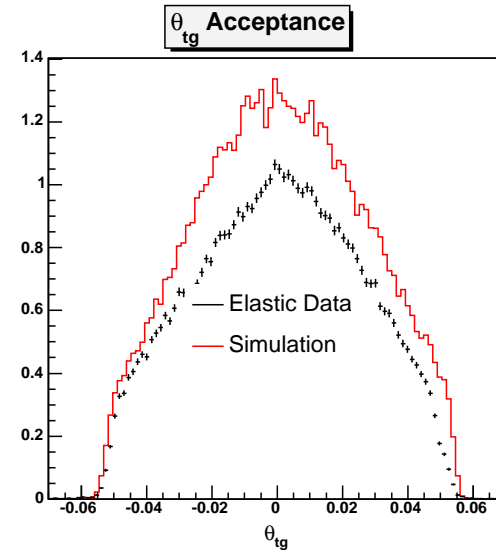
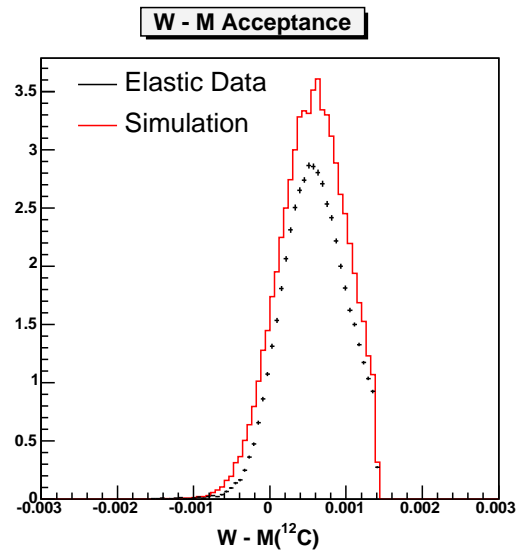
Carbon Foil Density: 49.1 mg/cm² (J. Katich), E94010: 51.46 mg/cm².

Elastic Carbon Cross Section

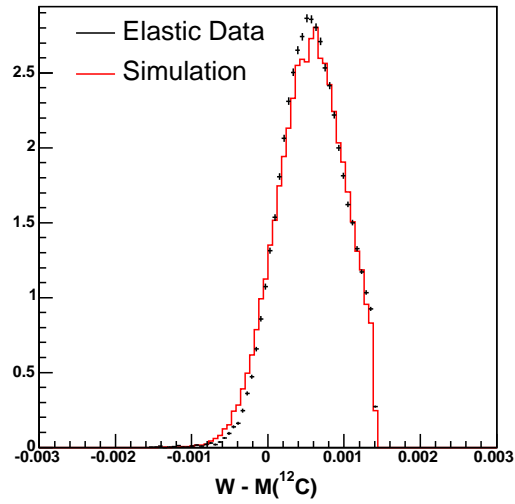
- Calculated the cross section from the background subtracted yield.
- Data and simulation are different by $\sim 20\%$.
- Cross Section is **extremely sensitive to the scattering angle**.



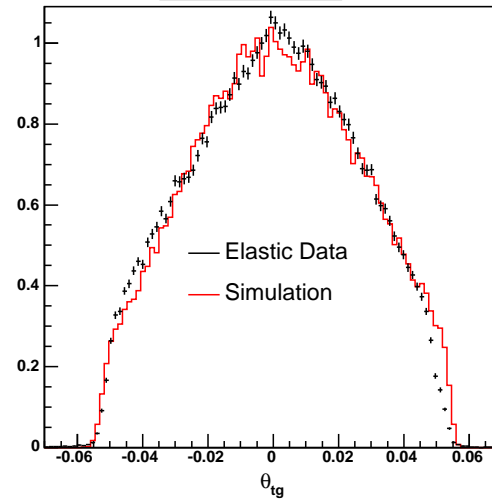
- Scattering angle from survey: $5.99 \pm 0.04^\circ$, ($\sigma = 0.5$ mm).



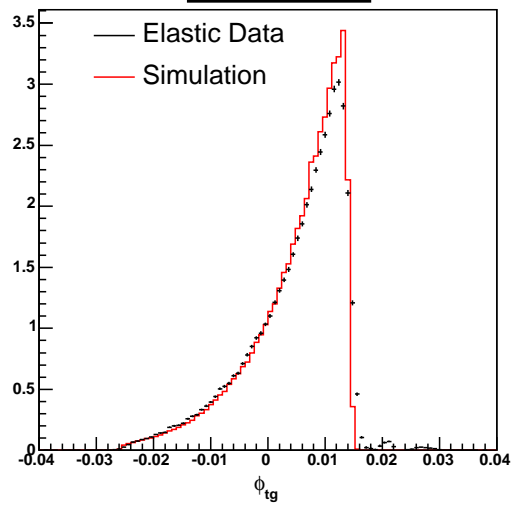
W - M Acceptance



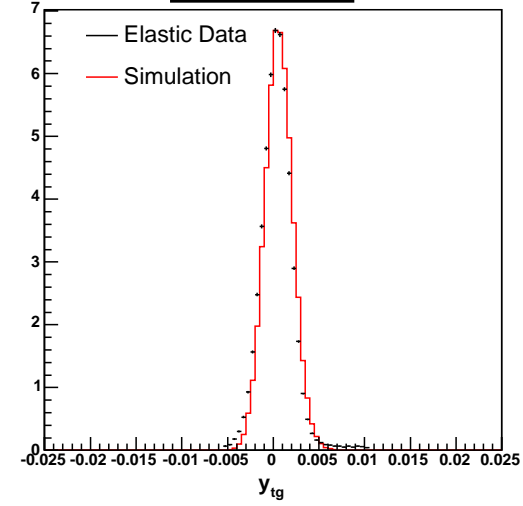
θ_{tg} Acceptance



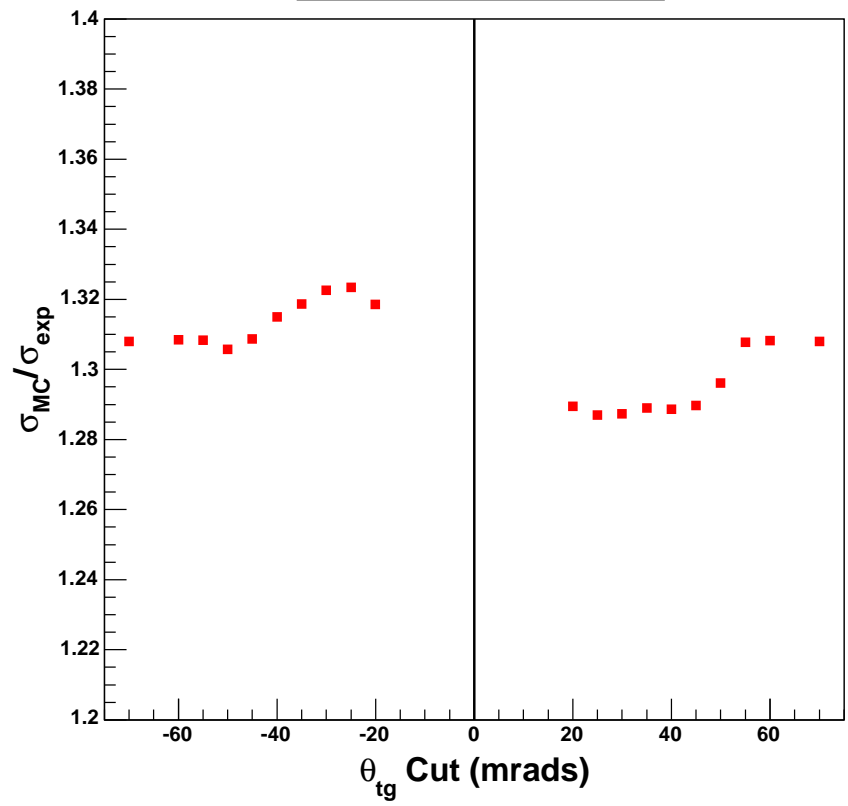
ϕ_{tg} Acceptance



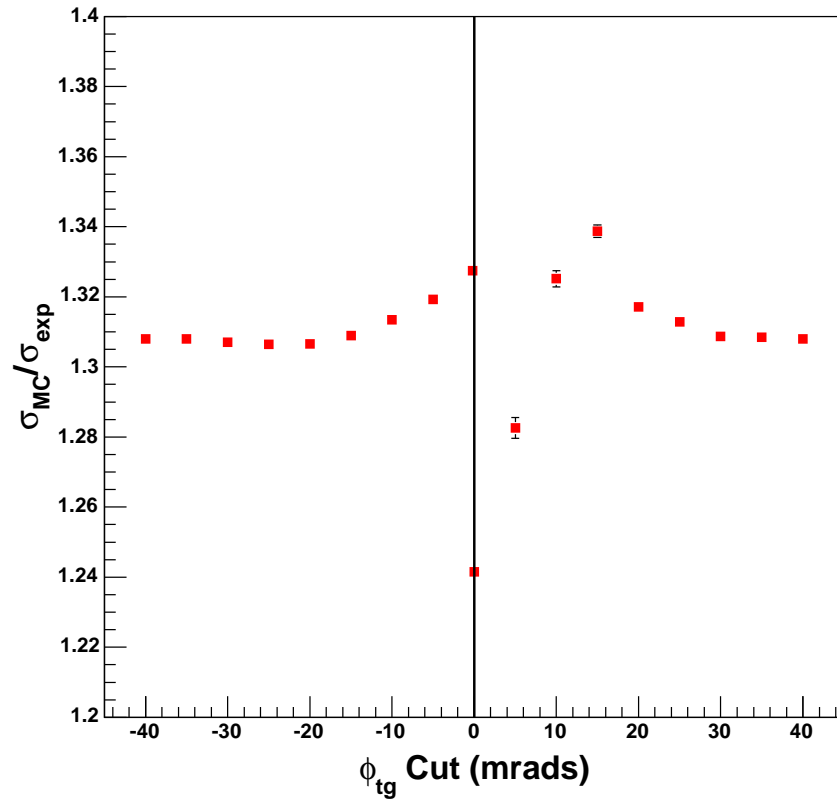
y_{tg} Acceptance



Acceptance Cut Study



Acceptance Cut Study



Remaining Items

- Check cross section calculation and simulation for discrepancy.
- Check density of foils (Nilanga).
- Check all four delta settings.
- Finalize errors and uncertainties.
- Check 1 GeV data, 3 delta settings.
- Generate new transfer functions for 9° .
- Check data with simulation at 9° .
- Elastic Carbon cross section analysis.

Summary

- New shower calibration for 2.1 GeV, Penelope data (H. Lu).
- Acceptance
 - Discrepancies for y_{tg} understood and mostly solved.
 - Foil resolution changes across y_{tg} acceptance.
 - Simulation reproduces the data fairly well.
- Carbon Elastic Cross Section
 - “No Target” background subtraction done.
 - Approximation needed at higher momentum settings, 1–2% uncertainty.
 - Detector efficiencies are high, except for the VDC, 91–97%.
 - Preliminary cross section comparison differs by $\sim 23\%$.
 - Extremely sensitive to the scattering angle.

Still To Do

- Finalize ^{12}C elastic cross sections.
- Acceptance study at 9° .
- Calculate unpolarized cross sections.
- Calculate asymmetries and polarized cross sections.
- Finish technote for Duality target analysis.