F2 Update

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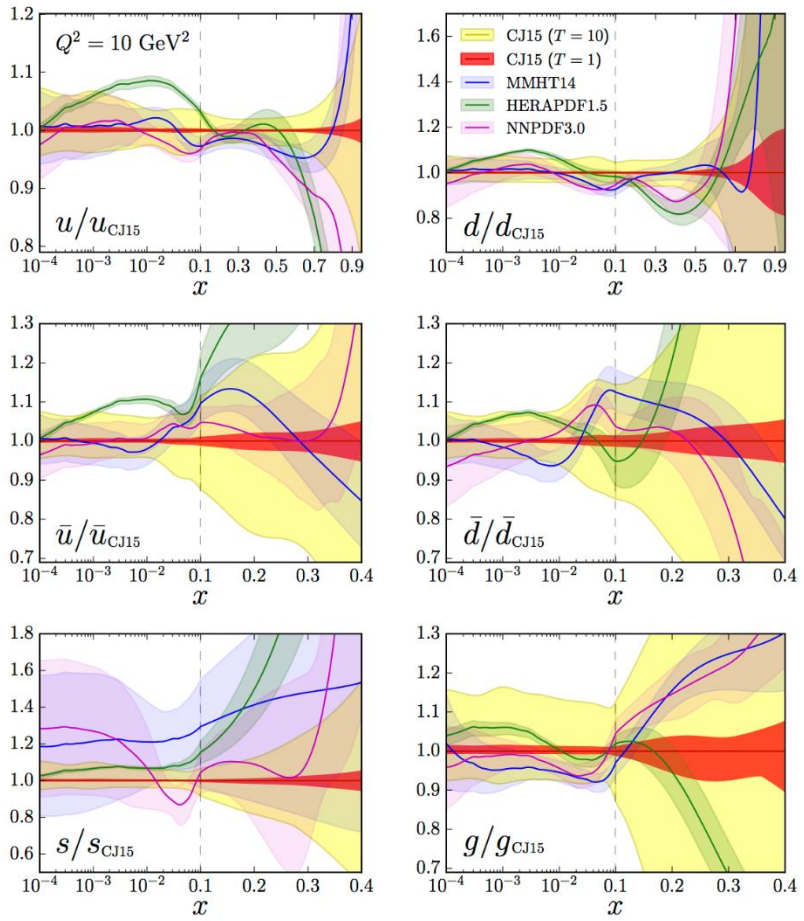
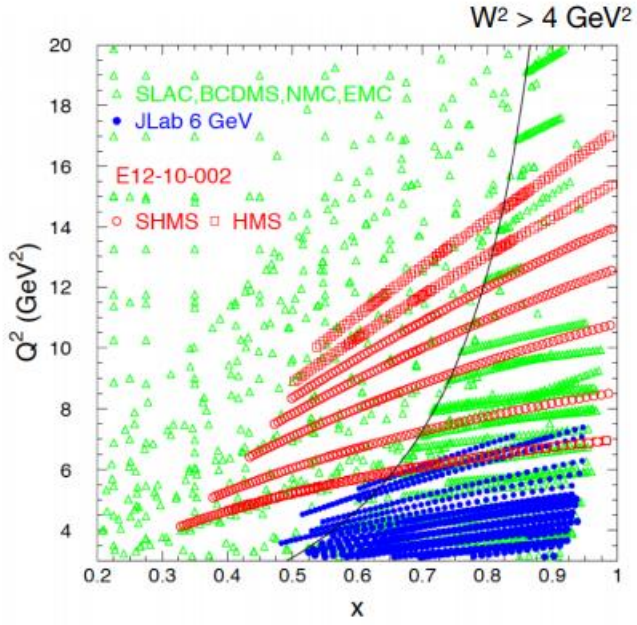
Motivation

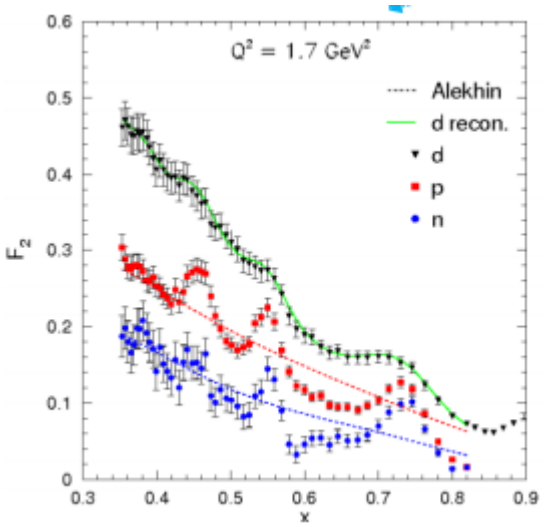
- Underlying motivation is to make precision measurements, particularly in high-x region
- Data from this region is used in global PDF analysis to constrain uncertainties
- Currently, many analyses rely on models to extrapolate PDF behavior at large x – leads to large uncertainties

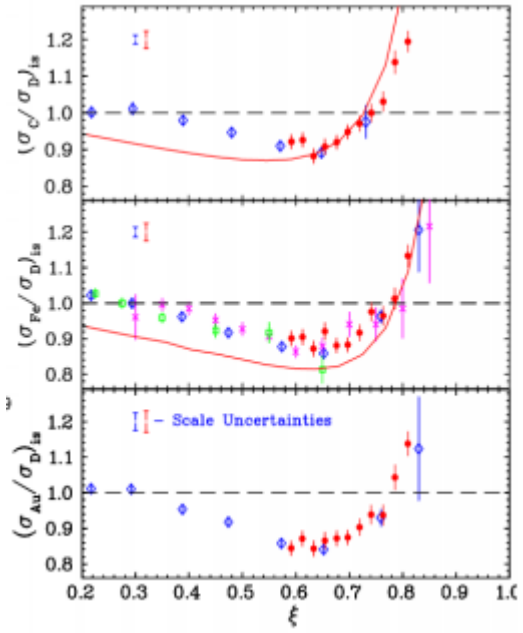


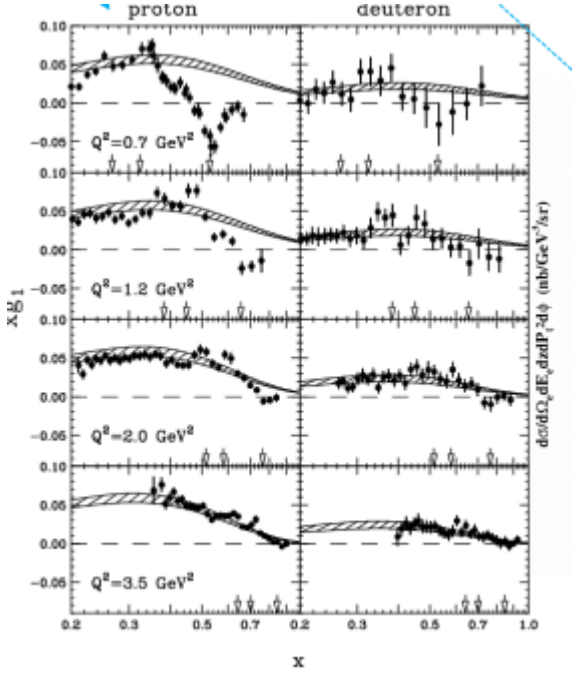


Motivation

- QHD -- observation that structure functions in the NRR, on average, behave like structure functions in the DIS regime
- QHD has been observed in $F_2^{P/n}$, $F_2^{C/Fe/Au}$, $g_2^{P/n}$ -- suggests QHD is a fundamental phenomenon of nuclear structure
- Resonance region measurements allow us to explore this phenomenon

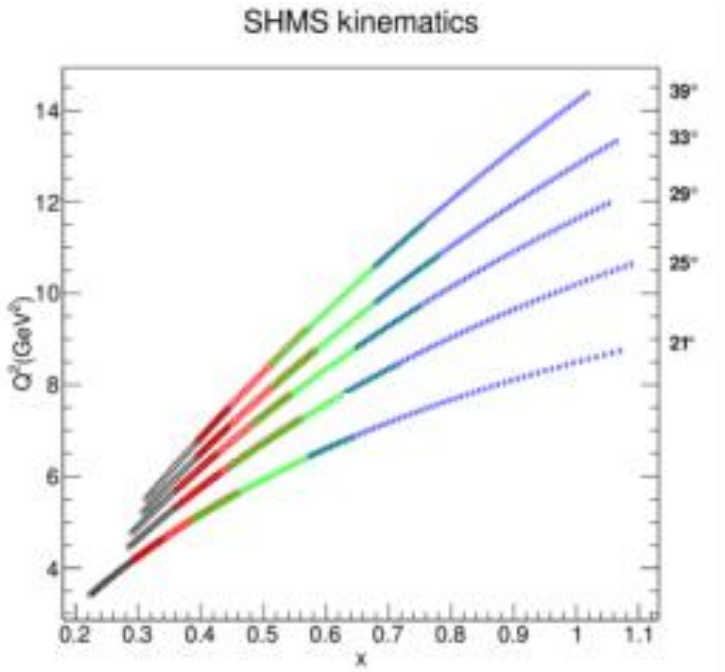


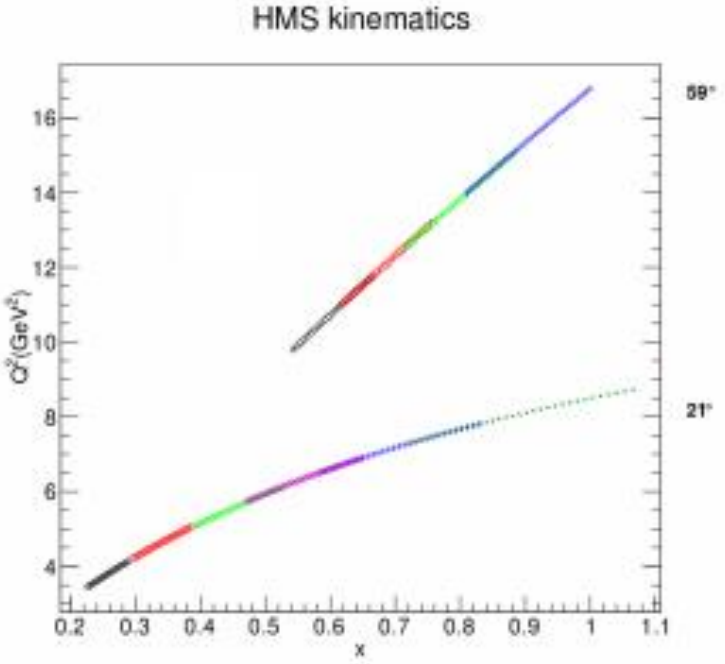




Kinematics

	Angle (deg)	Momentum (GeV/c)
SHMS	21	5.1, 4.0, 3.3, 2.7
	25	4.4, 3.5, 3.0, 2.5
	29	3.7, 3.0, 2.4, 2.0
	33	2.5, 2.0, 1.6, 1.3
	39	2.5, 2.0, 1.6, 1.3
HMS	21	5.7, 5.1, 4.5, 4.0, 3.3
	59	1.5, 1.35, 1.18, 1.05





Time Windows

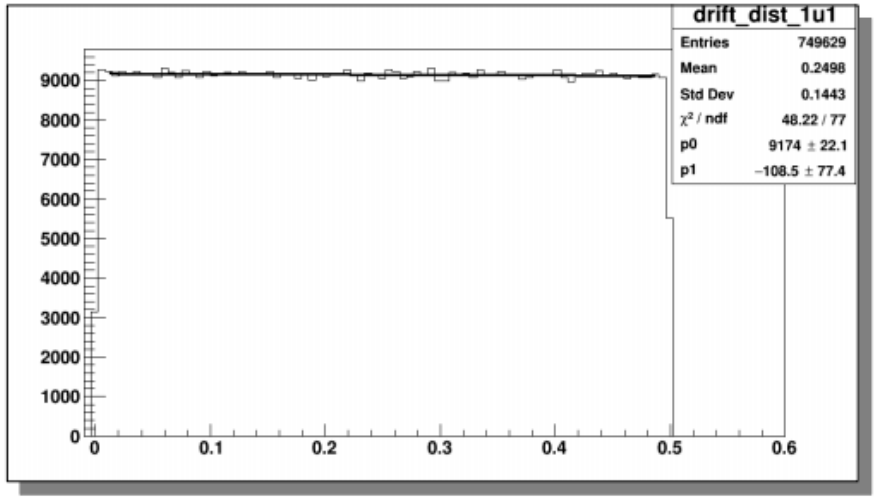
- Choosing appropriate time windows for each detector is important for hit selection
- Want to capture prompt peak signal and minimize background
- Sometimes signal is clean (calorimeter), sometimes window selection is nontrivial (Cerenkov)
- Ongoing time window study for calorimeter, drift chamber noble/heavy gas cerenkov

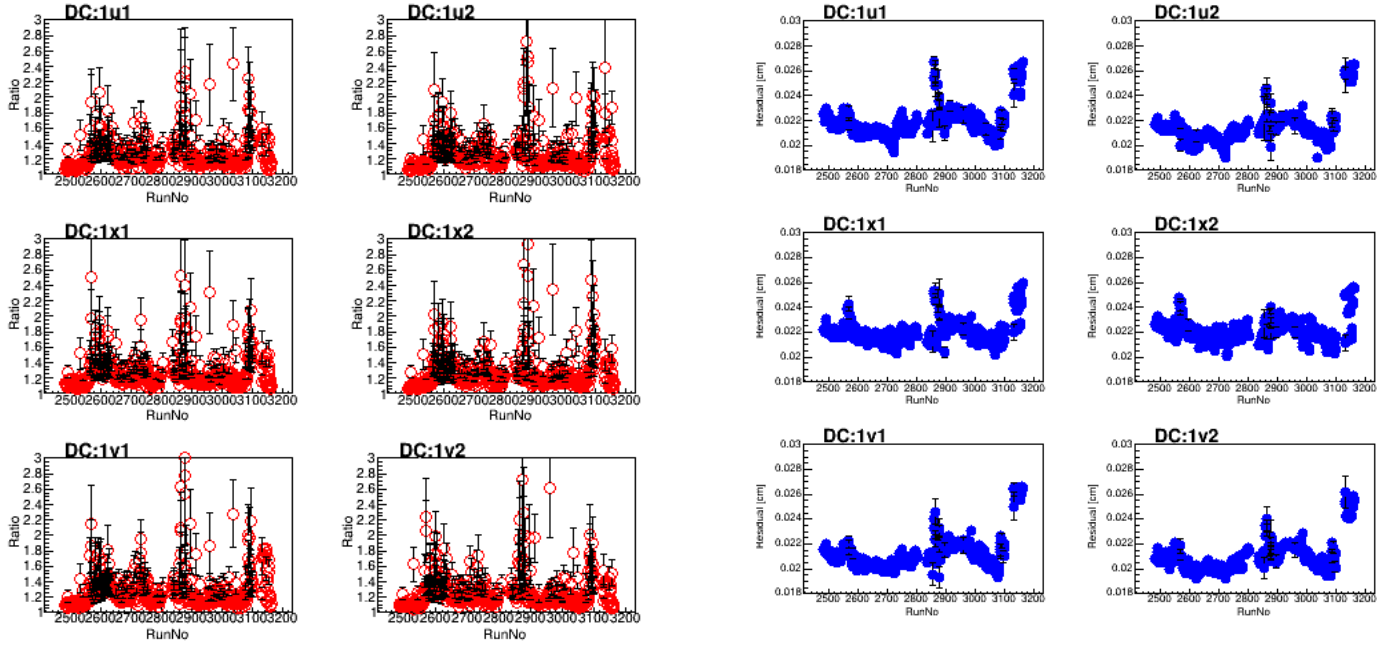
Calibrations

- Preliminary calibrations have been done – calorimeter and drift chamber calibration completed for both spectrometers for all kinematic points

Calibrations: Drift Chamber

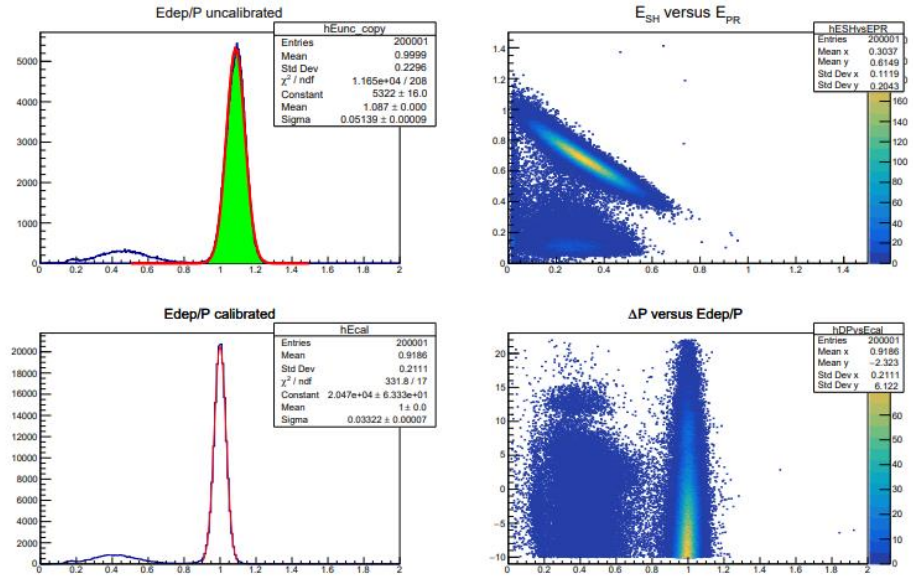
- TDC values averaged over all wires forms drift time distribution – turned into drift distance
- Calibrations checked against Drift Distance plots and residuals – “good” calibration produces flat drift distance

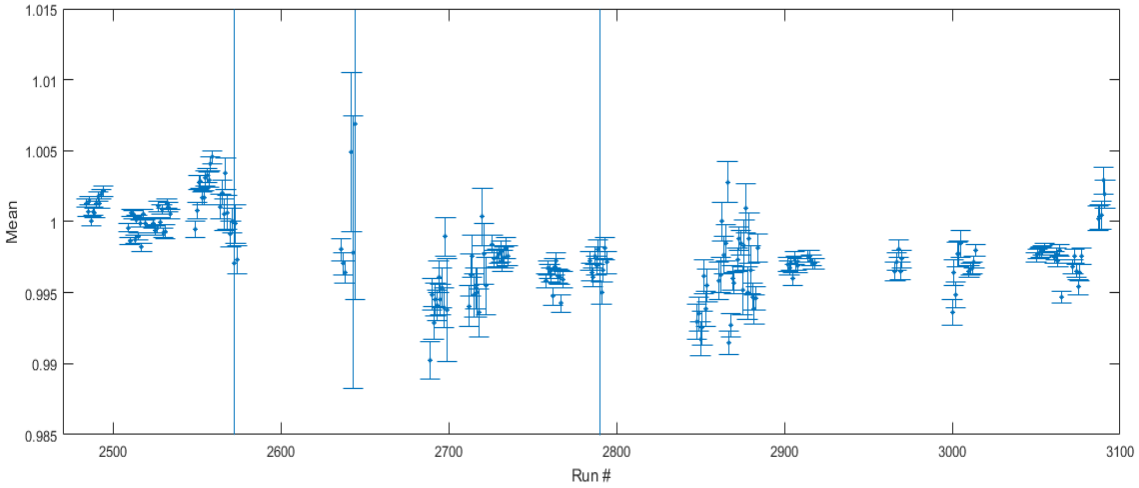


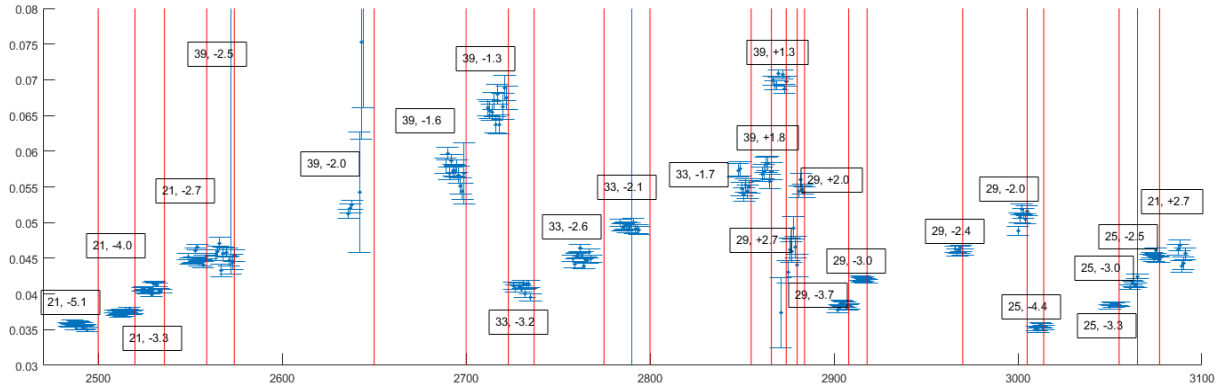


Calibrations: Calorimeter

- Linear equation solves for “calibration constants” for each PMT, under constraint that difference between calculated energy deposition and known energy deposition is minimized

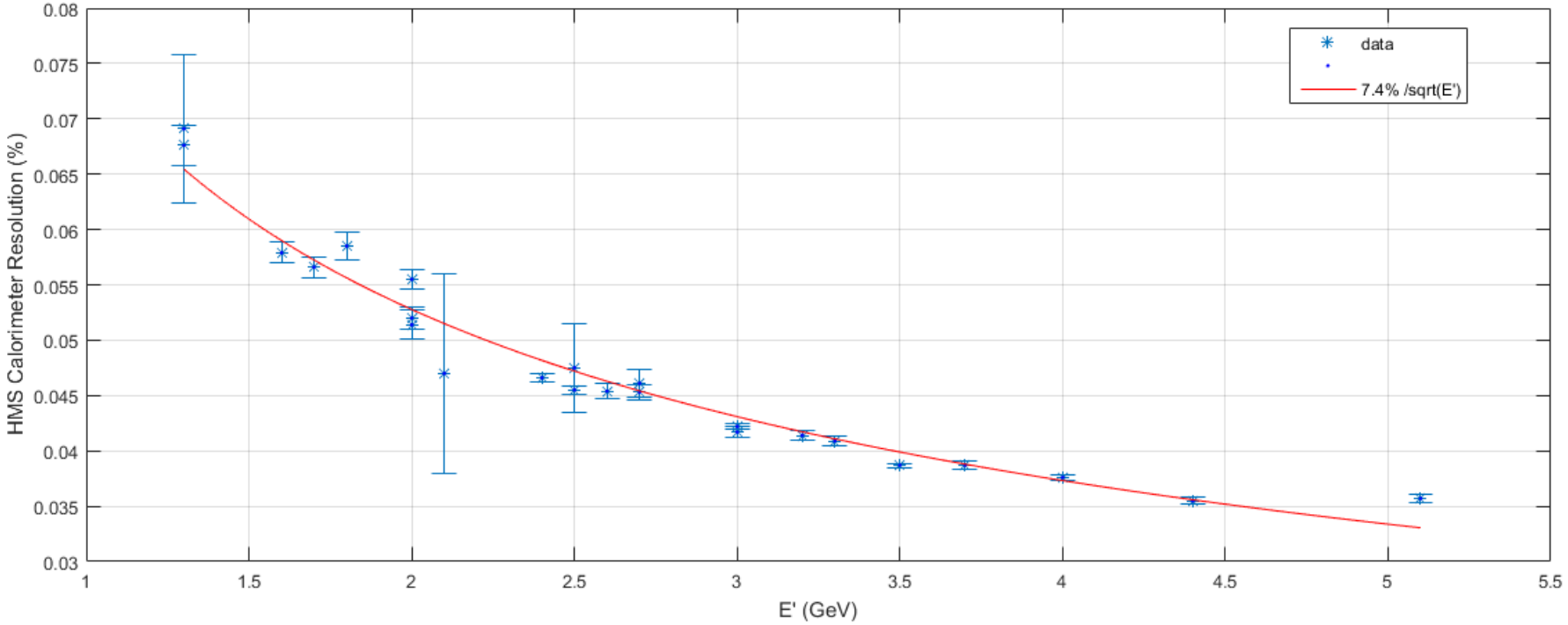






Calibration: Calorimeter

- Calorimeter resolution can be characterized from sigma energy dependence

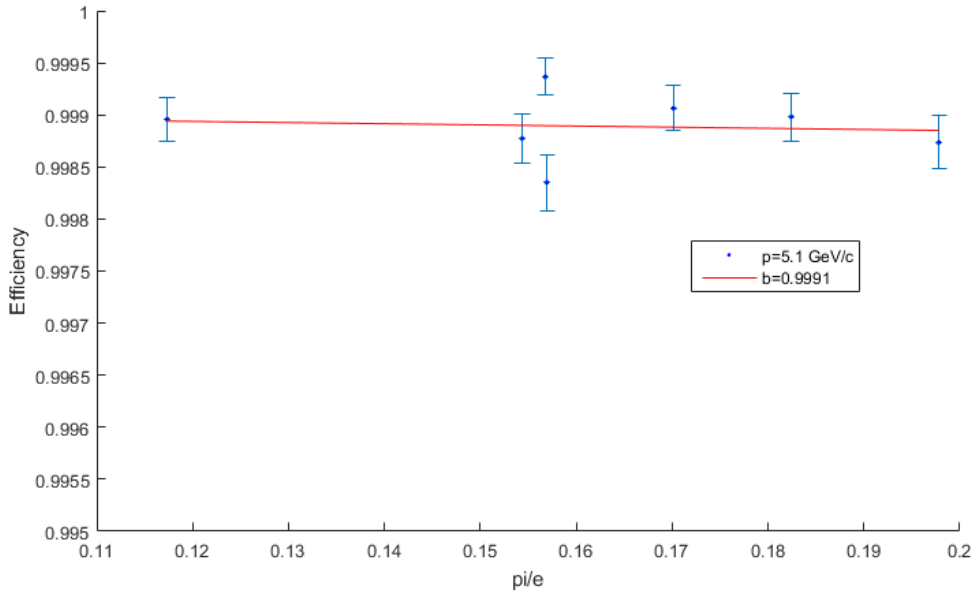


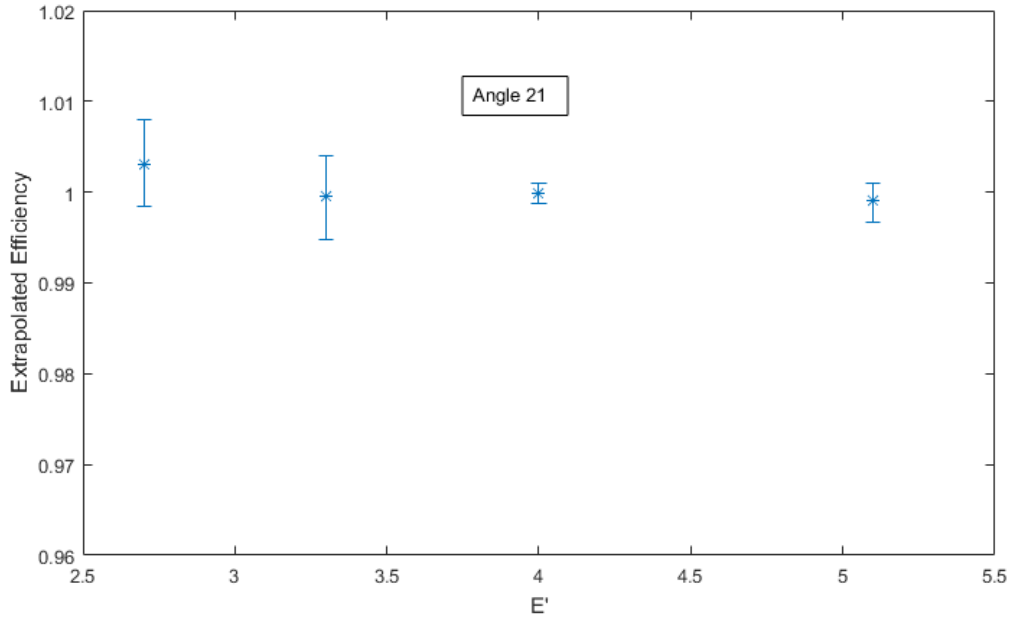
Detector Efficiency

- Characterizing detector efficiency is crucial for any physics driven analysis
- Calculate efficiencies for various targets and plot versus pi/e – extrapolate to zero pi/e to minimize pion contamination
- Ongoing efficiency studies for calorimeter and Cerenkov detectors

Efficiencies: Calorimeter

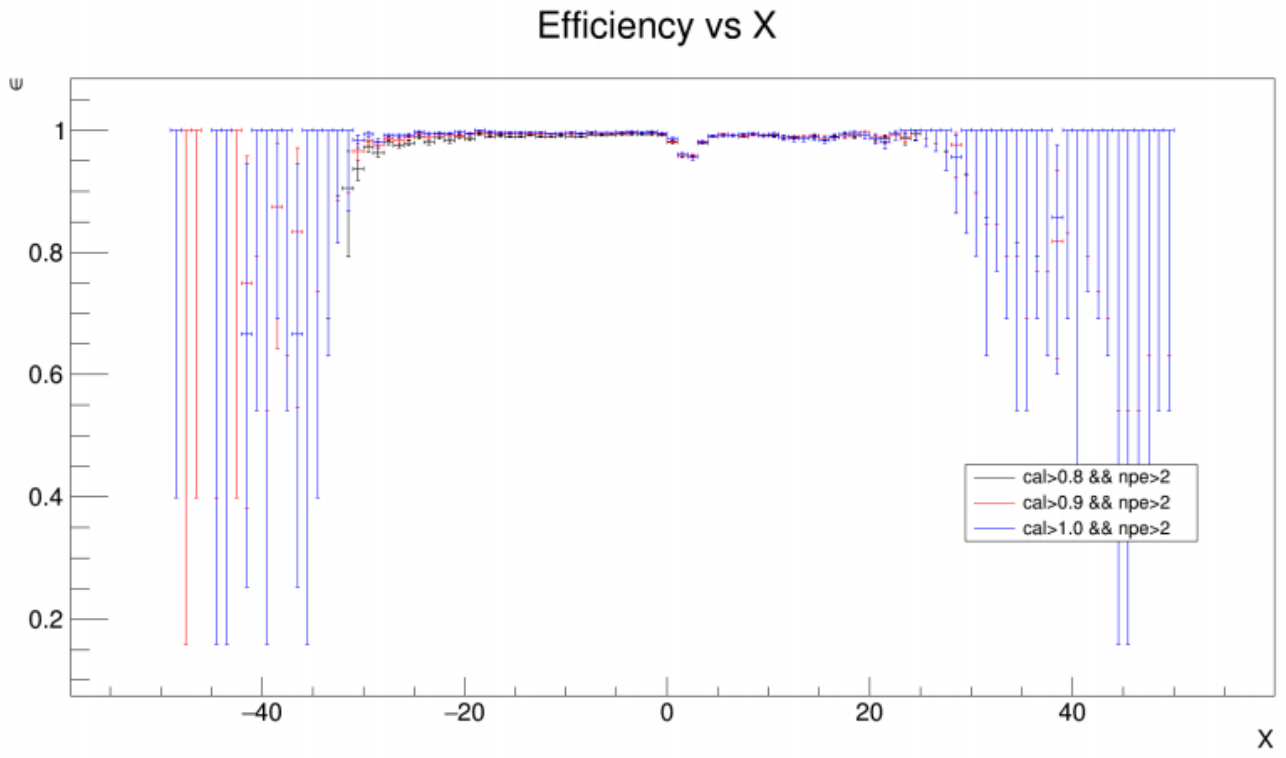
- “Clean” electron sample created by setting dp cuts, ELLO trigger only, Cerenkov cuts, fiducial cuts and scattering cuts

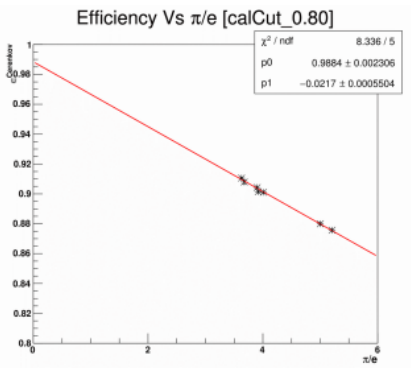


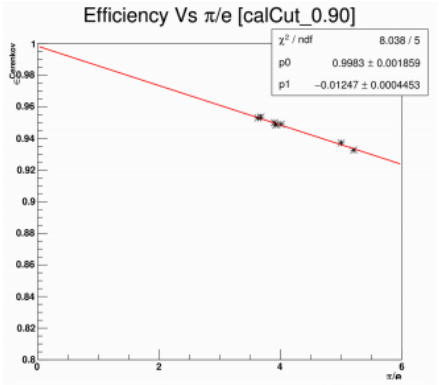


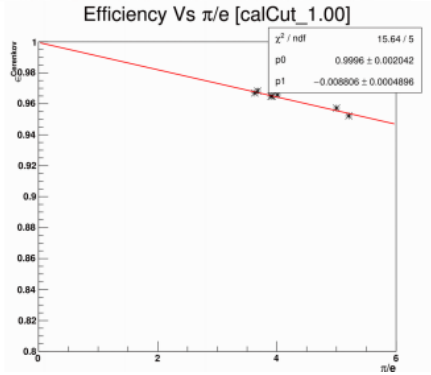
Efficiencies: Cerenkov

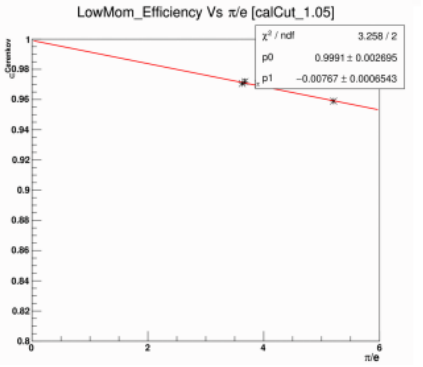
- Used dp cuts, calorimeter cuts, ELHI trigger





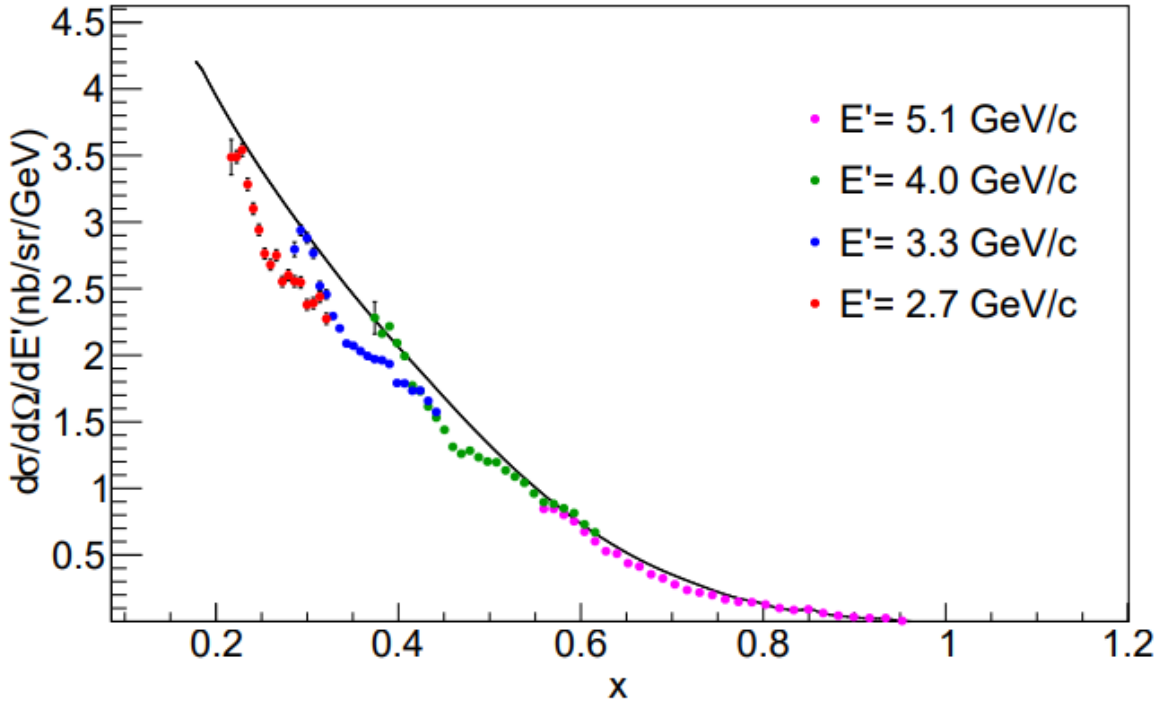


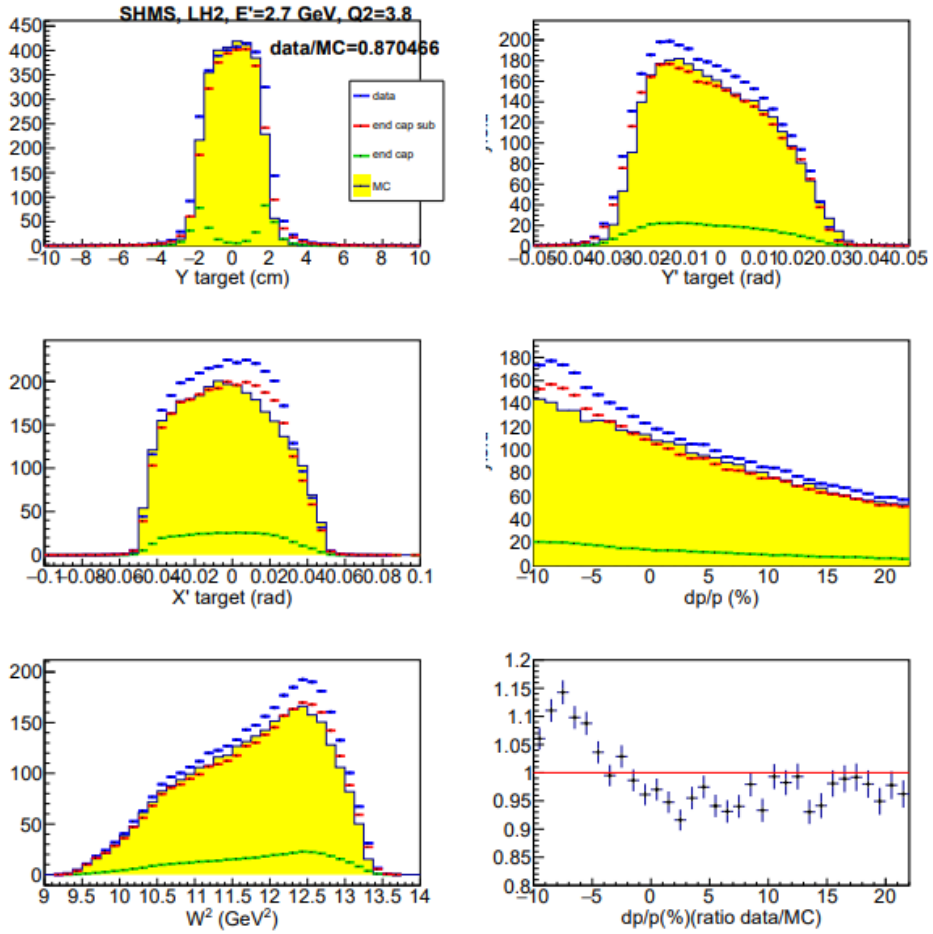




Monte Carlo Results

- See some disagreement between MC and data – exaggerated at lower momenta
- Disagreement cancels out in structure function ratios

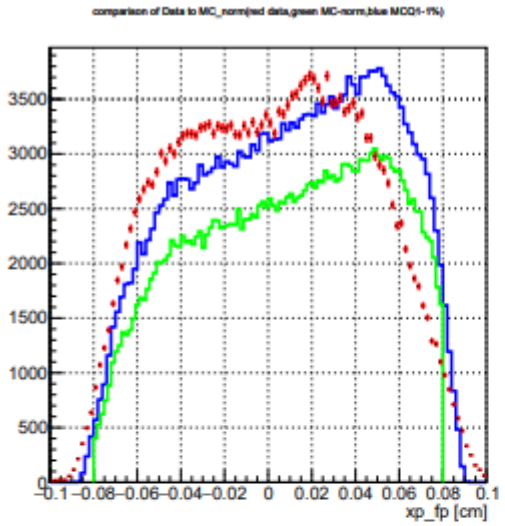


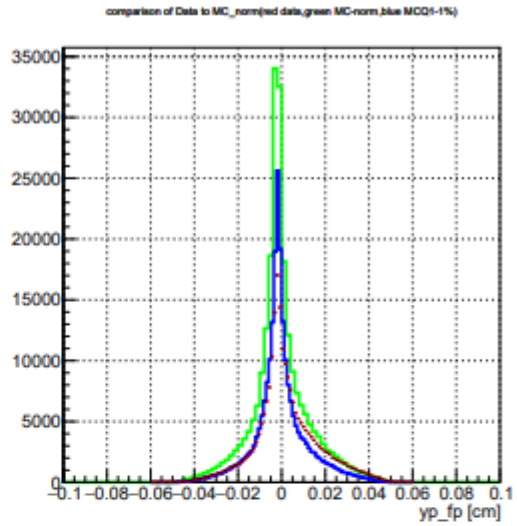


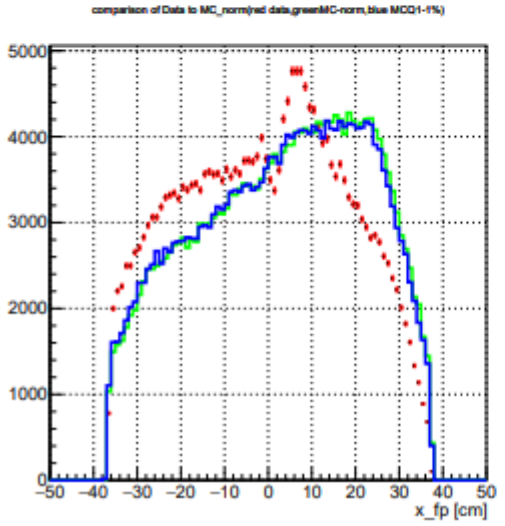
- SHMS – HMS provides cross check

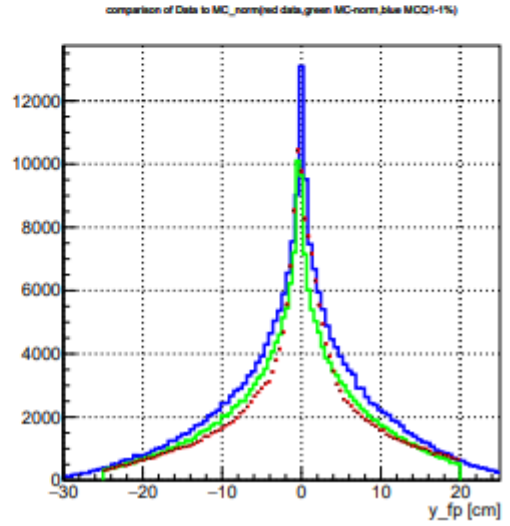
Monte Carlo Results

- Attempt at better agreement between MC and data by tuning optics in simulation



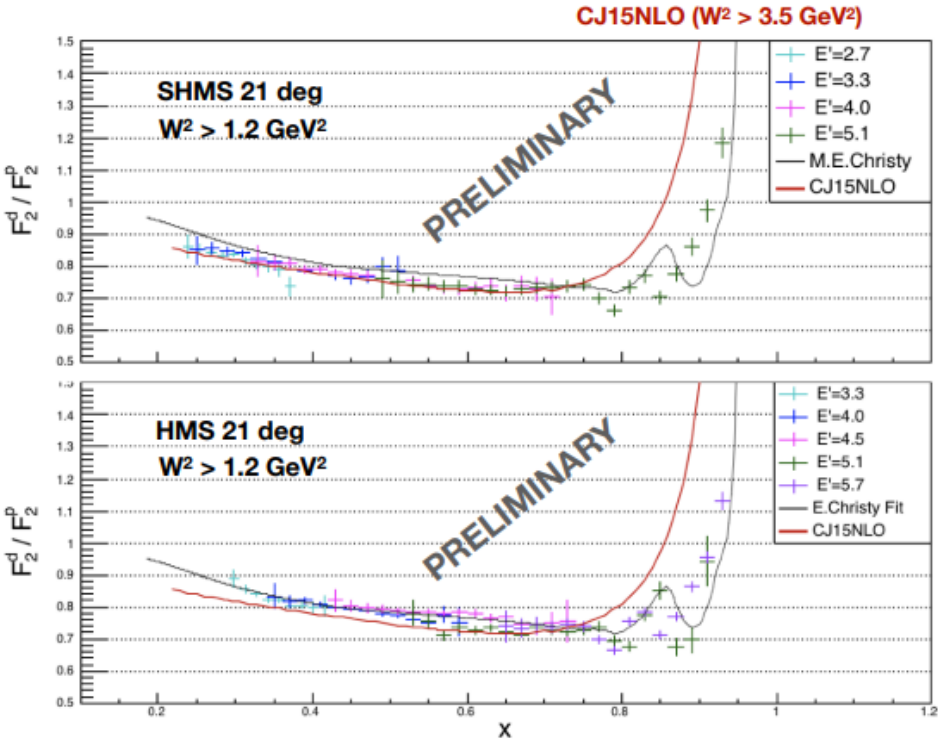


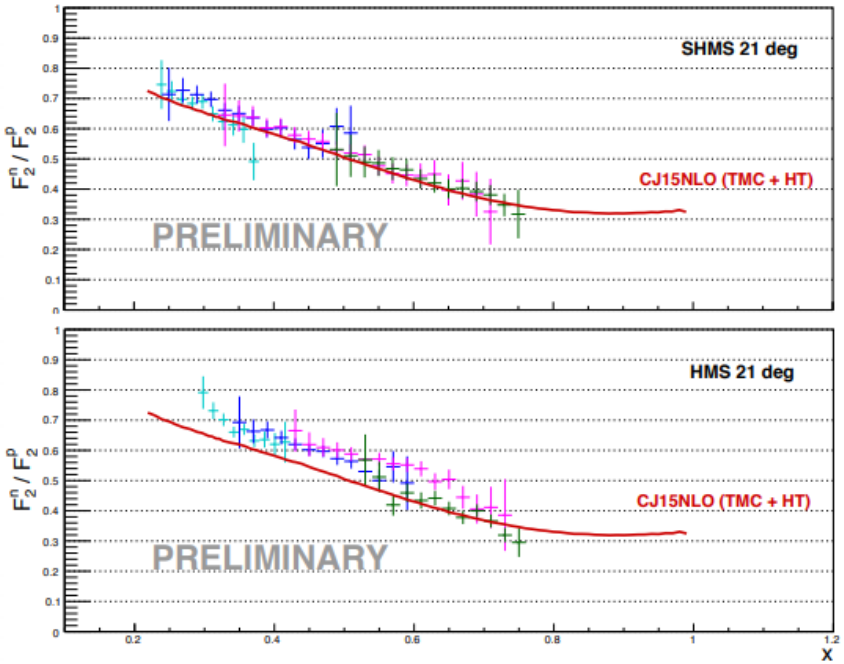




Preliminary Results

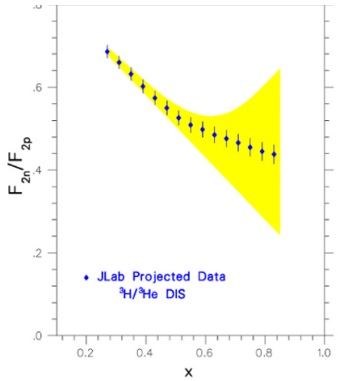
$$\left(\frac{F_2^n}{F_2^p}\right) = \left(\frac{F_2^d}{F_2^p}\right)_{Data} \times \left(\frac{F_2^n + F_2^p}{F_2^d}\right)_{CJ} - 1$$

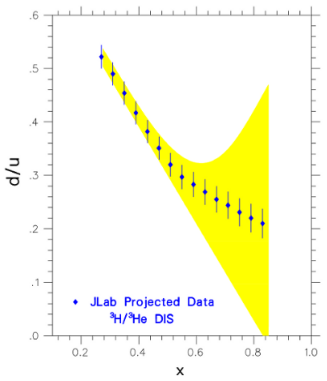


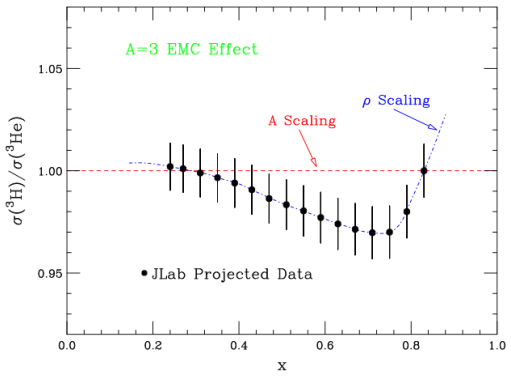


- Independent measurements by SHMS/HMS – allows for crosschecks

- Marathon also measures F2n/F2p ratio – another check







Moving Forward

- Finalizing timing cut procedure for all detectors
- Next data pass in about a month
  - Timing cuts will be implemented
  - Data will be replayed
  - Calibrations re-checked
  - Physics!
- Look for F2 related talks at
  - APS Meeting, F2/EMC meeting April 25, 26, Fall DNP, Fall GHP, INPC, EINN

Acknowledgments

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- Abishek Karki
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