Second look at EMC data from XEM2 experiment

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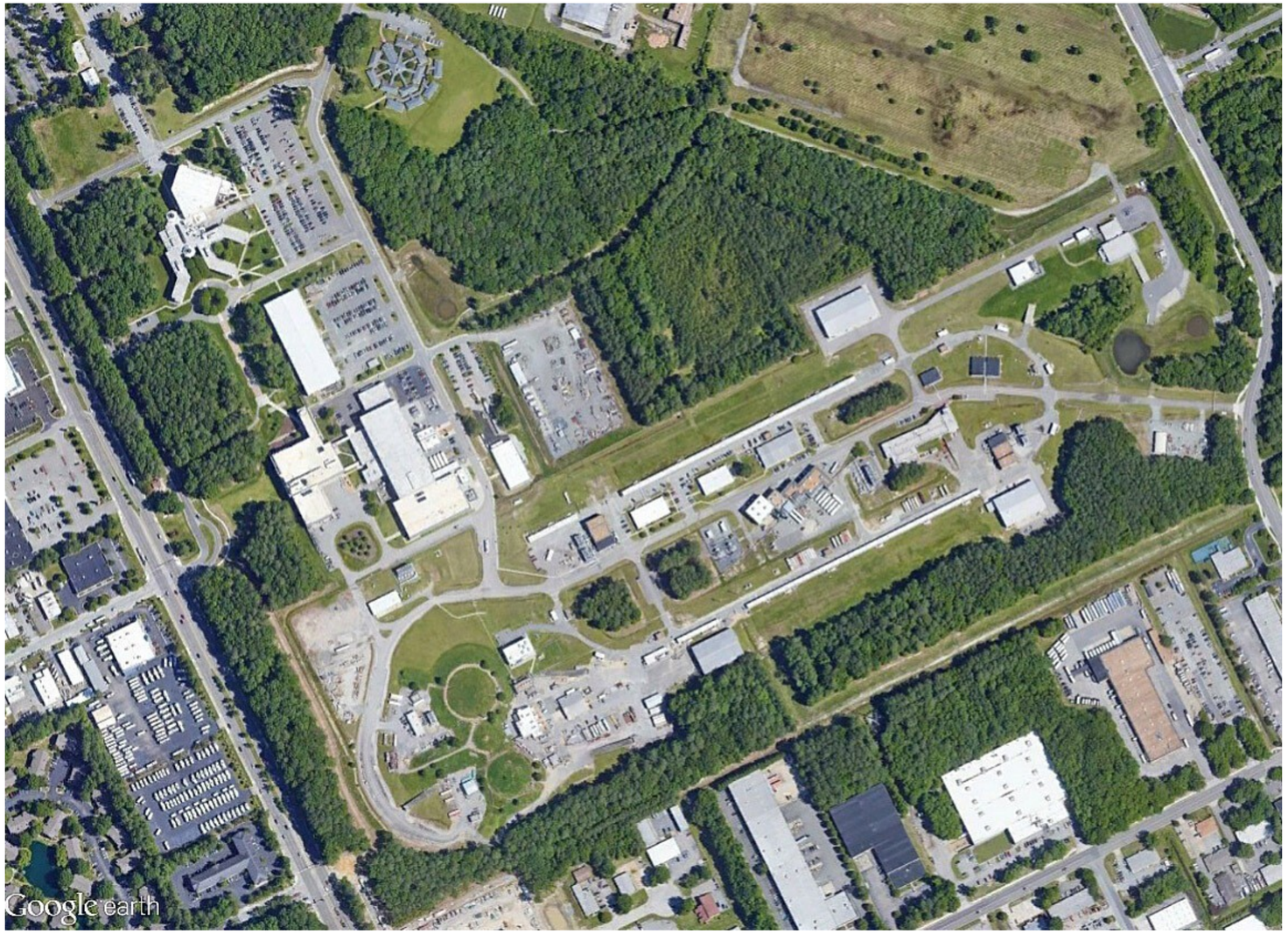
Overview

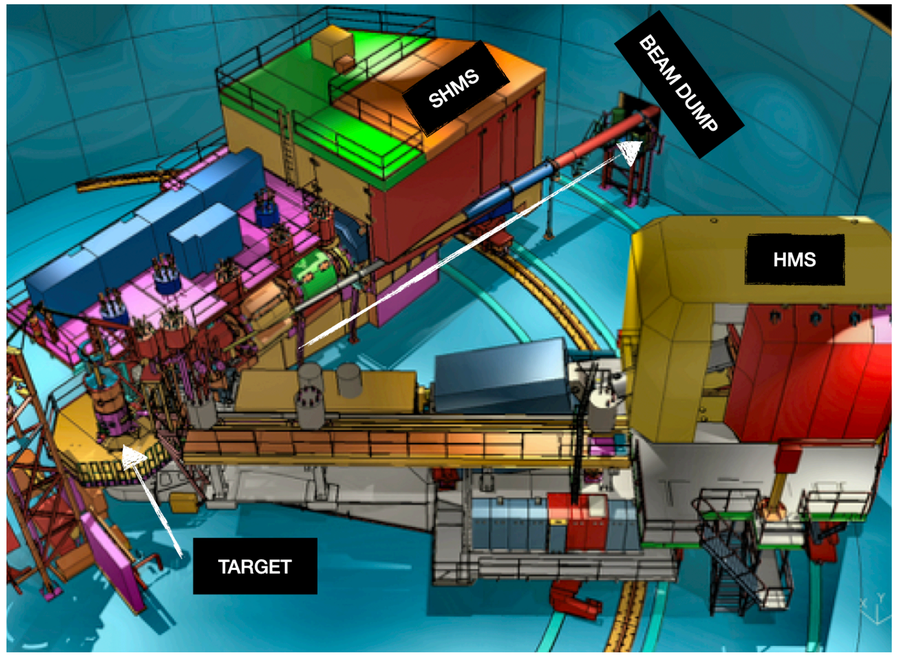
- Overview of E12-10-008
- Preliminary Data Analysis
- Calibration Update



EMC Data from XEM2

Experimental Overview

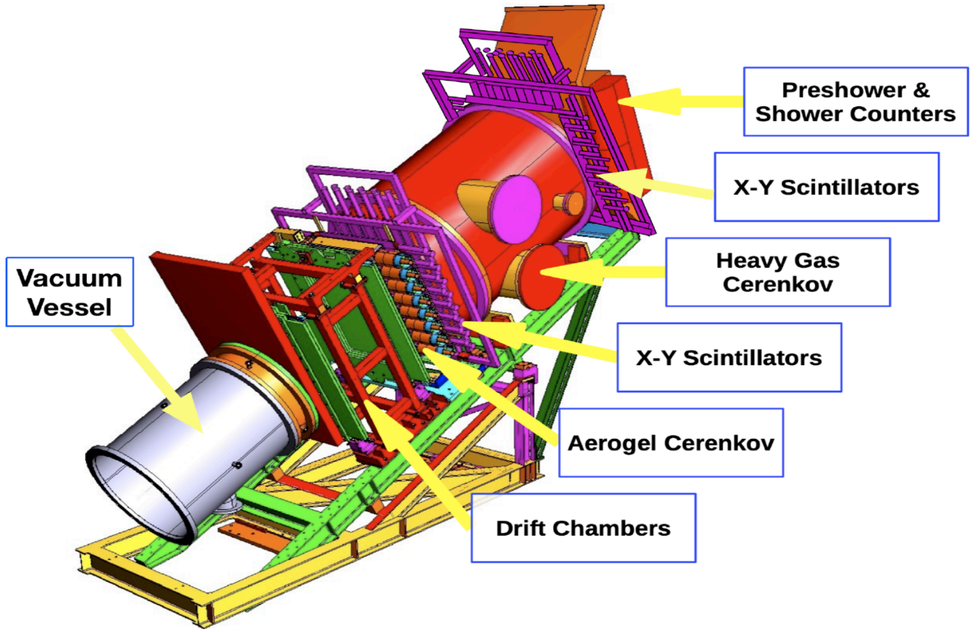
- Experiment E12-10-008 performed in Hall C at JLab
- Ran simultaneously with E12-06-105(SRCs)
- Single arm data taken in HMS
- E12-06-105(SRCs) took data in SHMS



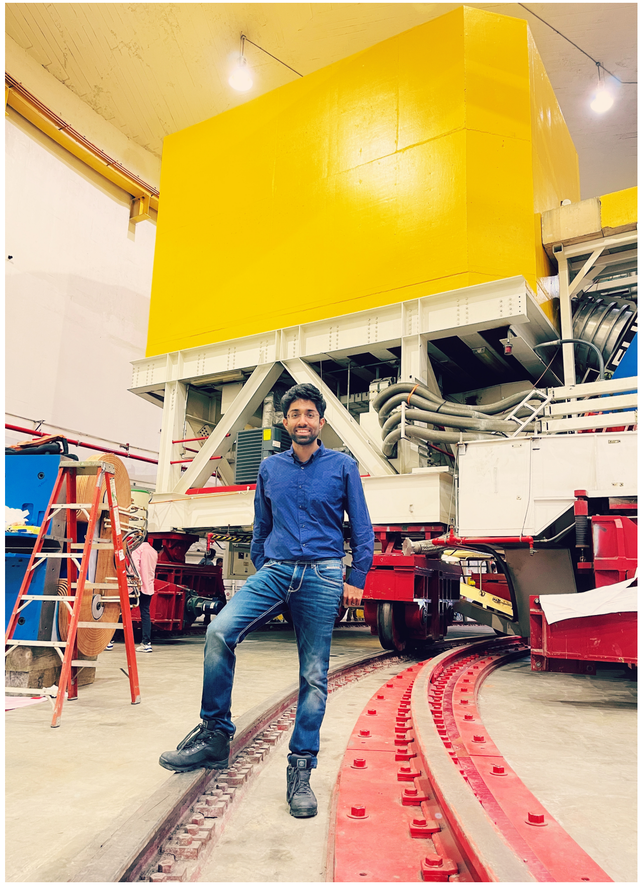
A CAD drawing of Hall C

High Momentum Spectrometer

1. **Drift Chambers**
   - Provides tracking information
2. **Cerenkov**
   - Particle identification
3. **Hodoscopes**
   - Trigger
   - Tracking Efficiency
4. **Calorimeter**
   - Particle identification



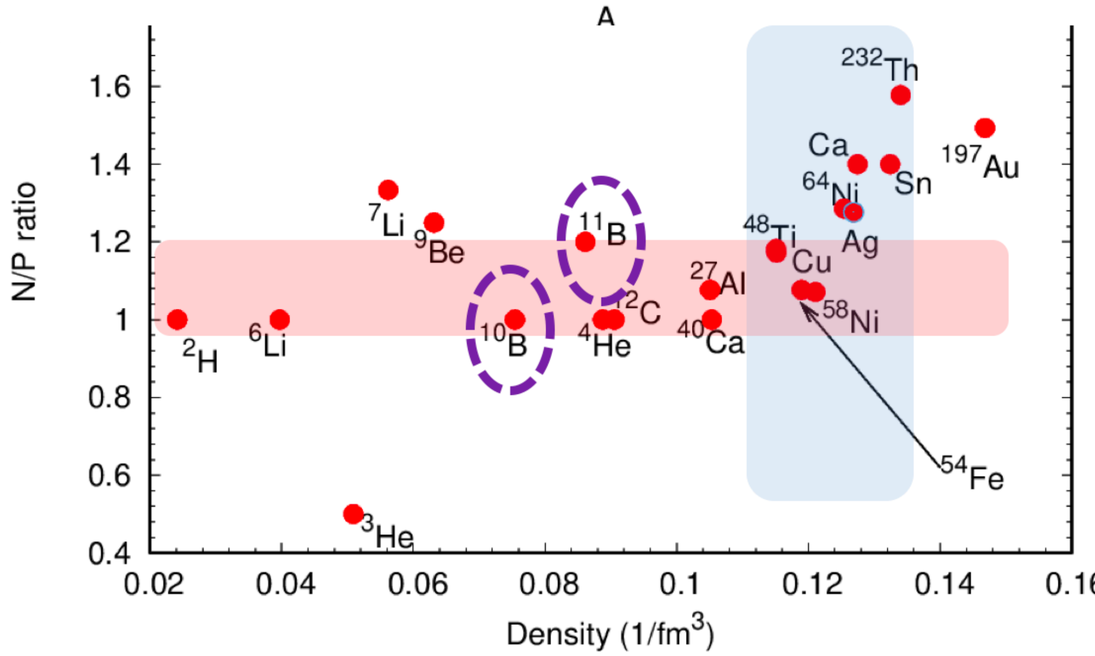
CAD Drawing of the HMS detector stack



EMC Data from XEM2

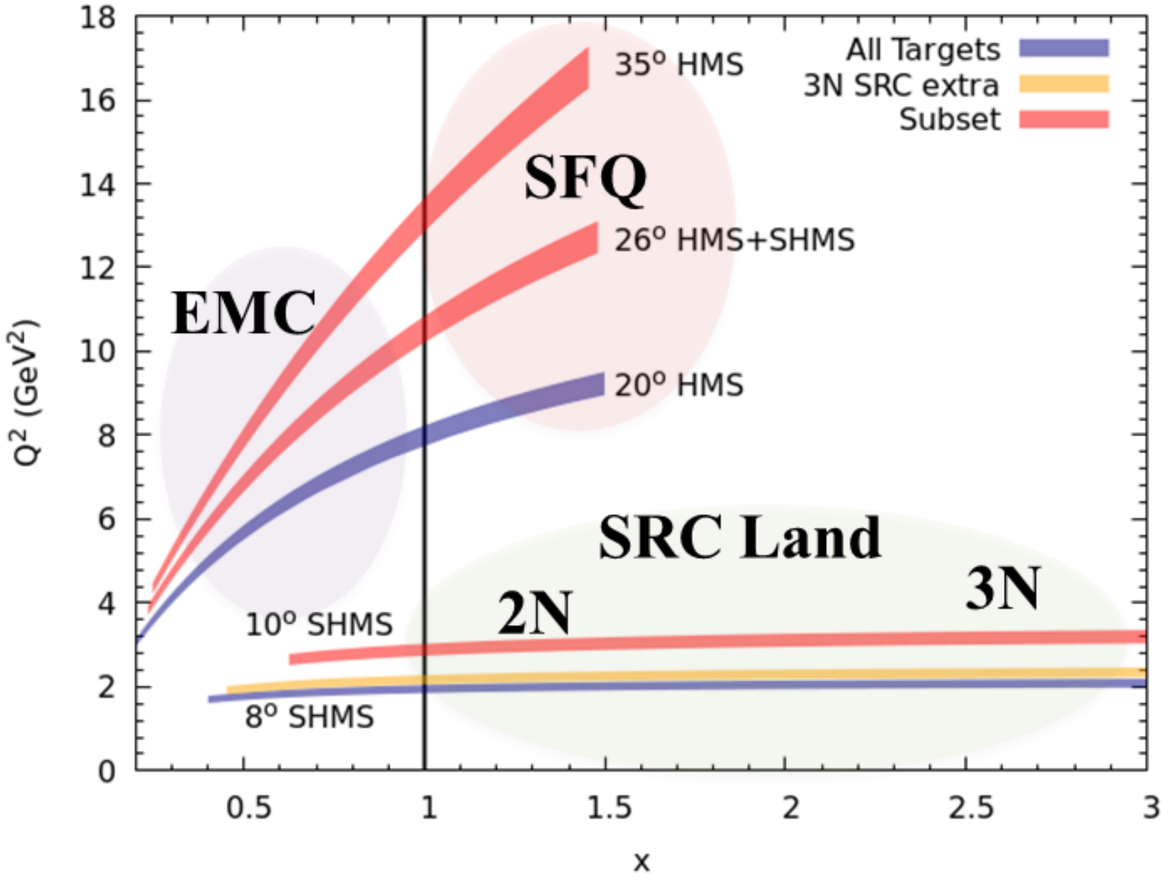
E12-10-008: Targets

- Investigates EMC effect in various light to medium nuclei
- Uses ^{40}Ca and ^{48}Ca which will provide insight into models predict a significant flavor dependence in the EMC effect.
- Will study the nuclei at low x and increased Q^2 than before, which will help in studying the EMC effect with greater precision
- Comparisons of nuclei which differ by just one nucleon (^{11}B-^{10}B, ^{7}Li-^{6}Li, ^{12}C-^{11}B) will allow to study isospin dependence



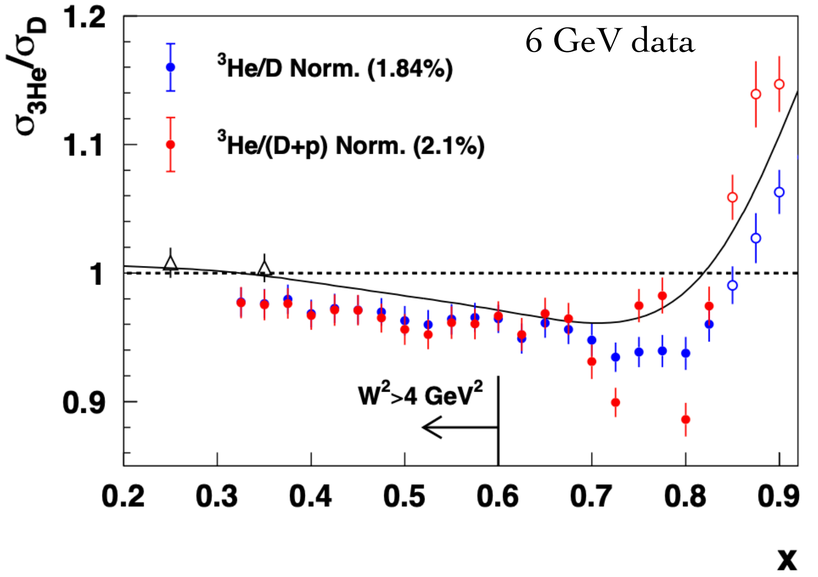
E12-10-008: Kinematic Coverage

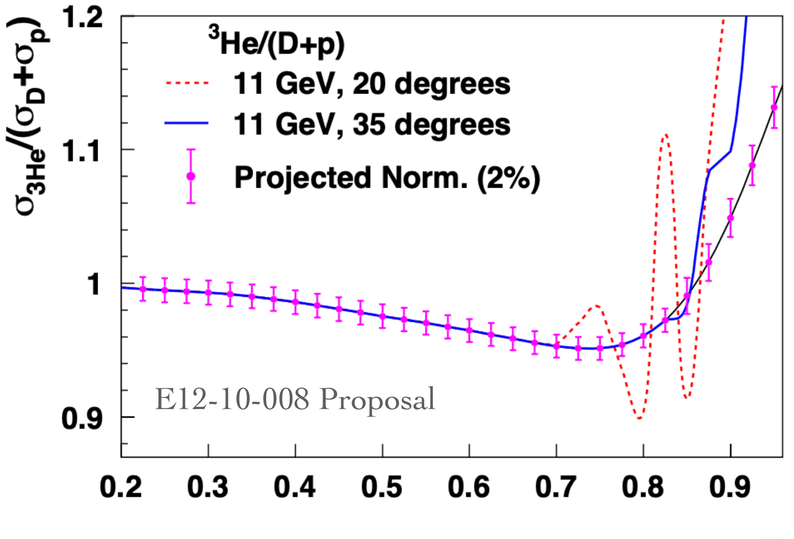
- Ran from Sep '22-Feb '23
- ~20 momentum settings for various targets
- HMS ran at high Q^2
- We measured EMC effect in several light nuclei(^{6}Li & ^{7}Li)
- Light nuclei are conducive to exact theoretical calculations



E12-10-008: With Great Energy Comes Great Data

- Higher beam energy+ higher Q^2 allows us to skip the resonance region
- Can access higher x
- Can get $^3He/(^2H+^1H)$ without relying heavily on large isoscalar corrections
- Avoids the uncertainty associated with knowledge of the neutron structure function

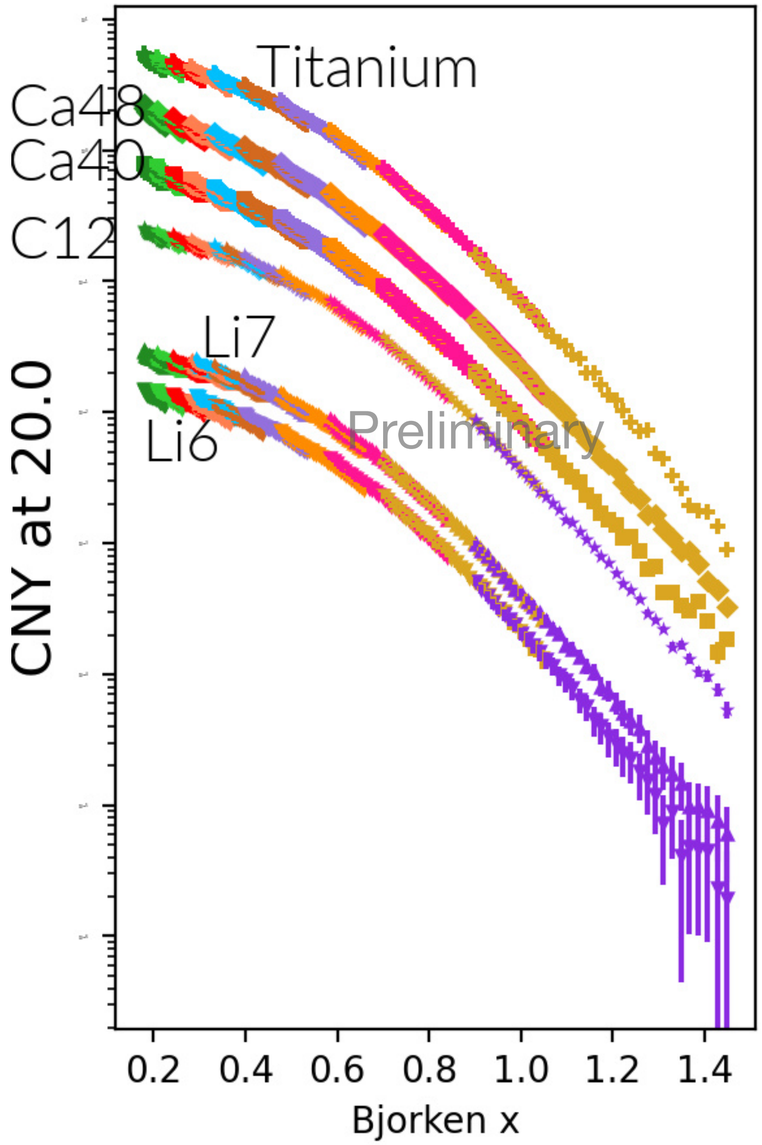




EMC Data from XEM2

Charge Normalized Yield vs Bjorken-x

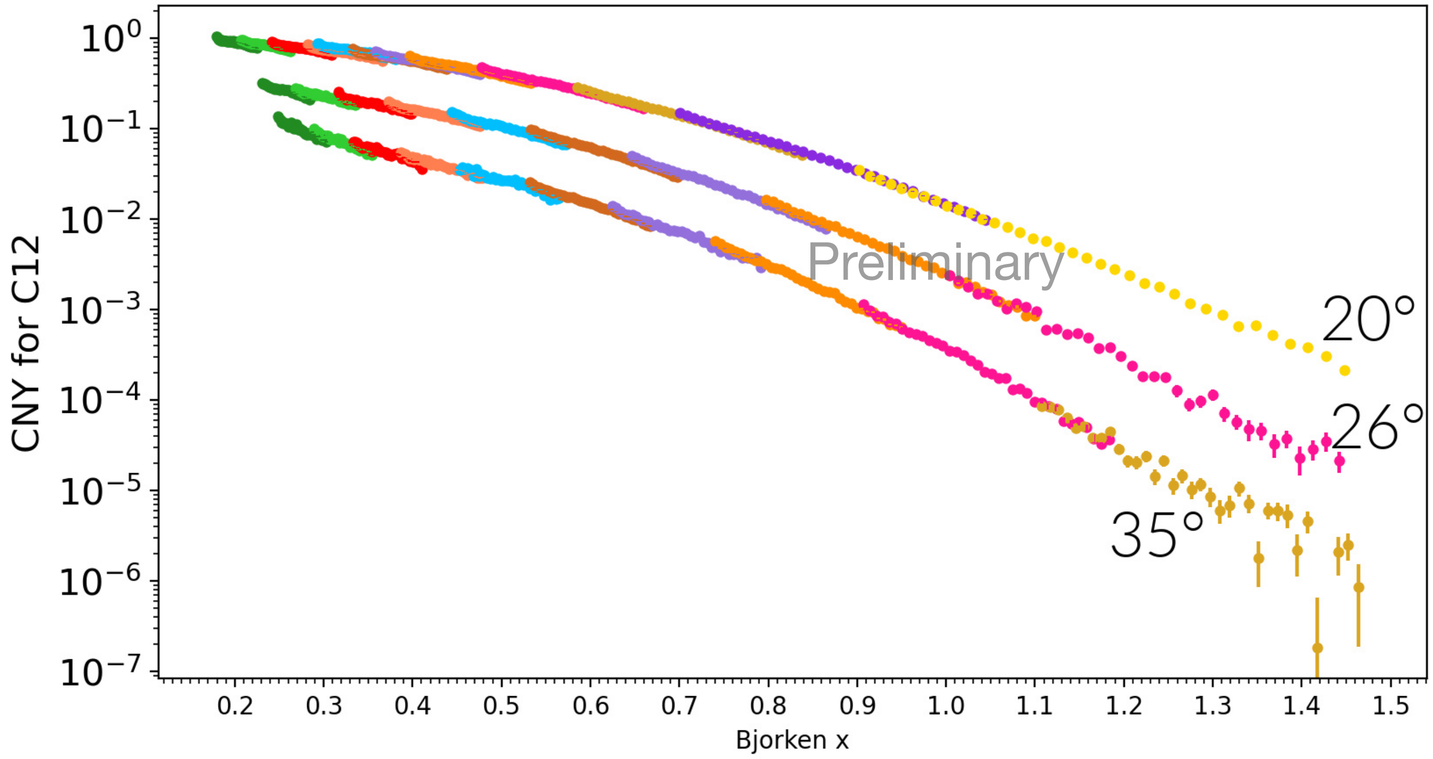
- Yield vs x for different targets
- Arbitrary scaling to differentiate targets
- Different colors indicate different central momentum settings for the HMS



EMC Data from XEM2

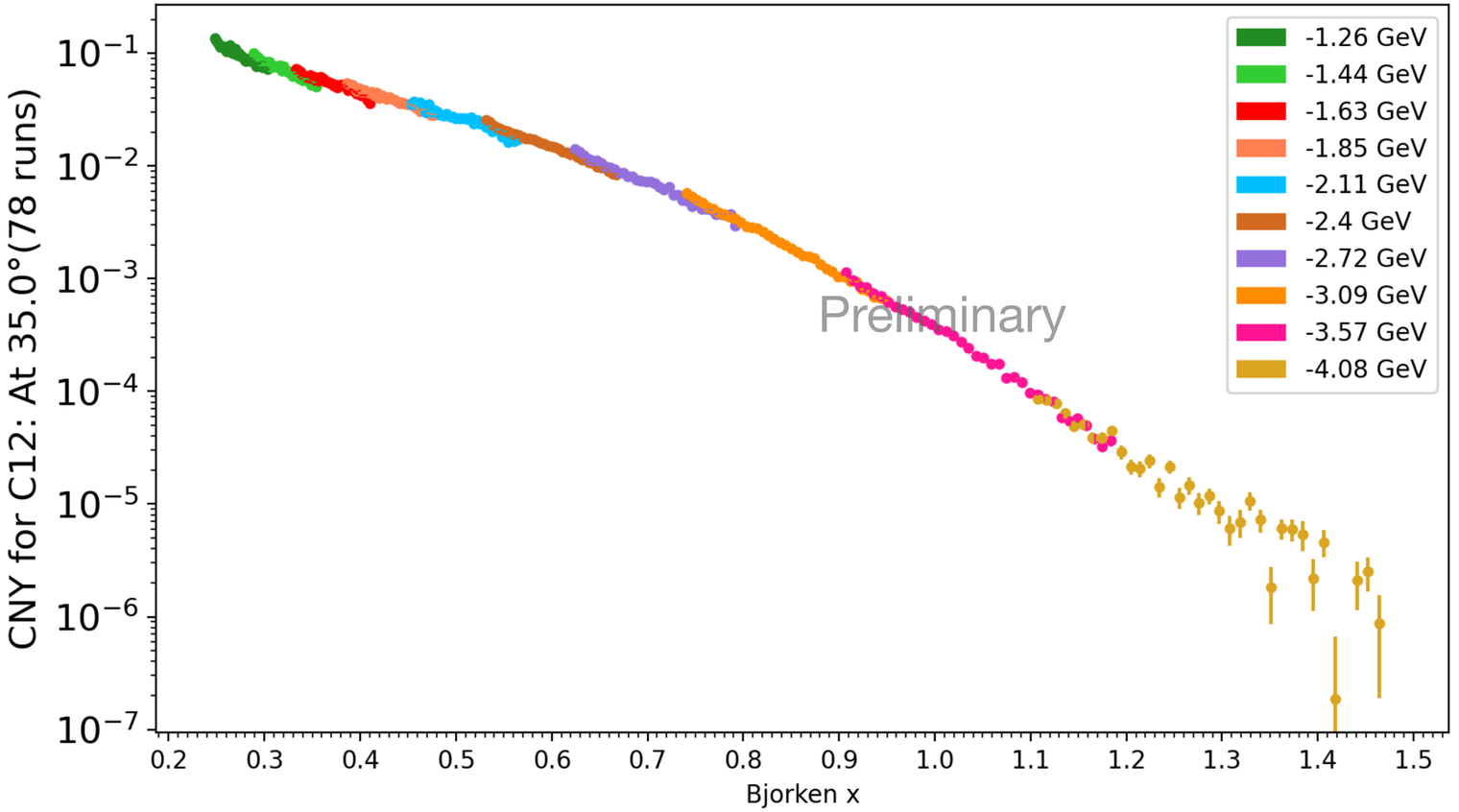
Charge Normalized Yield vs Bjorken-x

- CNY vs x at different angles
- Excellent Statistics



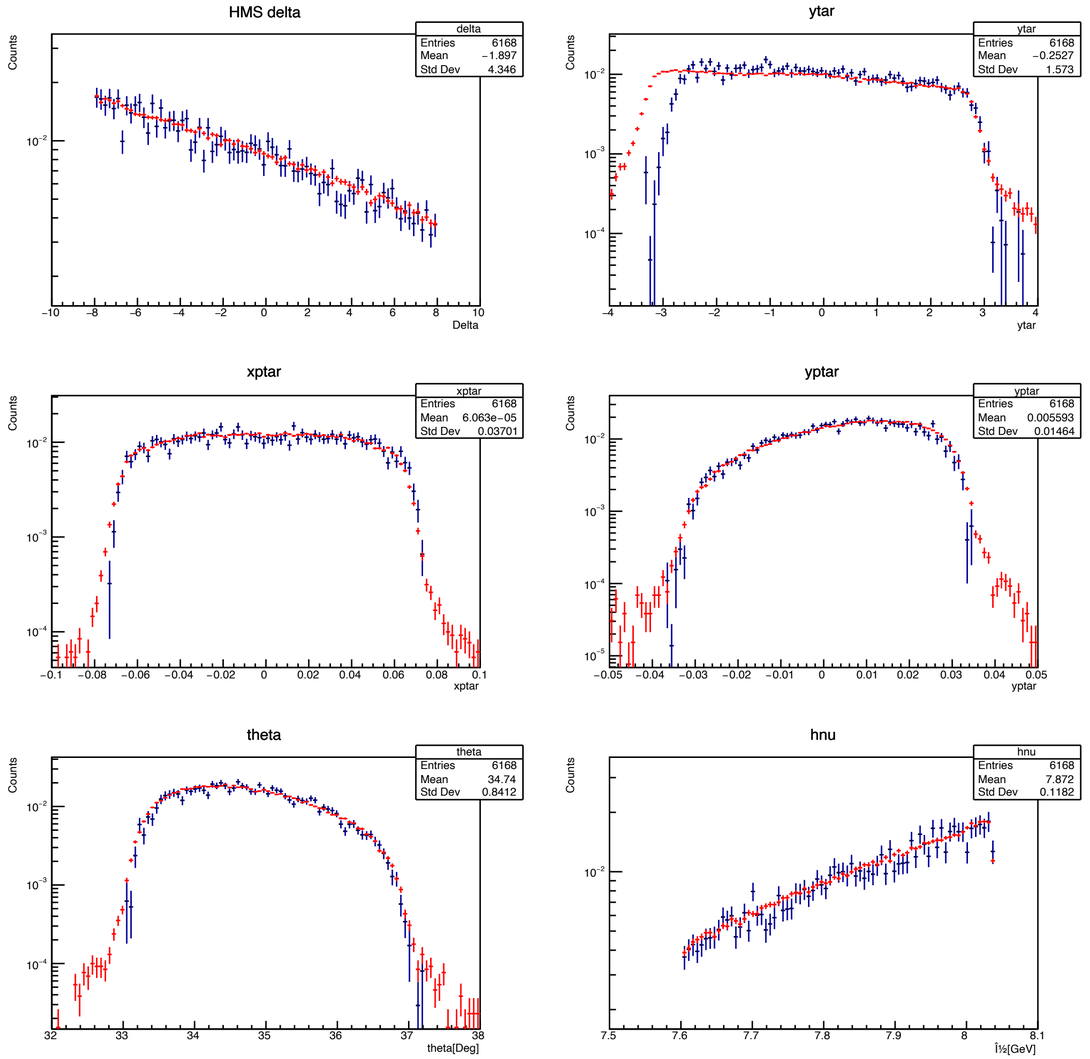
Superfast Quarks

- Q^2 ~17 GeV^2/c
- Multiquark Structures- 6 quark bag?
- Great data for testing exotic models
- SFQ data for: ^{2}H, ^{9}Be, ^{10}B, ^{11}B, ^{12}C, ^{40}Ca & ^{48}Ca!



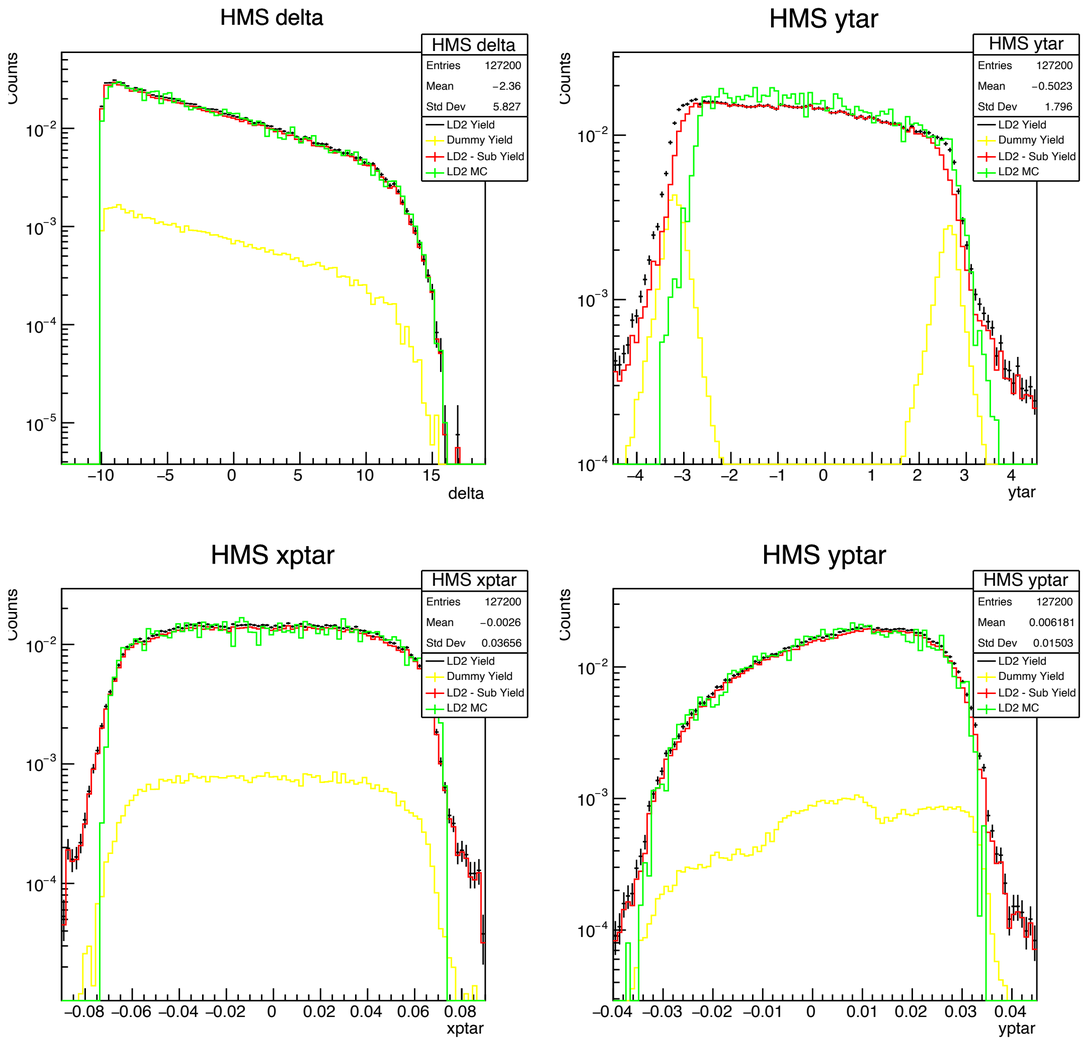
Data to Simulation Comparison

- Simulation: Single-arm Monte Carlo
- Simulation is a model of particle transport through the magnetic elements of the spectrometer, weighted by cross-section



Data to Simulation Comparison

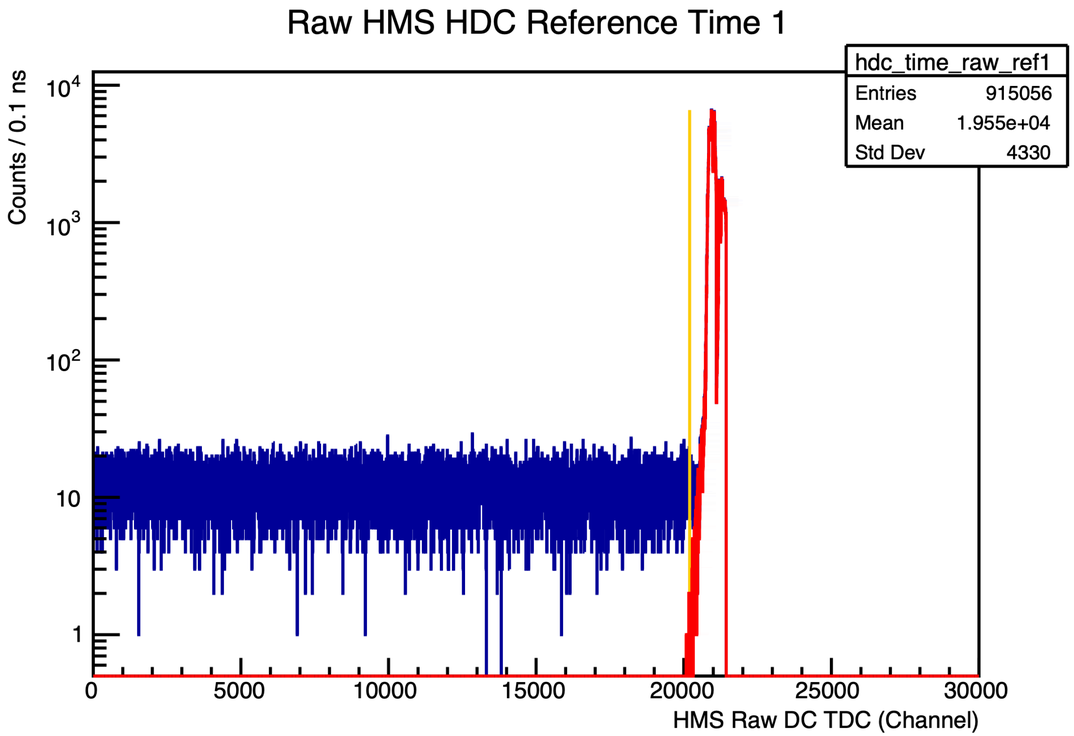
- Excellent agreement so far



Courtesy of Zoe Wolters(UNH)

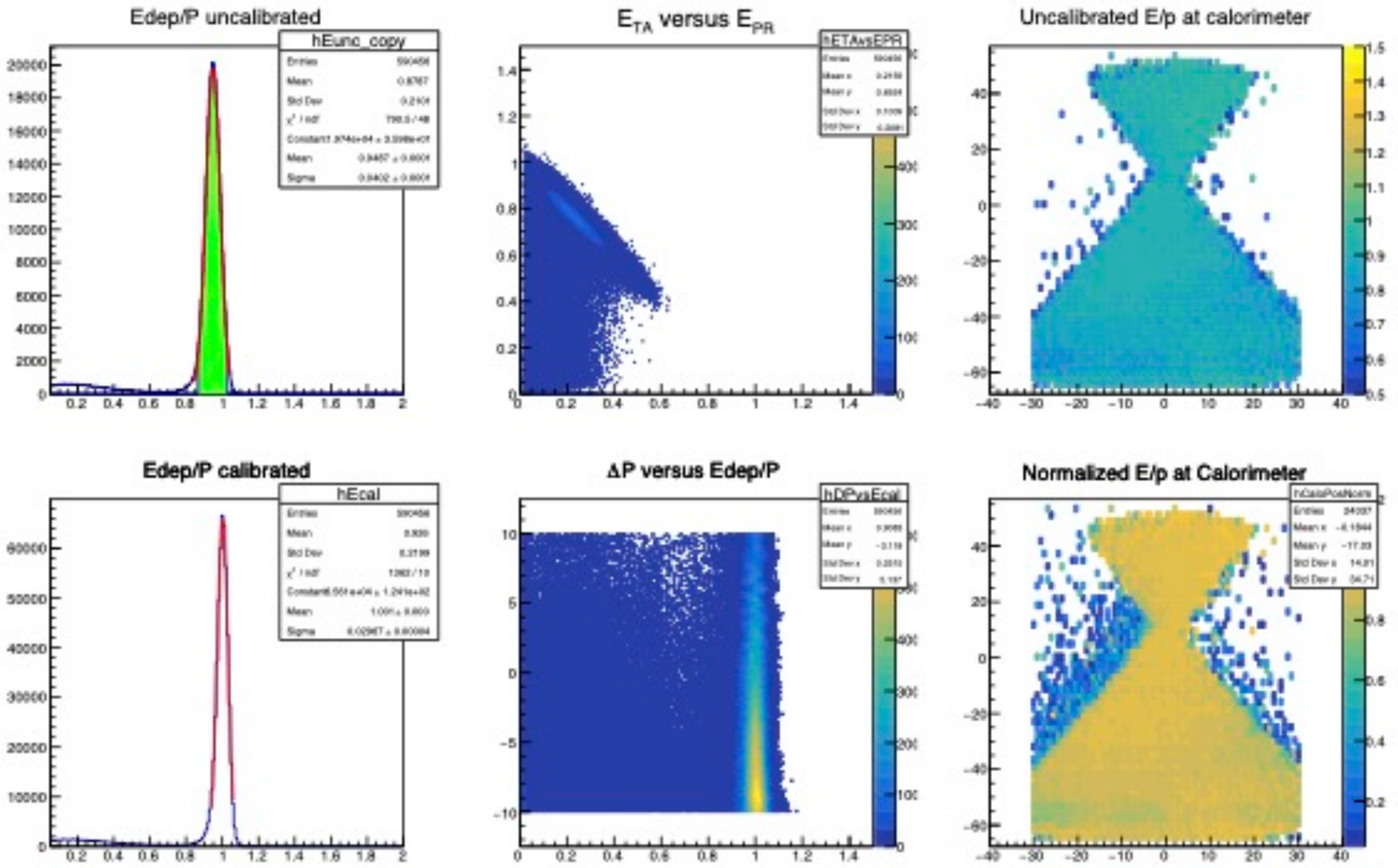
Current Status

- Data taking completed 5 months ago
- Detector Calibrations almost finished for the HMS
- Data checks



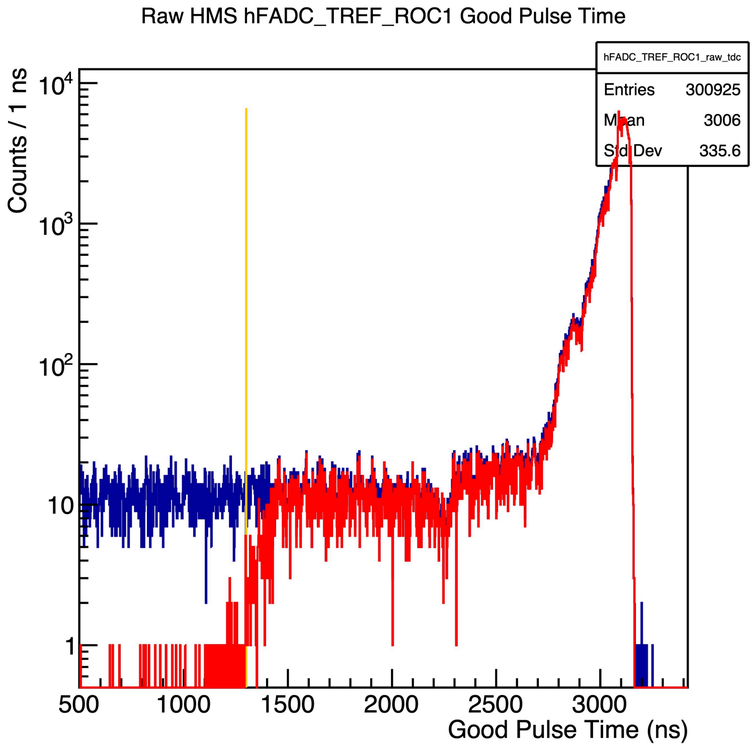
Calorimeter Calibrations

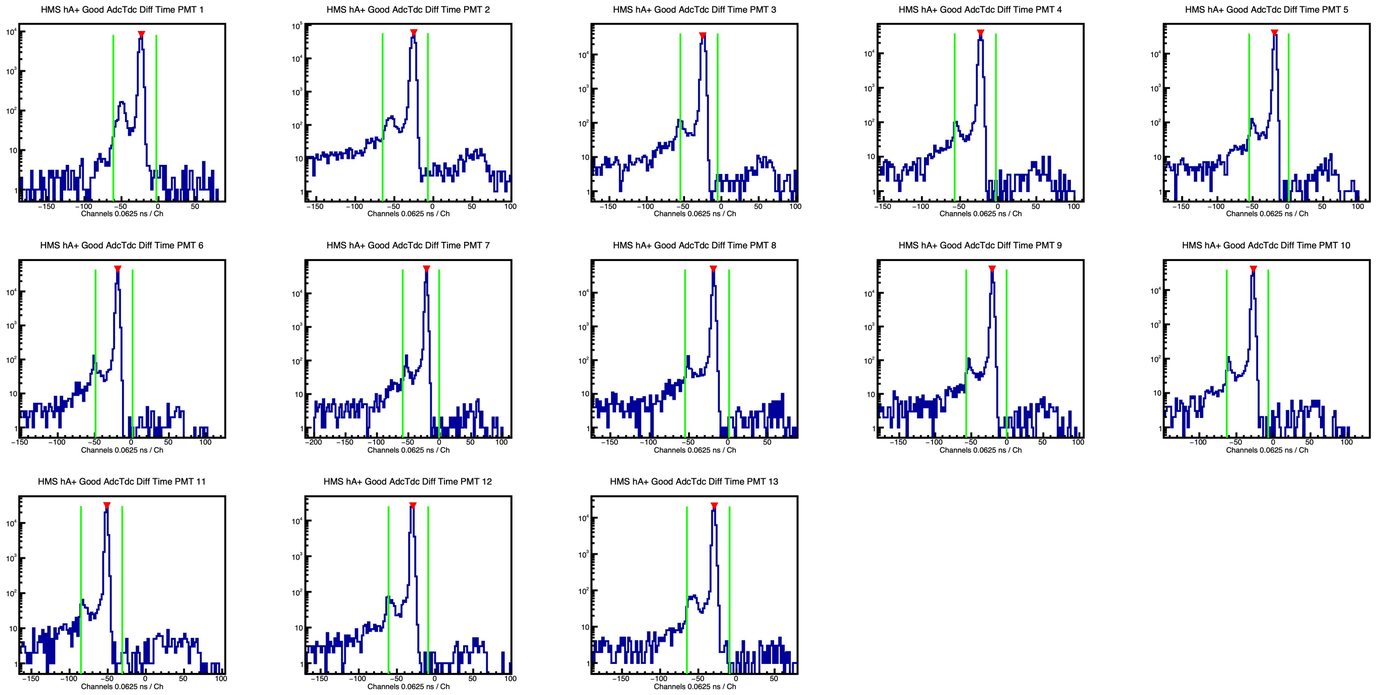
- Calorimeter calibrated by varying gain correction for blocks to keep output signals of the same size



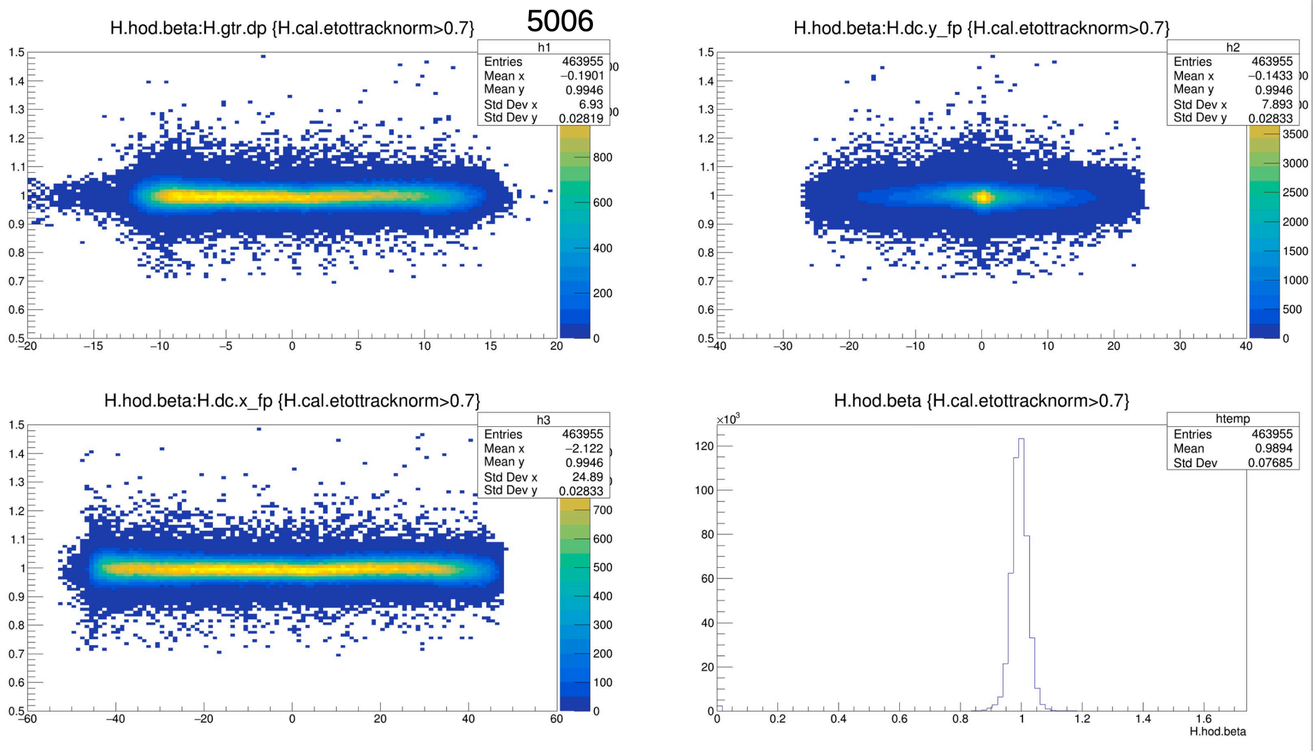
Timing Windows and Reference Time Cuts

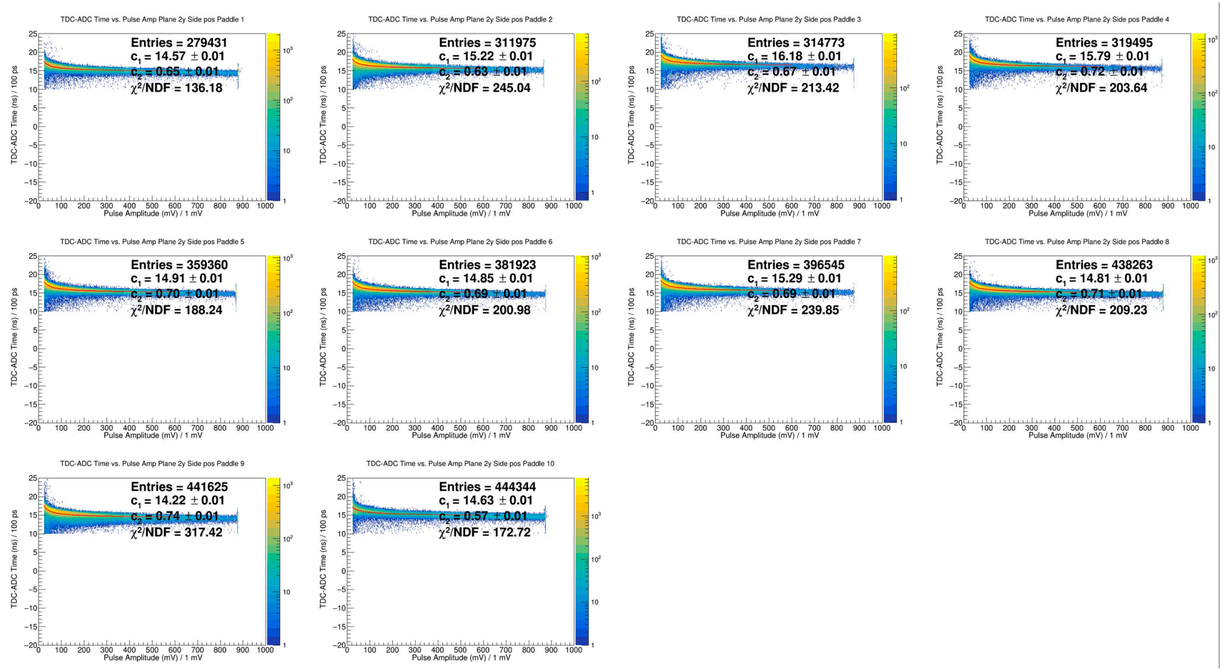
- Cuts made to exclude background events





Drift Chamber and Hodoscope Calibration





Courtesy of Cameron Cotton

Summary

- The origin of the EMC effect is still a mystery
- E12-10-008 will provide several key results:
  - Isospin dependence
  - Measurement in several light nuclei
  - More data for comparison with SRCs
  - Can get $^{3}He/(^{2}H+^{1}H)$ without relying heavily on large isoscalar corrections
- We have some results and much more to come

Acknowledgement

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