Neutron Magnetic From Factor G_M^n from $^3H/^3He$ ratio

Nathaly Santiesteban

University of New Hampshire

Hall A/C Meeting Collaboration
June 28/2019

Precision measurement of the isospin dependence in the 2N and 3N short range correlation region

P. Solvignon, J. Arrington, D. B. Day and D. Higinbotham (Spokepersons)

Run Summary

Fall 2018

LHRS: Dedicated NN and 3N SRC study (1<xbj<3) with 4.3 GeV beam

RHRS: QE scan

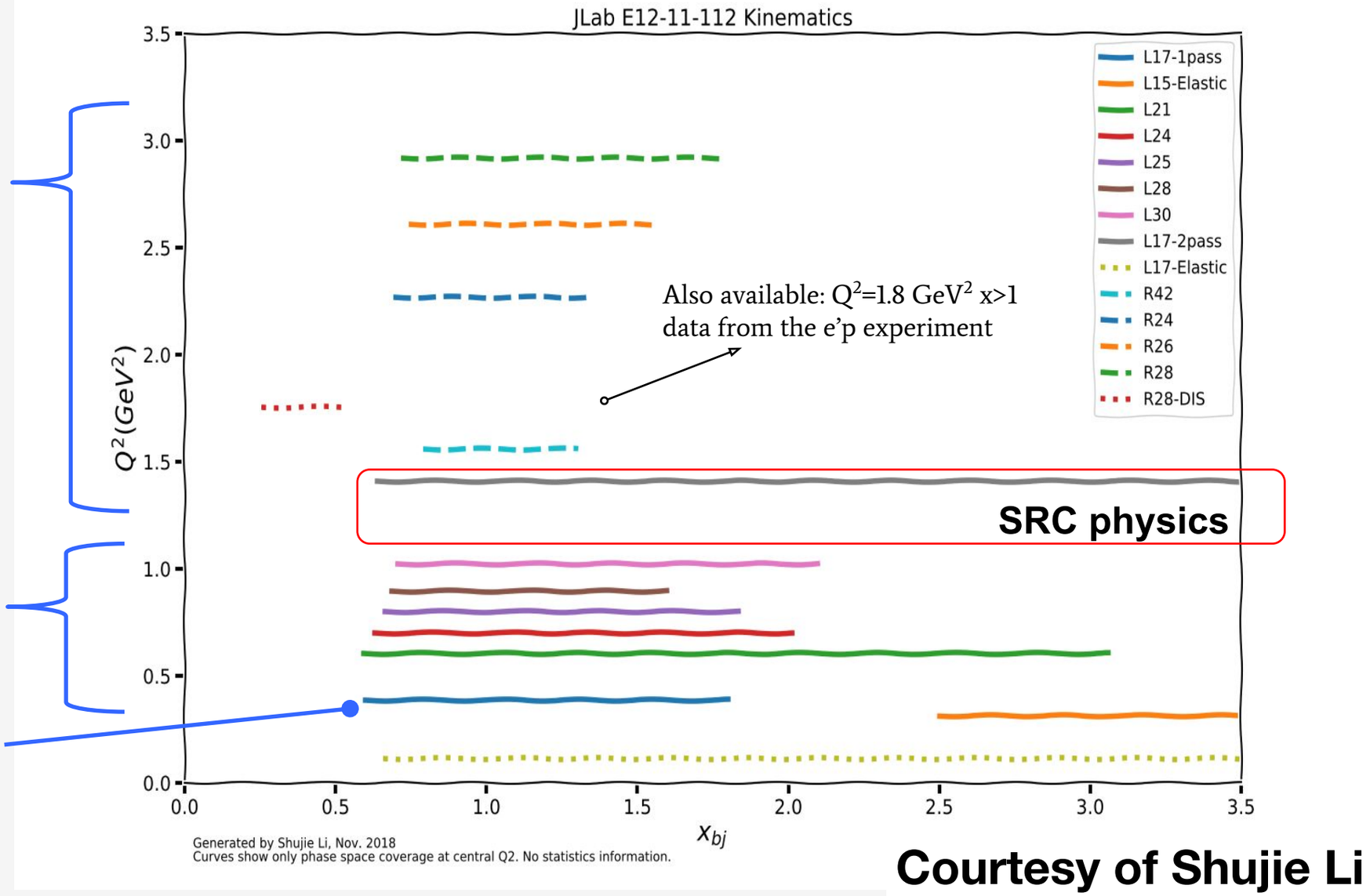
May 2018:

QE scan with 2.2 GeV beam

Dec 2017:

Commissioning

Target “boiling” study (also QE data at Q2=0.4 GeV2)



Courtesy of Shujie Li

Precision measurement of the isospin dependence in the 2N and 3N short range correlation region

P. Solvignon, J. Arring ... **both**

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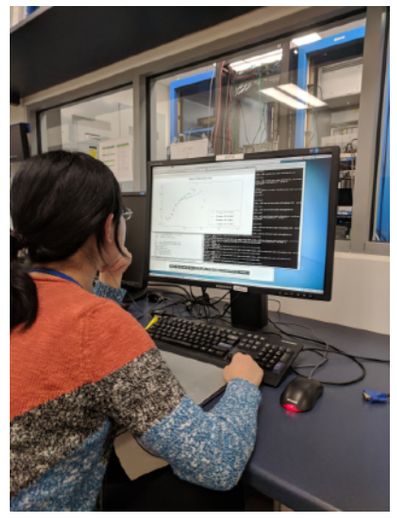
Nathaly Santiesteban
x=1



Shujie Li
x>1

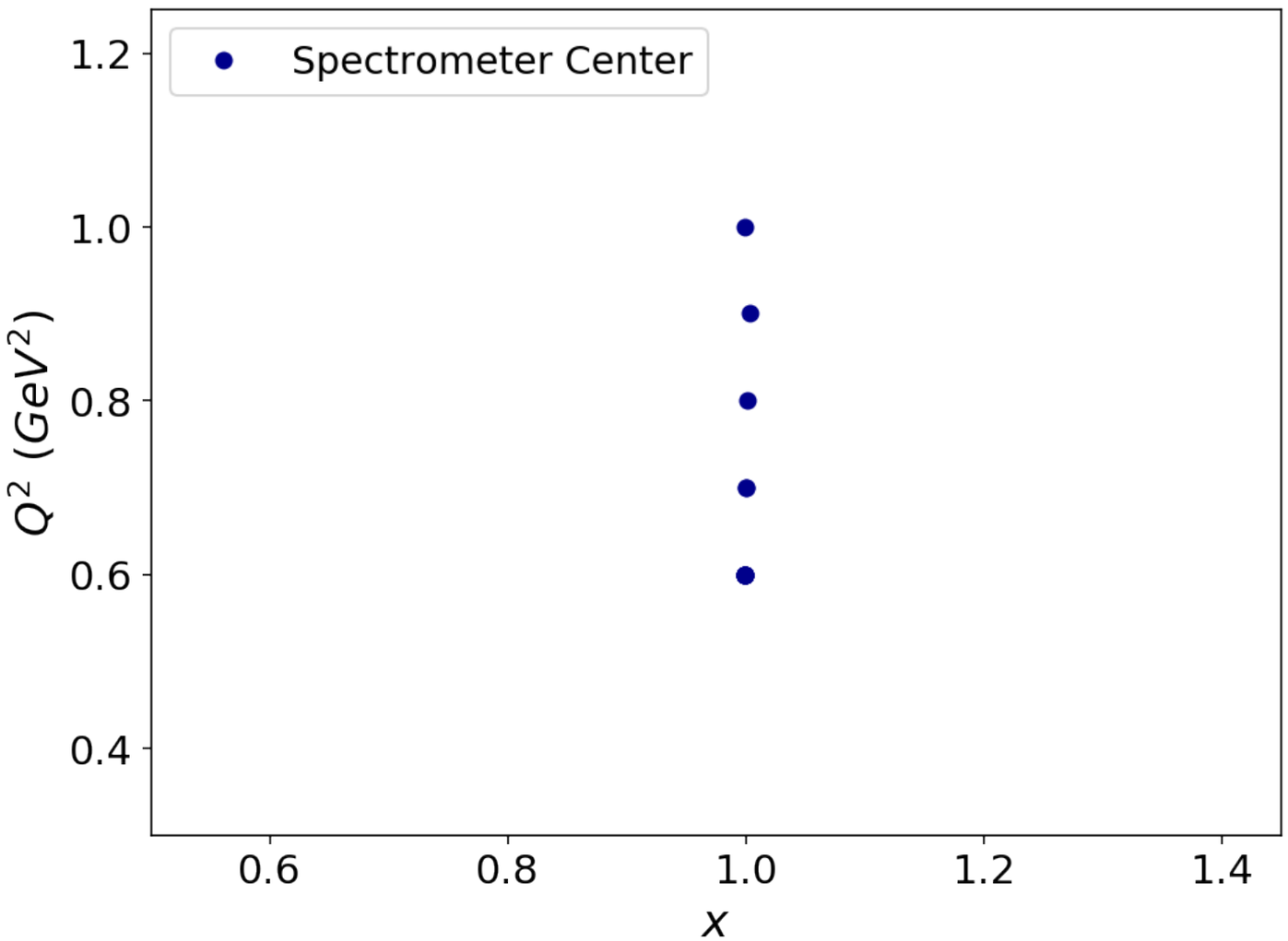
Tyler Kutz
x<1

Leiqaa Kurbany
x=3

E12-11-112 Collaboration

This talk: G_M^n parasitic measurement

Data in the next slides was taken with the LHRS at Hall A



Extraction of the G_M^n using:

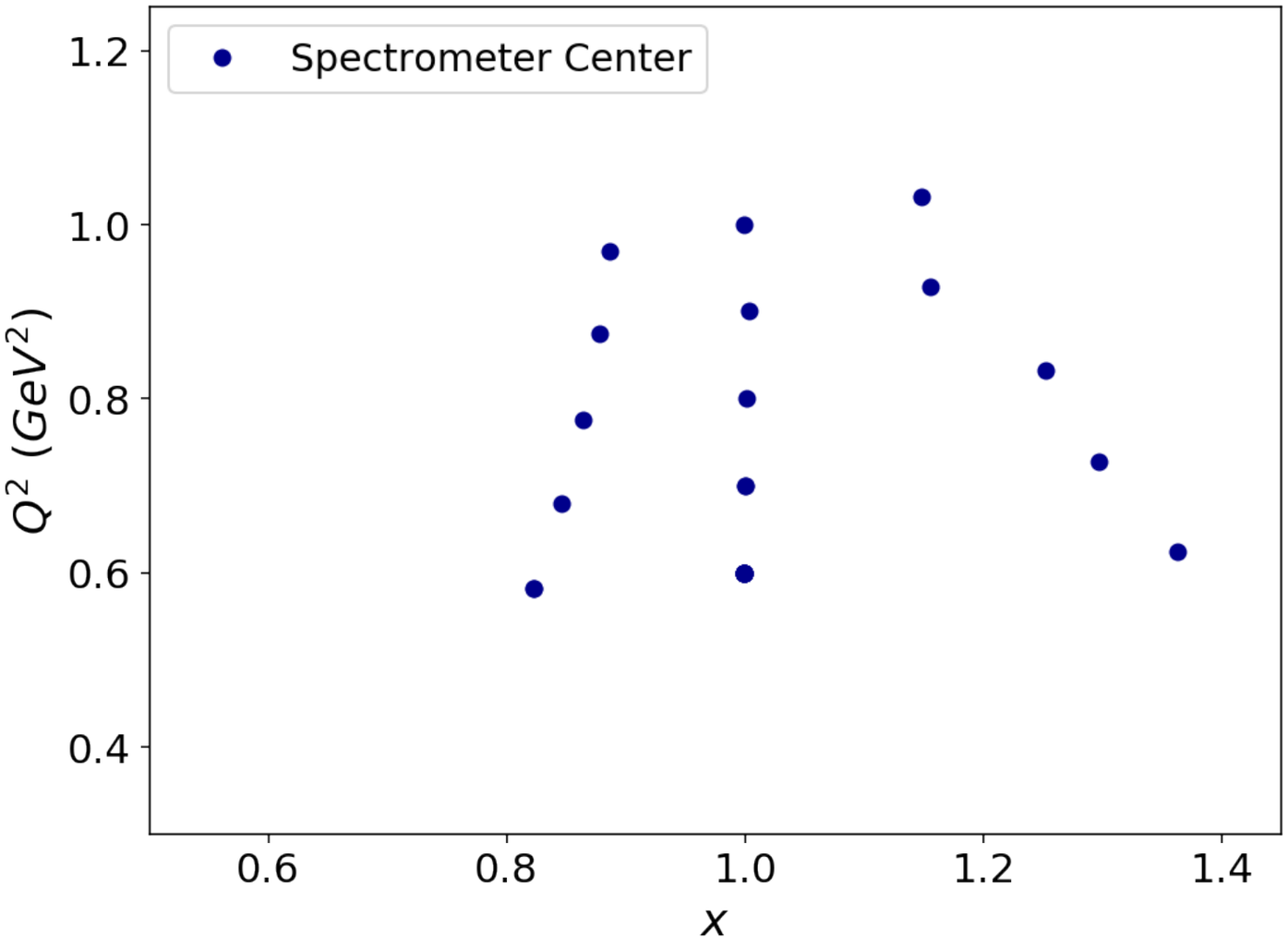
$$\sigma(^3H)/\sigma(^3He)$$

In the QE peak.

x = 1

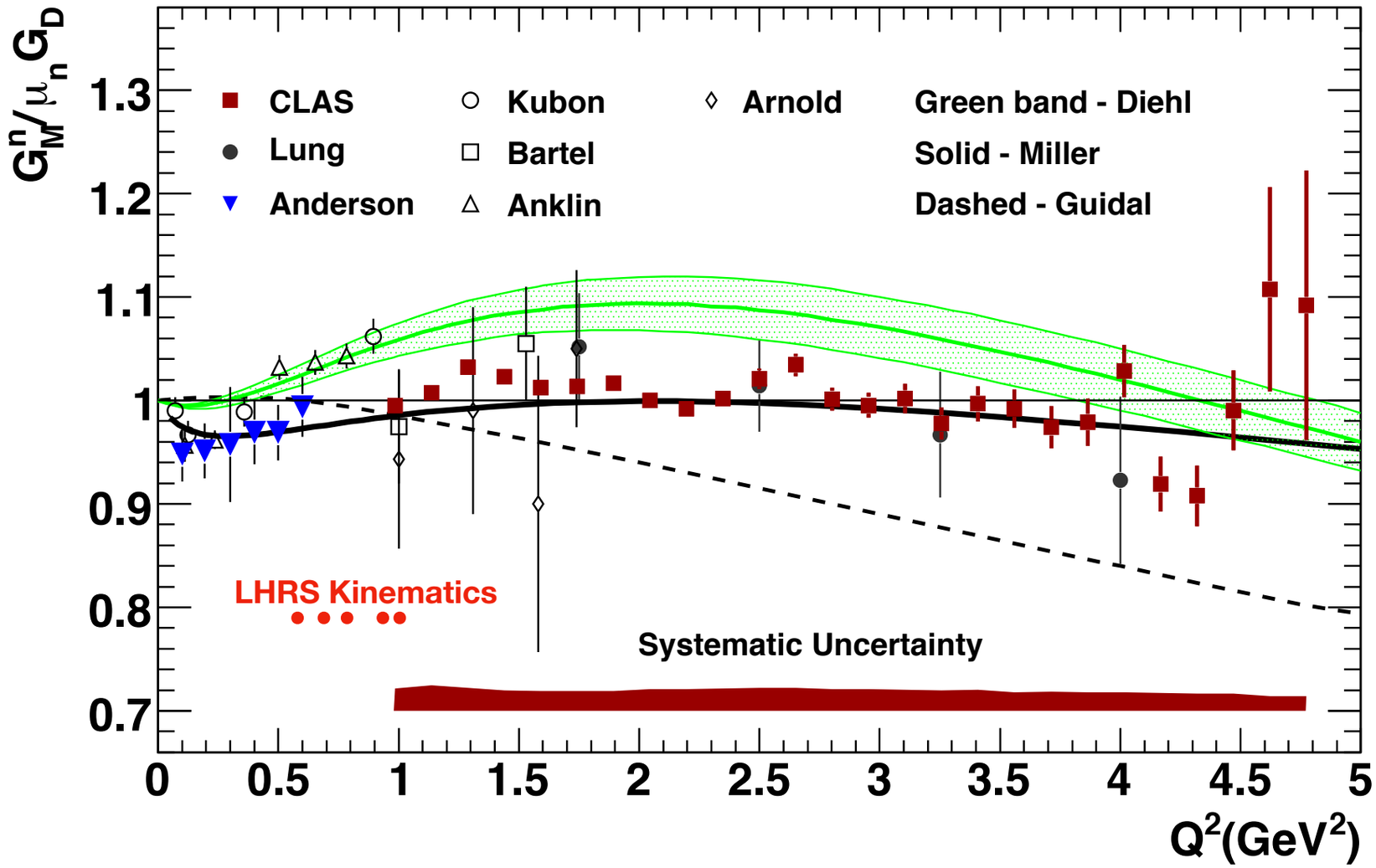
This talk: G_M^n parasitic measurement

Data in the next slides was taken with the LHRS at Hall A



Data was also taken in the low and high side of x to understand the cross-sections.

LHRS data:
0.595, 0.695, 0794, 0.902, 0.992 GeV^2



Motivation

$Q^2 < 1\ GeV^2$

J. Lachniet et al. (CLAS), Phys. Rev. Lett. 102, 192001 (2009)

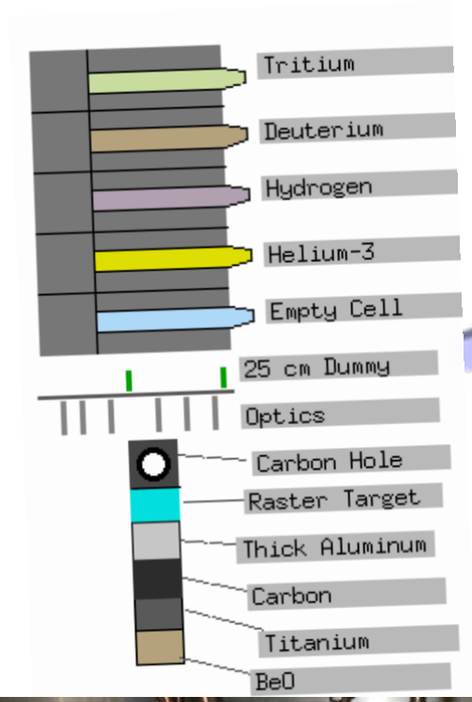
This region has ~8% discrepancy between the Anklin, Kubon data and the CLAS ratio and the Hall A polarized ^3He **extraction.**

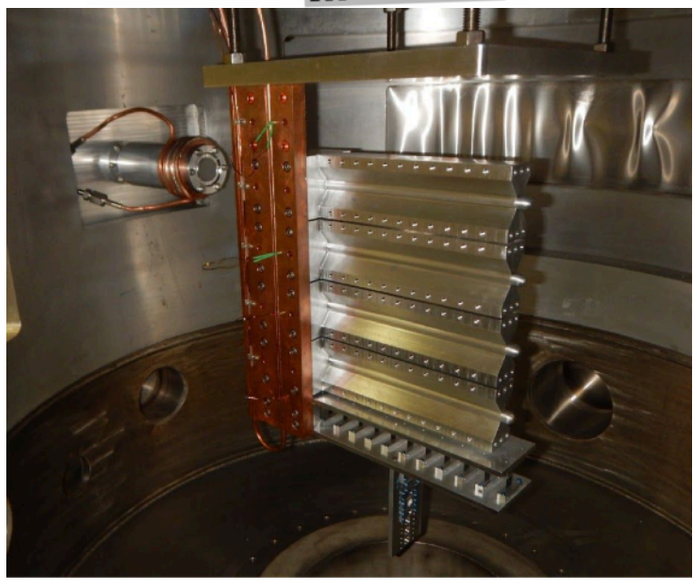
LHRS

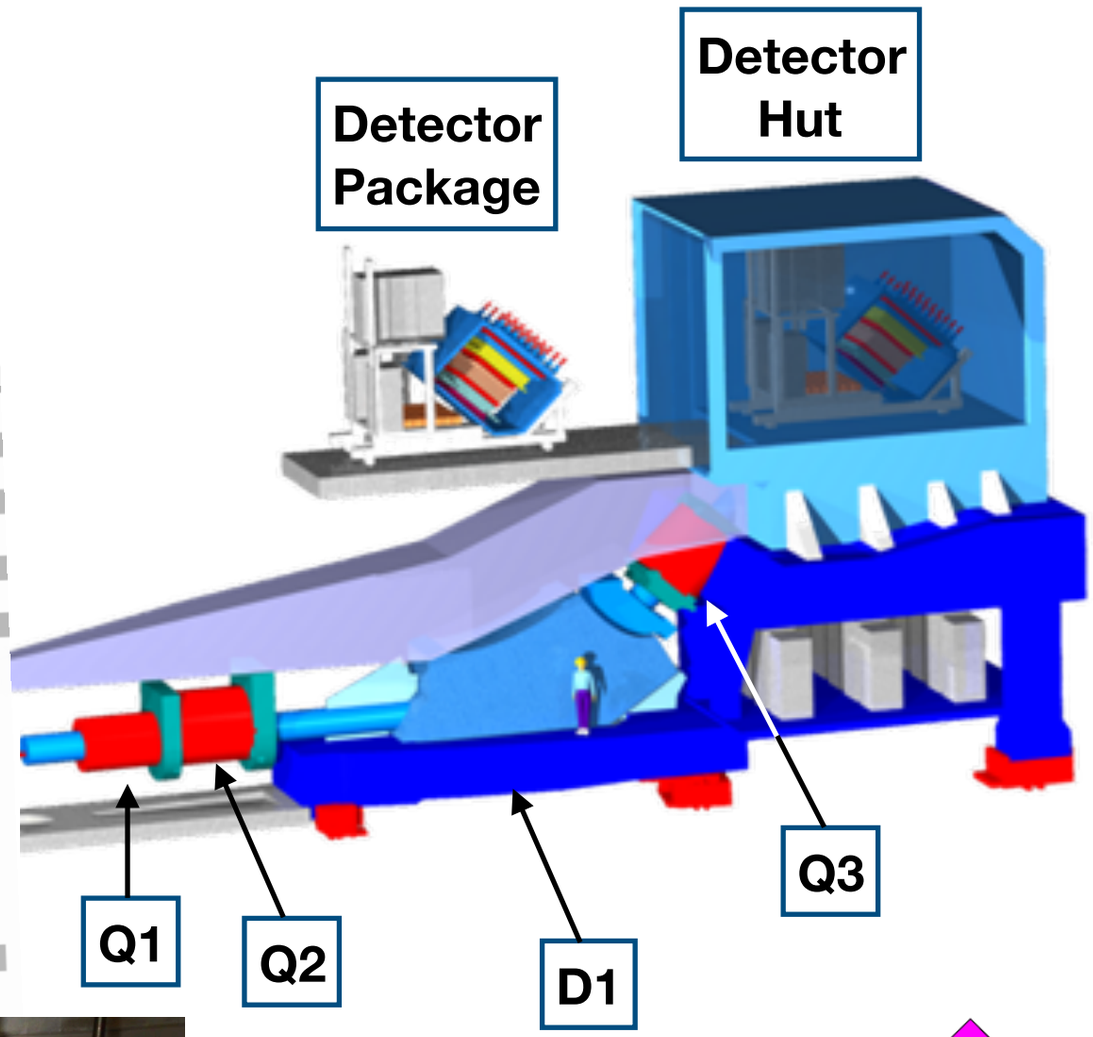
$$E = 2.2GeV$$

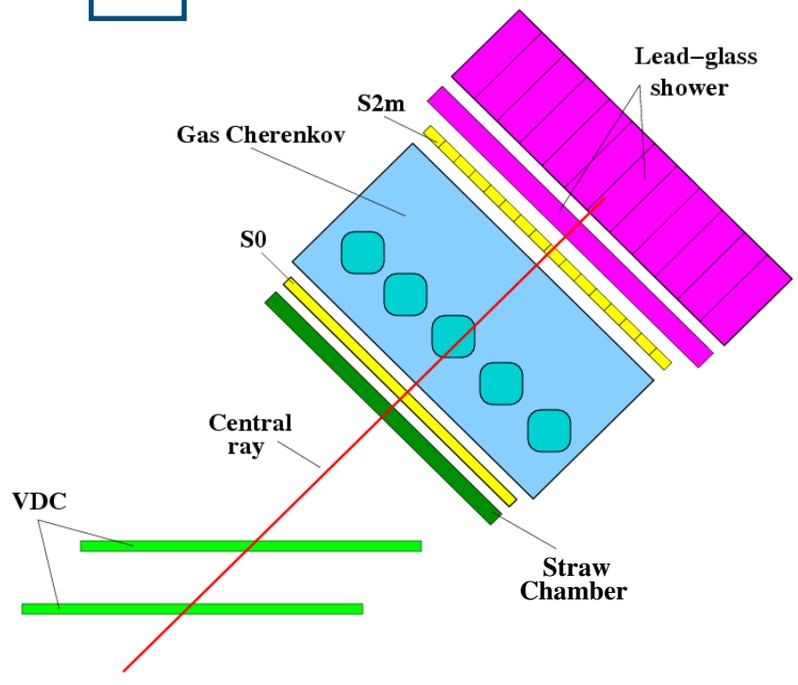
Electron Beam

$\theta(^\circ)$	$E'(GeV)$
21.7	1.83, 1.89,1.97
23.89	1.78, 1.84, 1.91
25.95	1.73 ,1.79, 1.86
28.00	1.68, 1.73, 1.78
30.00	1.63, 1.68, 1.73





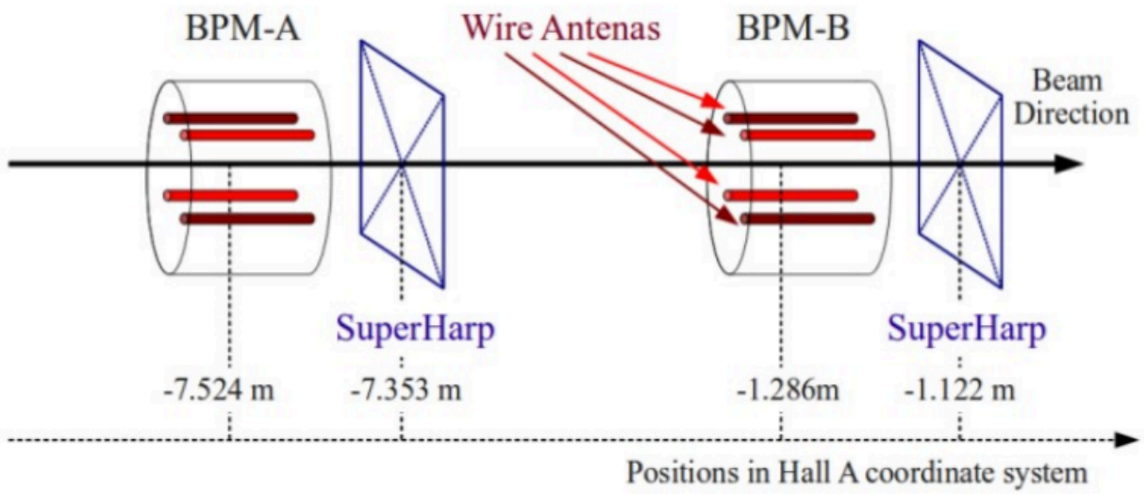


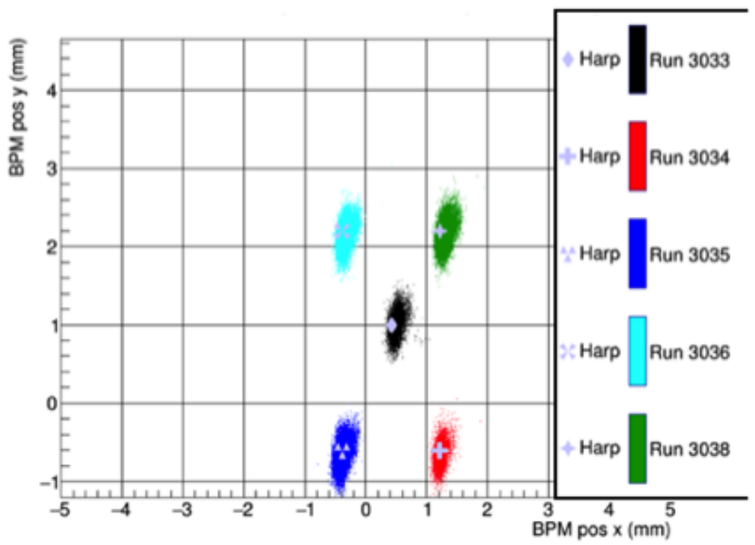


Calibrations

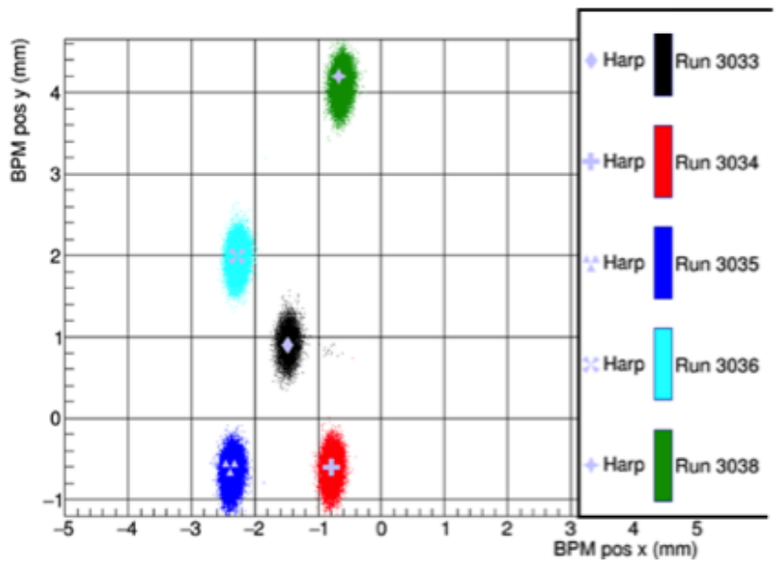
1) Beamline Calibrations

BPMs





(a) BPMA.

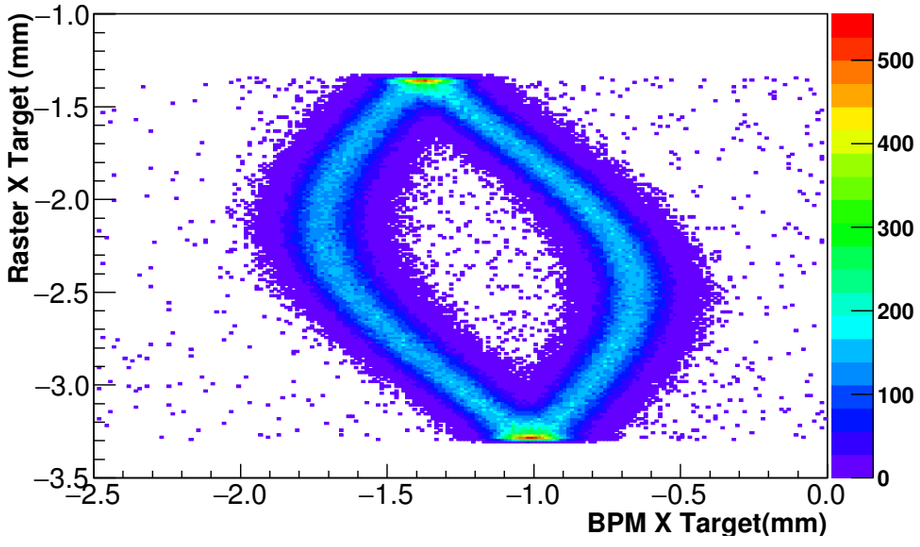


(b) BPMB.

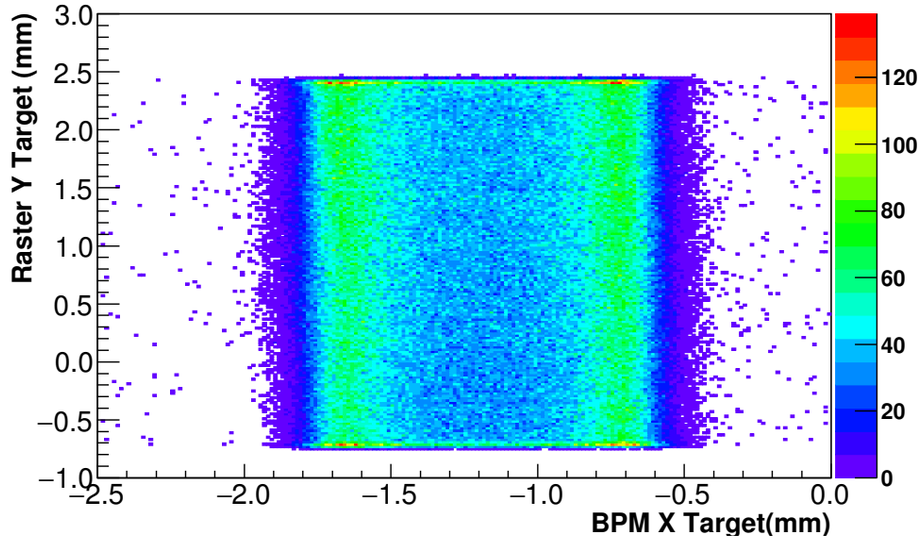
BPMs positions plotted with the positions measured by the harp scans after calibration.

Courtesy of Jason Bane

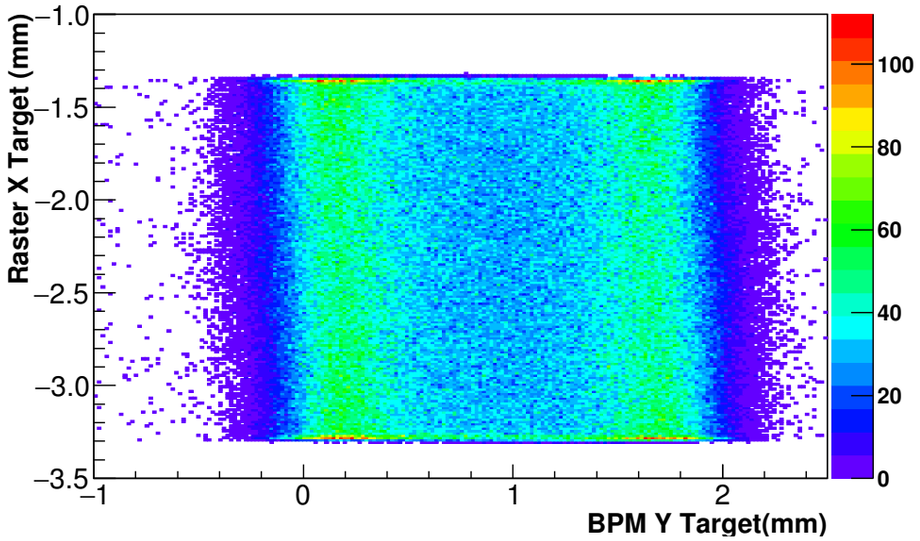
Raster Calibration



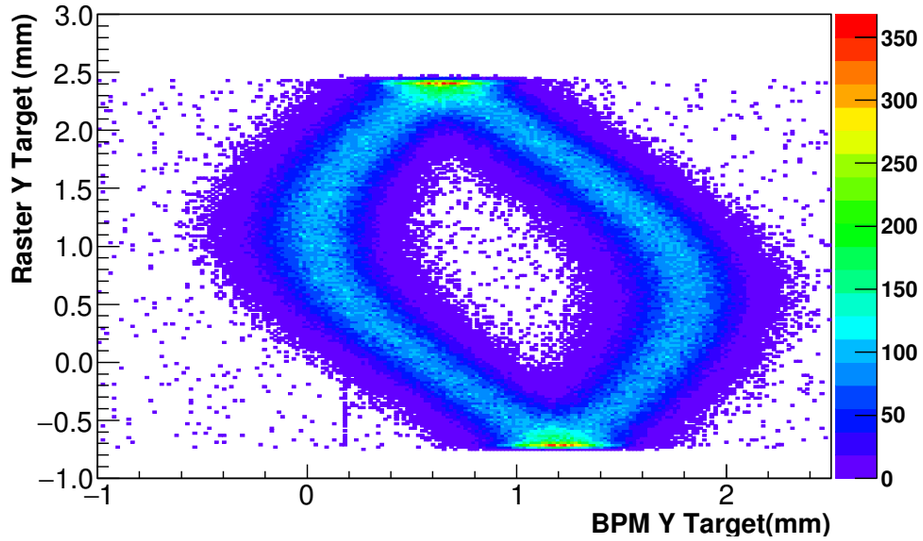
(a) Raster Target X Position vs BPM X Target Position.



(b) Raster Target Y Position vs BPM X Target Position.



(c) Raster Target X Position vs BPM Y Target Position.

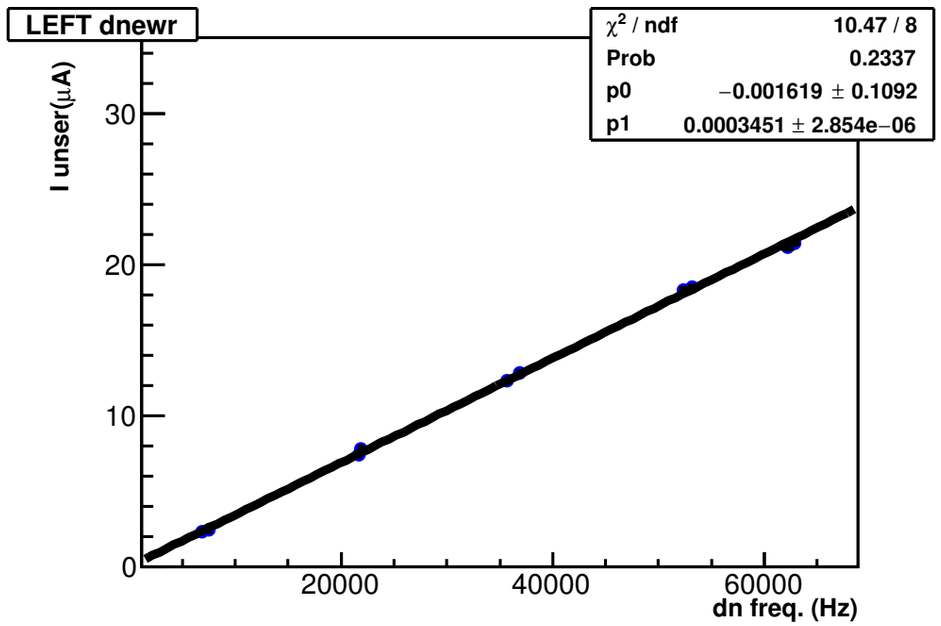


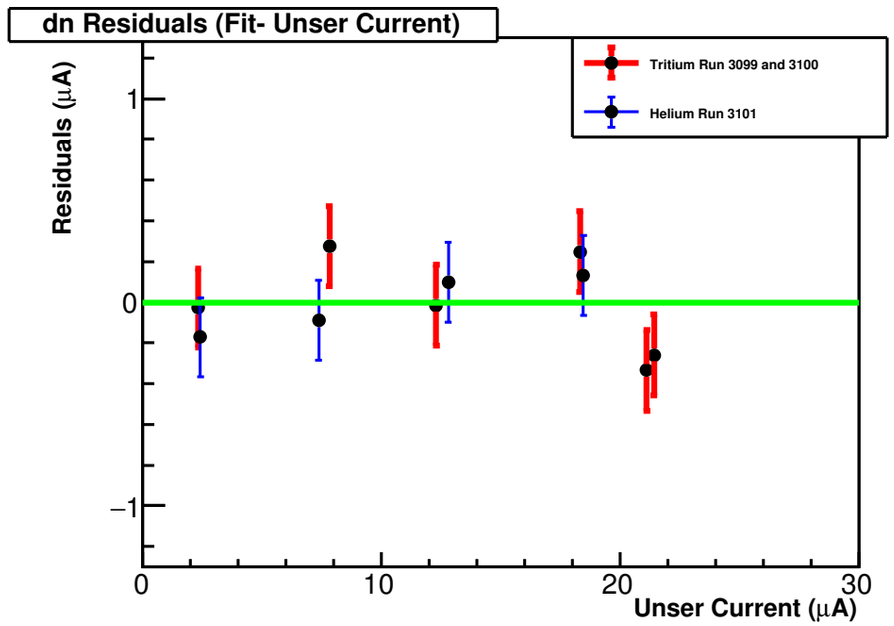
(d) Raster Target Y Position vs BPM Y Target Position.

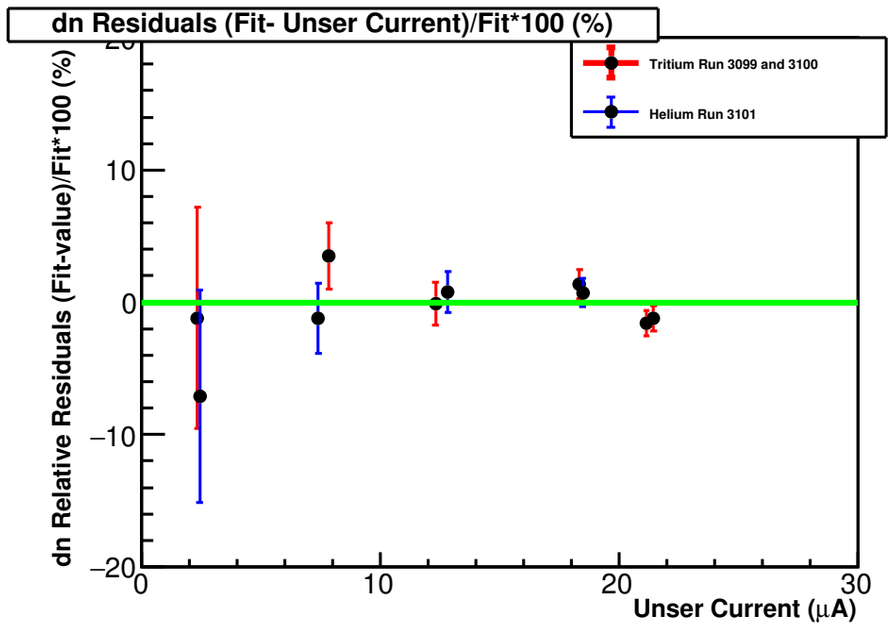
Hague, T. Calibrating the Hall A raster (2019)

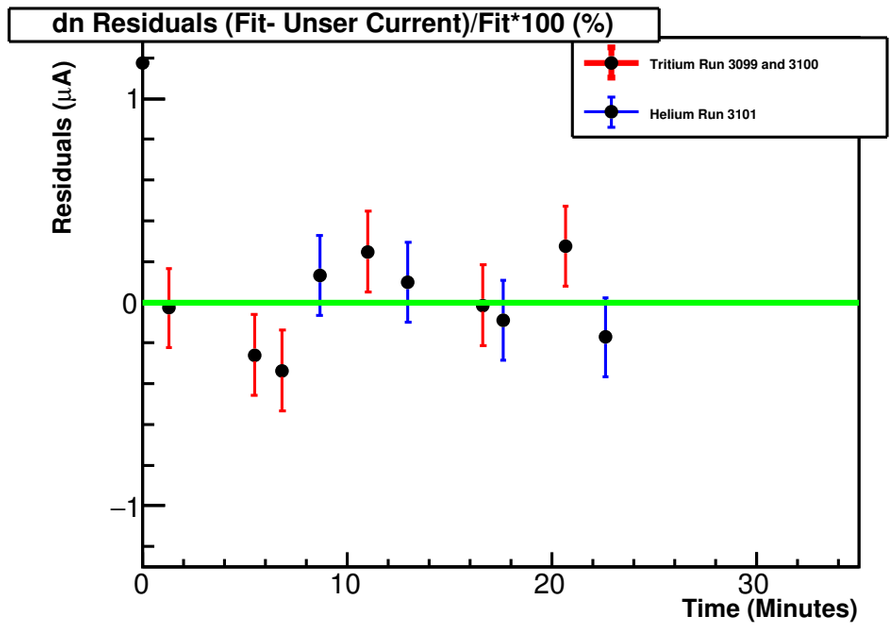
Courtesy of Tyler Hague

BCM



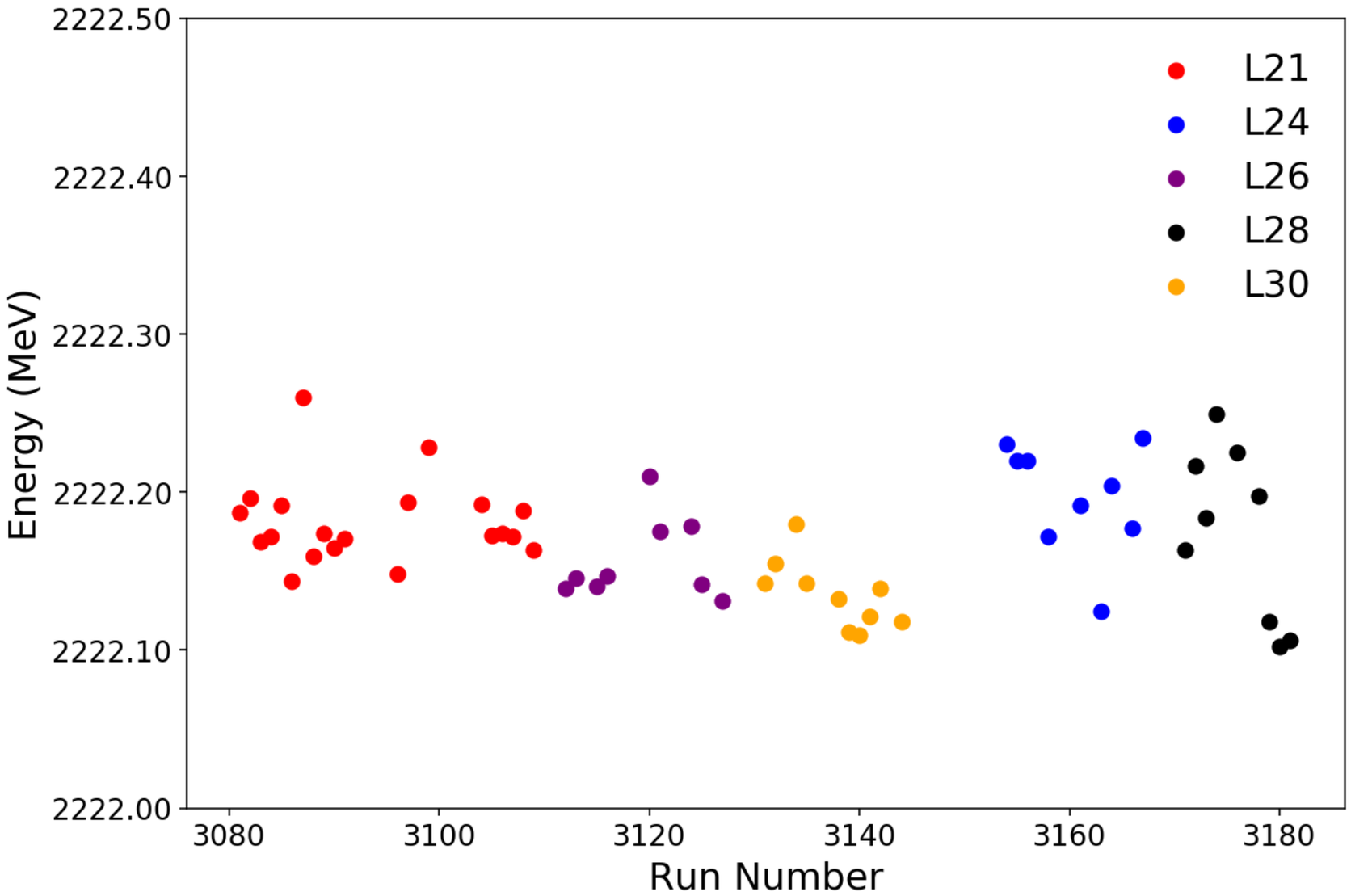






dnew signal was used to measure the charge.

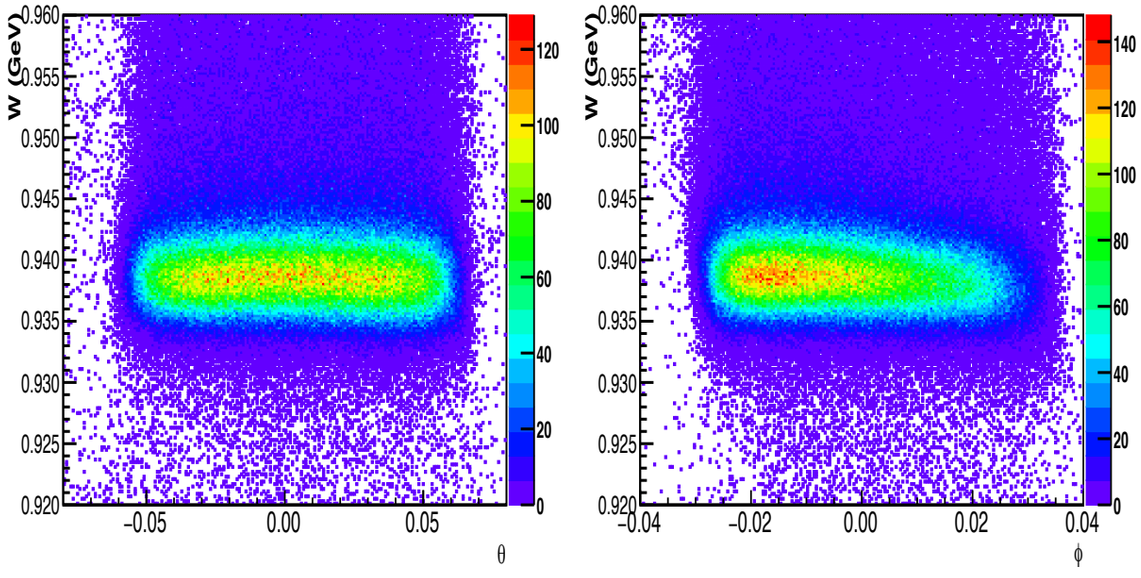
Energy



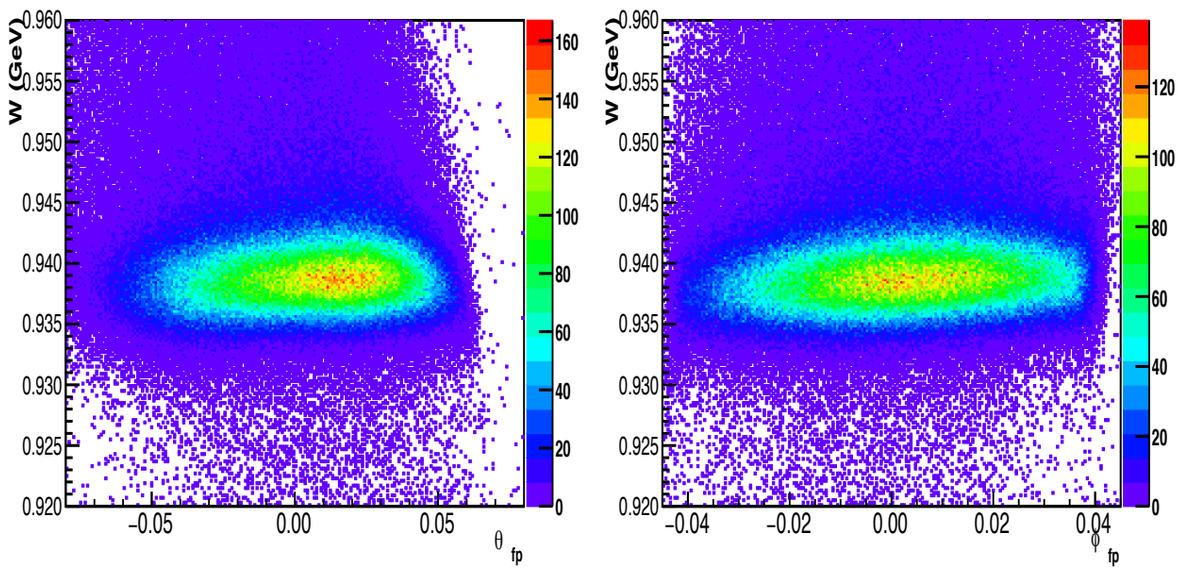
- Due to the high rates: Only one run per target in each kinematic.
- Energy values were taken from the average root files values (HALLA_p) with I > 5 mA and coming from the arc measurement.
- The energy values are corrected by the scaling factor of 1.002 given by: ENERGY MEASUREMENT: Courtesy of Douglas Higinbotham

2) Optics

Same than G_M^p optics



^1H elastic target variables

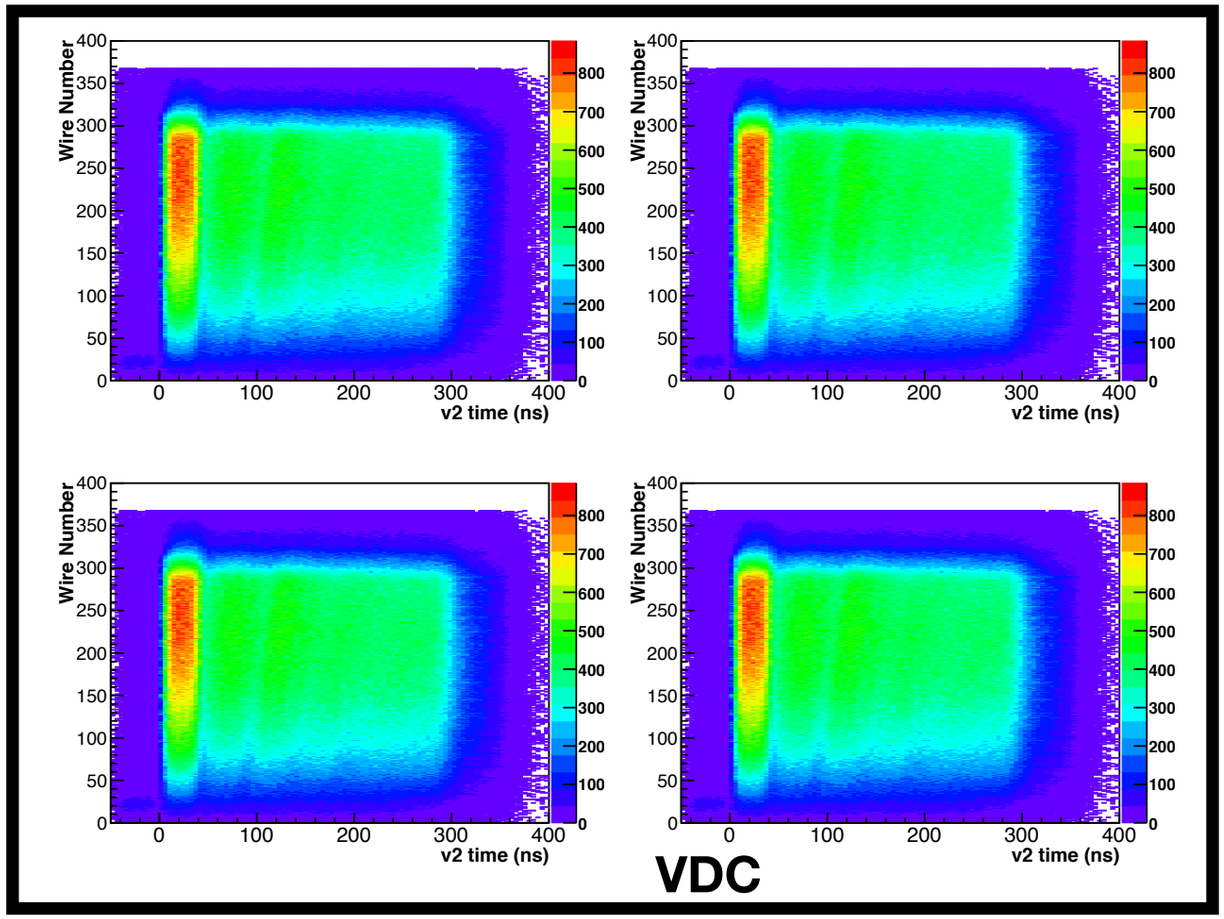


^1H elastic focal variables.

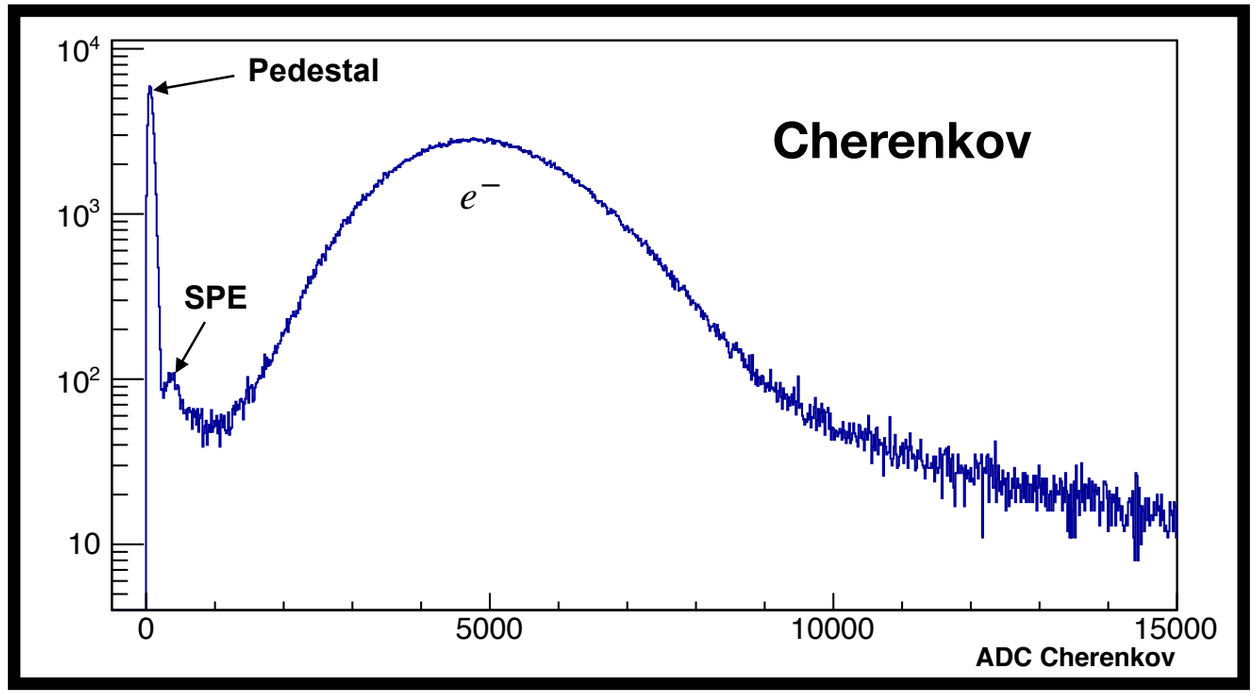
Run 3118 with E = 2.222 GeV and $\theta = 25.952°$.

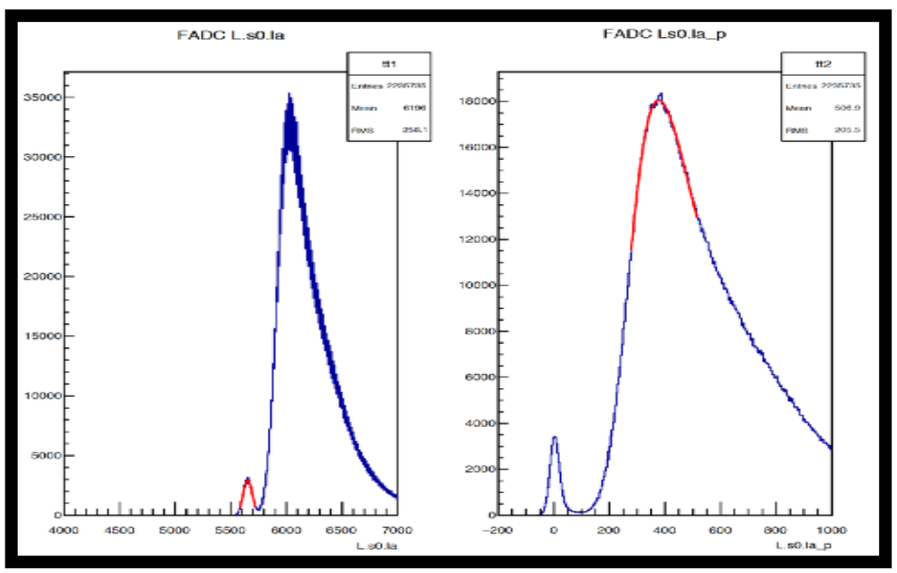
Courtesy of the G_M^p collaboration

3) Detector Calibrations

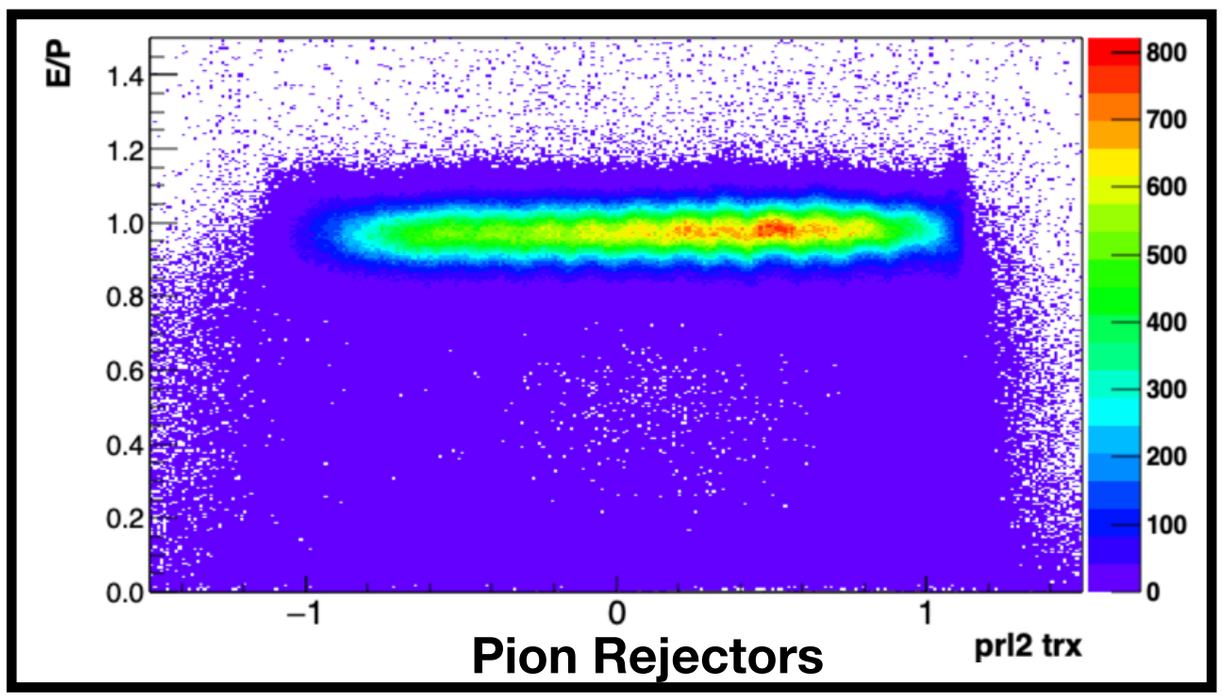


VDC



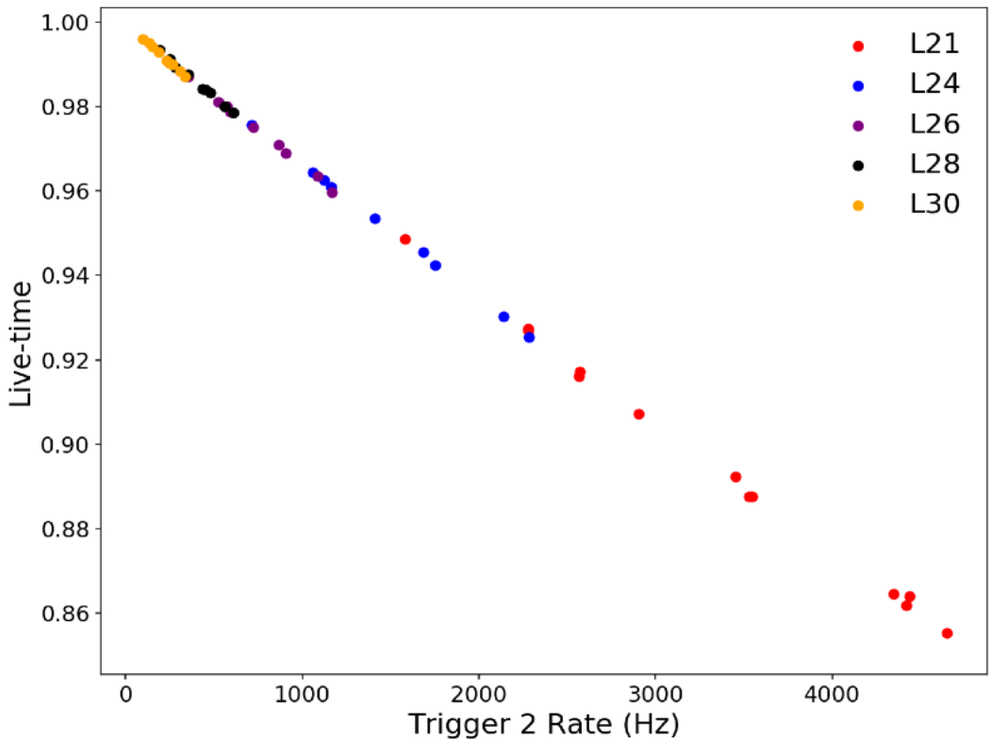


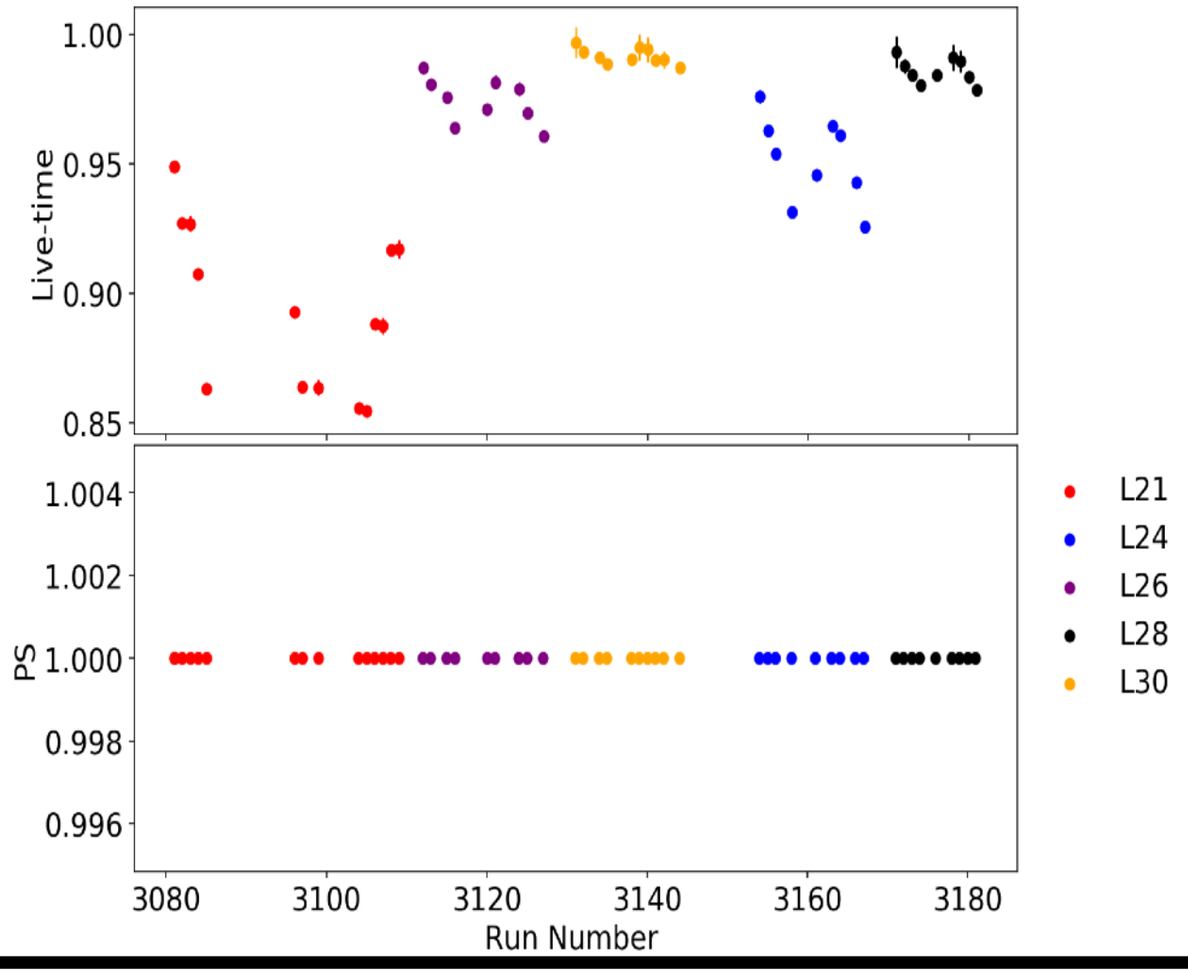
S0

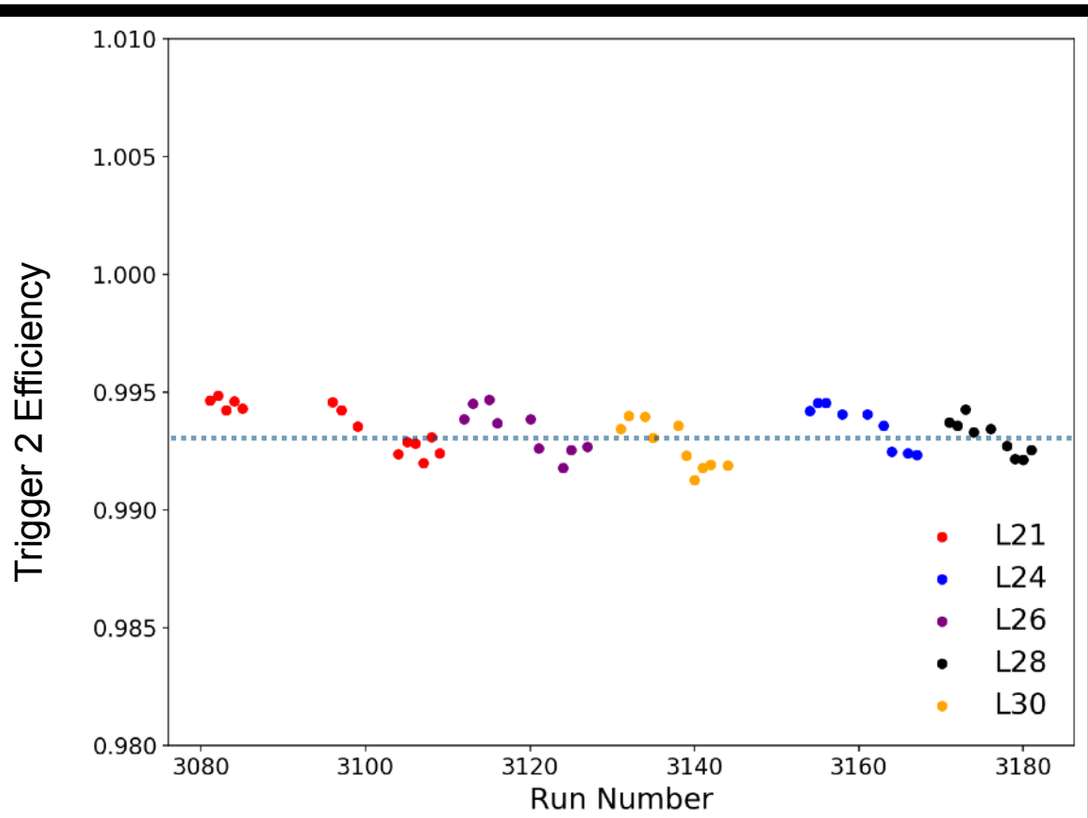


Data Analysis

1) Live-time

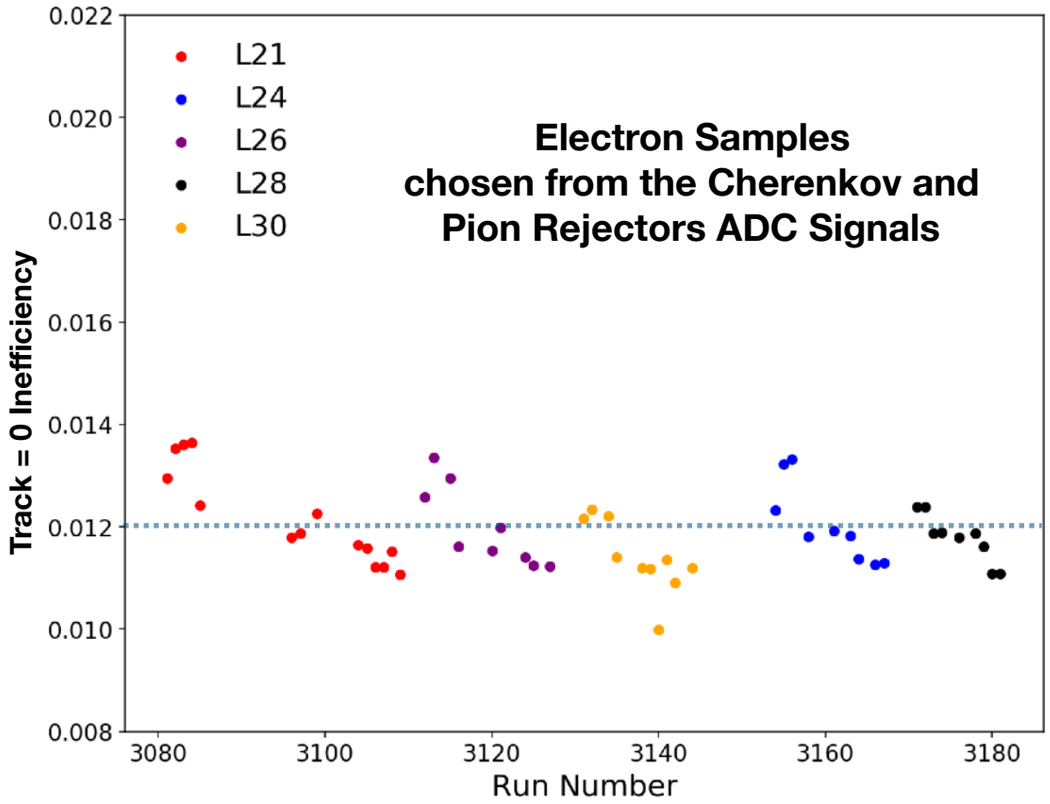


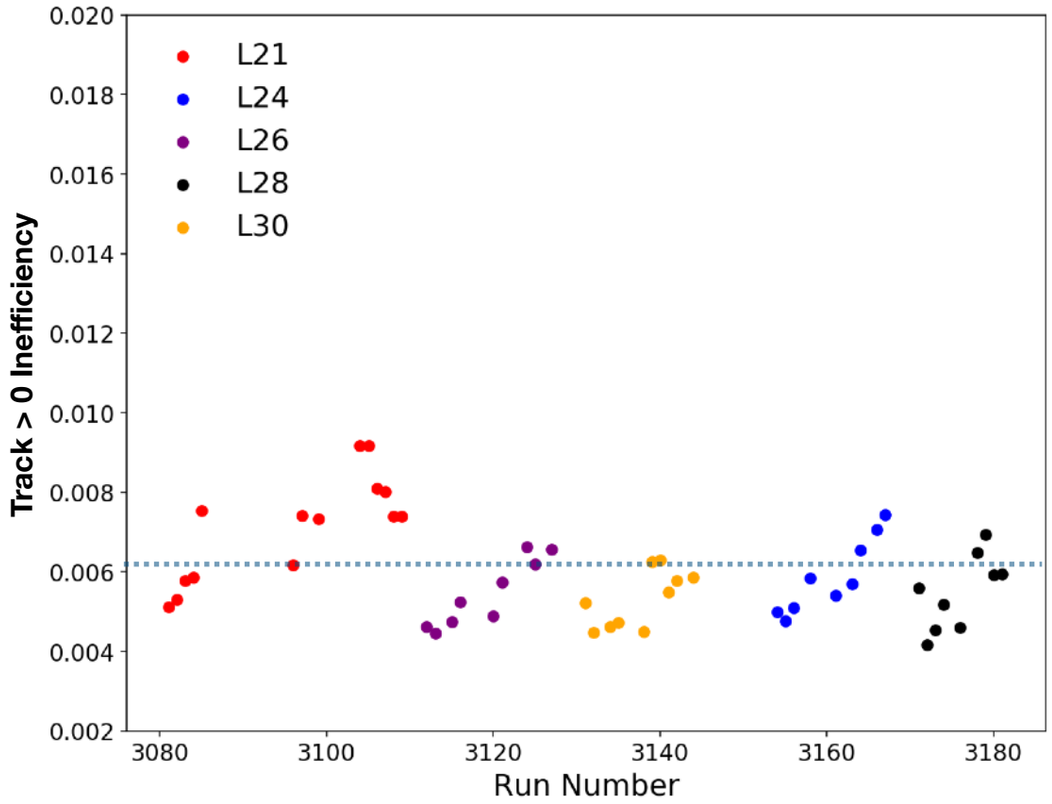




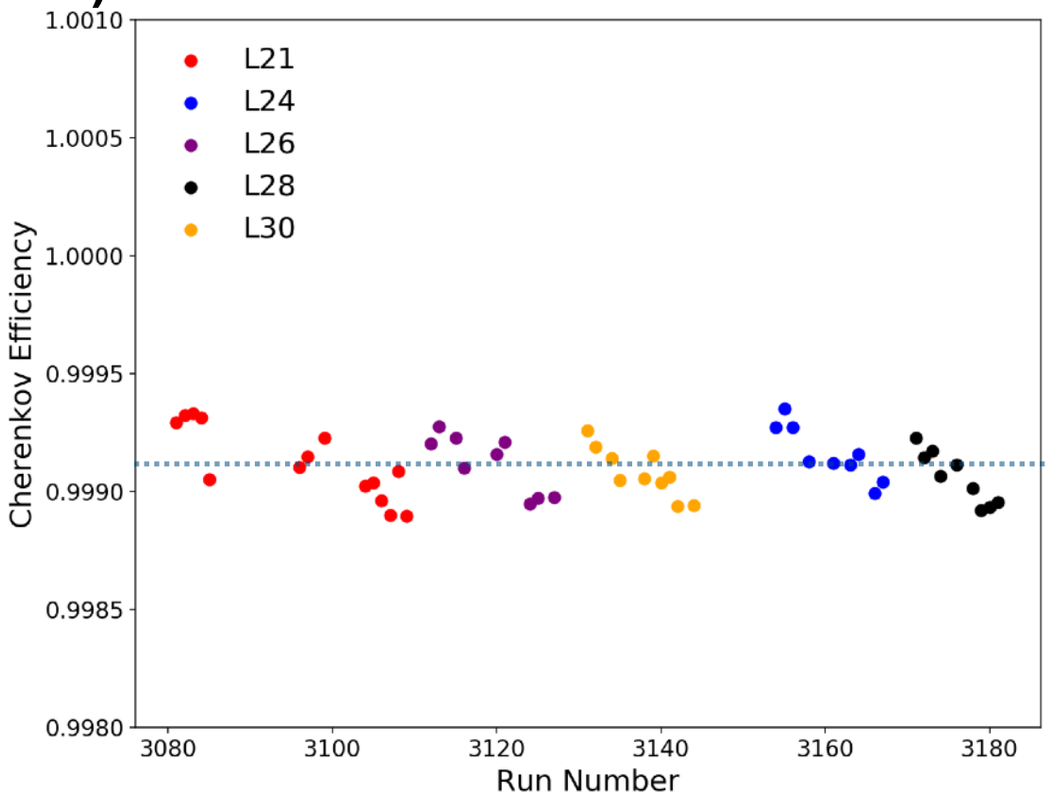
2) Trigger 2 = (s0&s2)&cer

3) Tracking

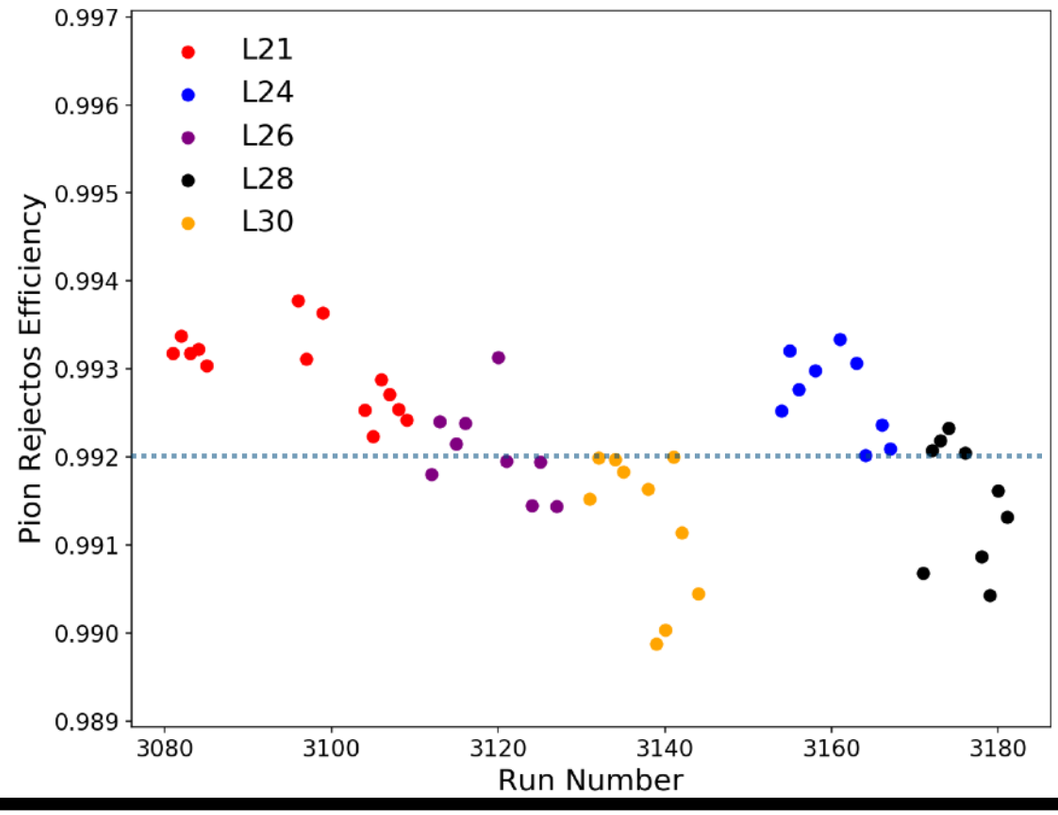




4) Cherenkov



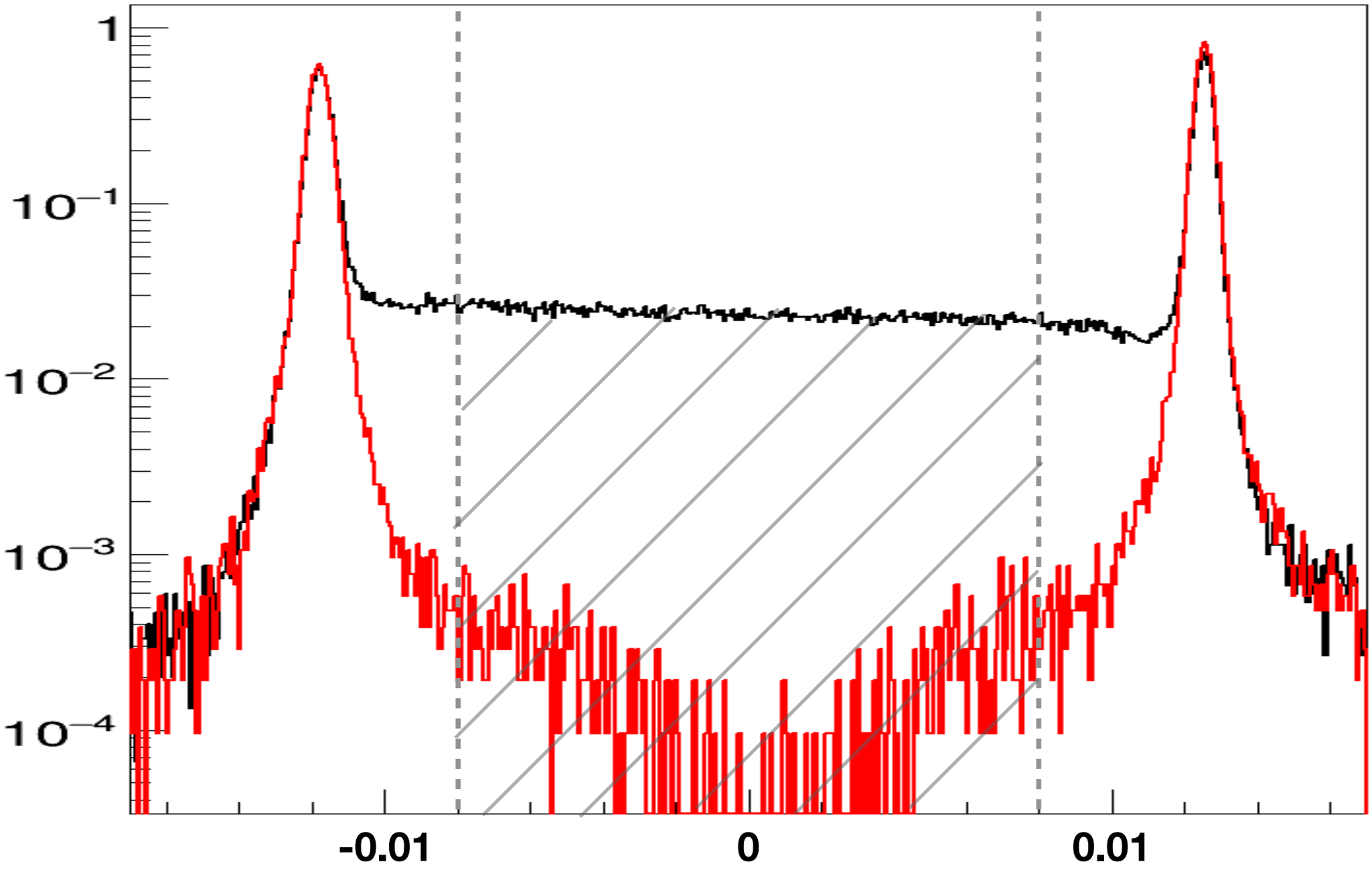
5) Pion Rejectors



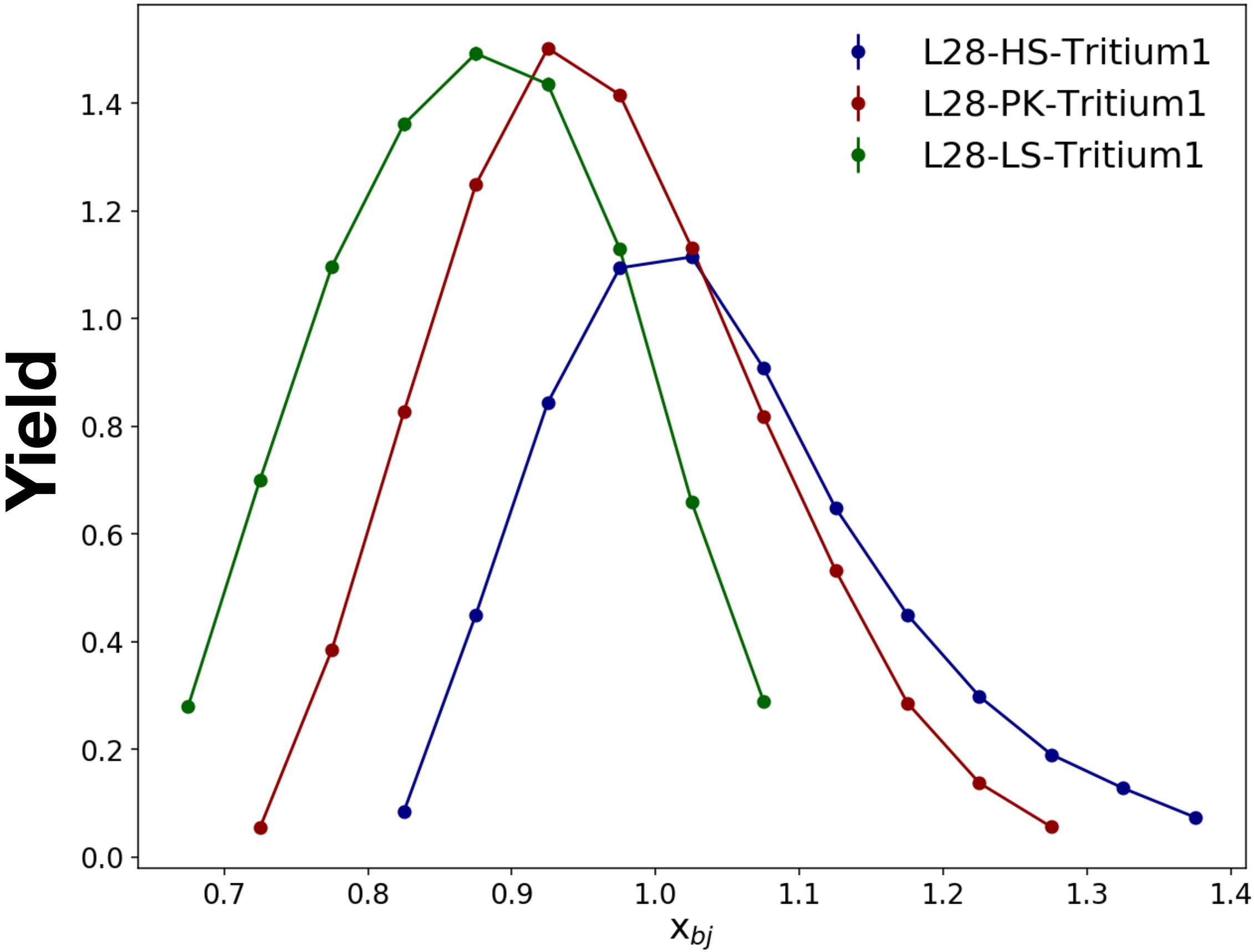
Background Contamination

|dp|<0.03
|dθ|<0.035
|dϕ|<0.035

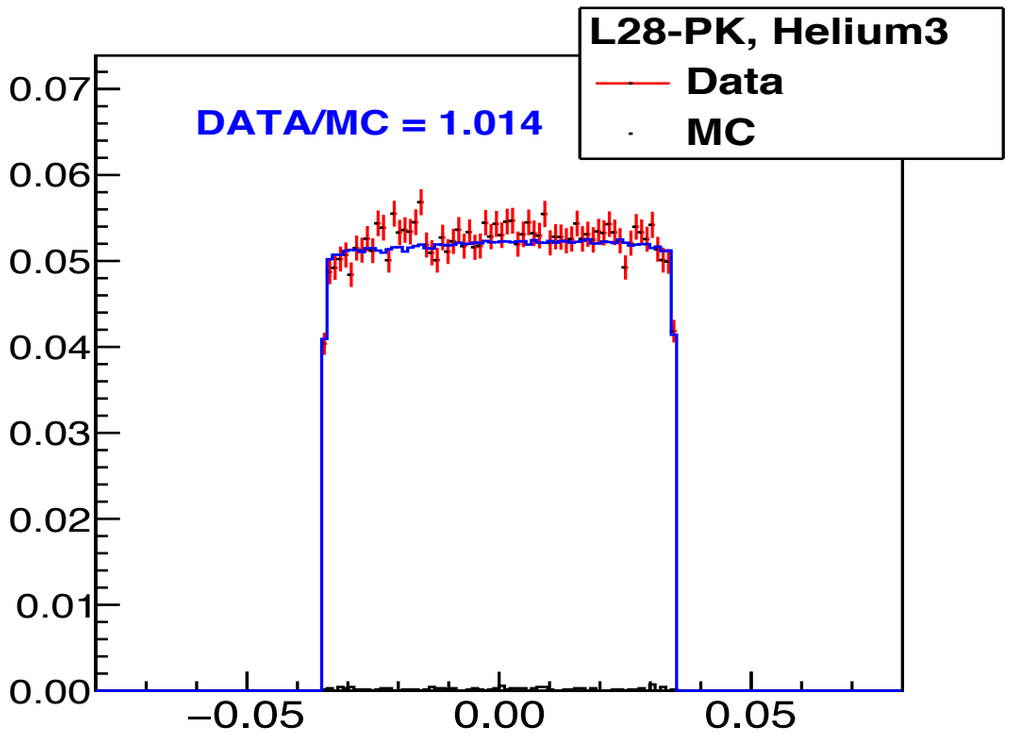
cer_sum > 1500
E/p > 0.7
1 Track

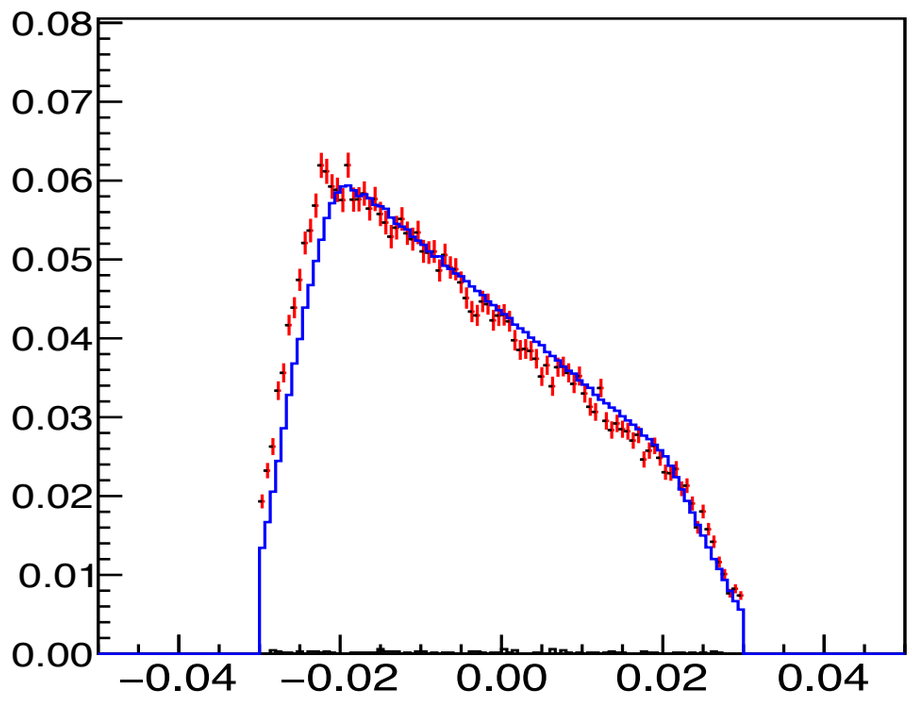


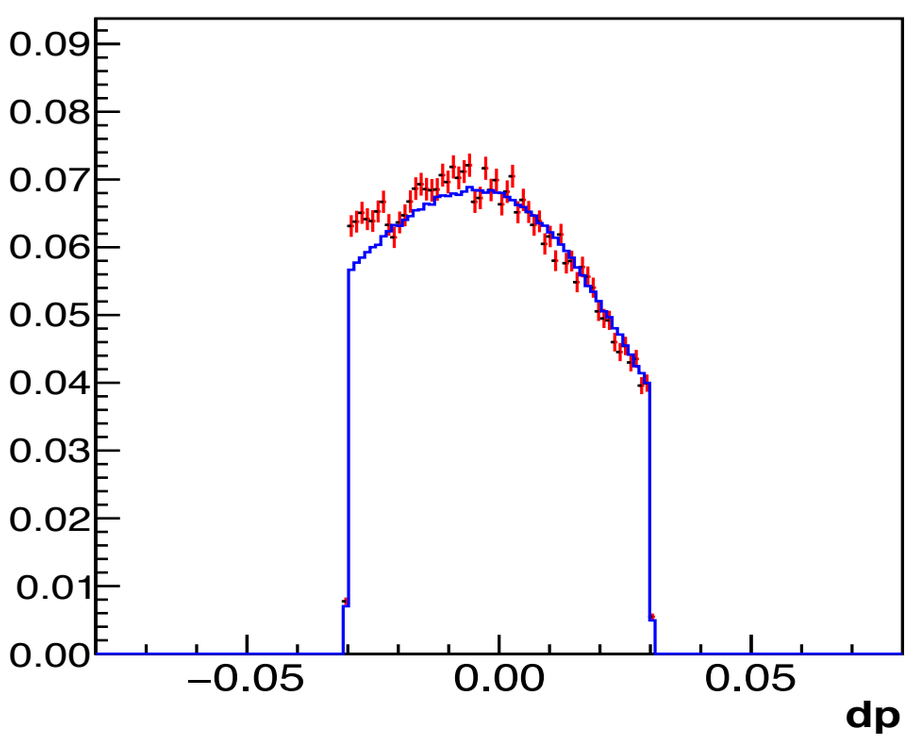
Overlapping Kinematics

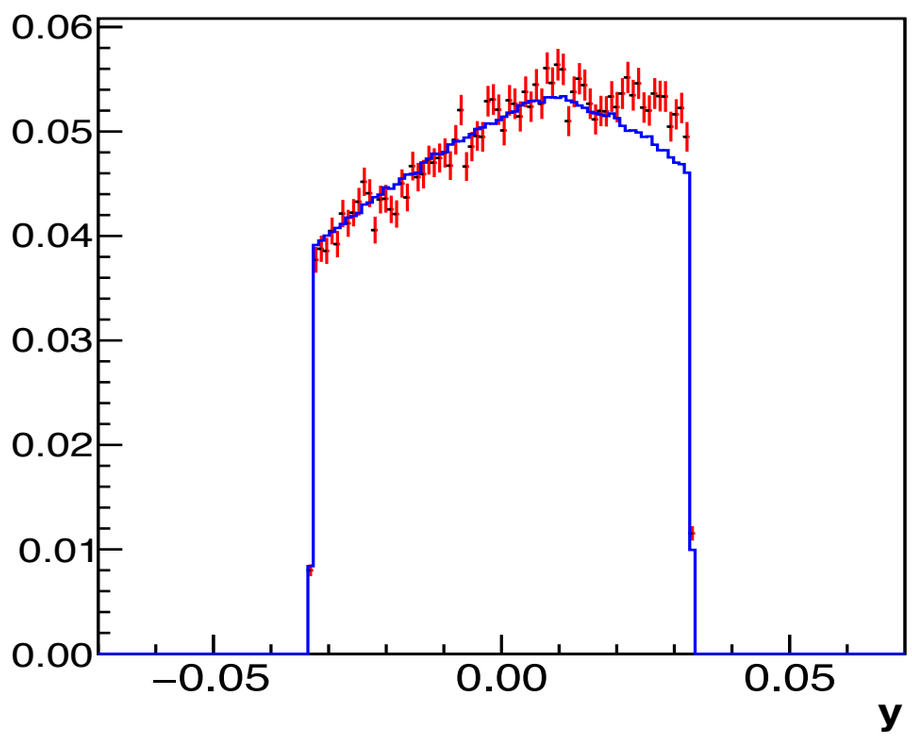


MC Comparison

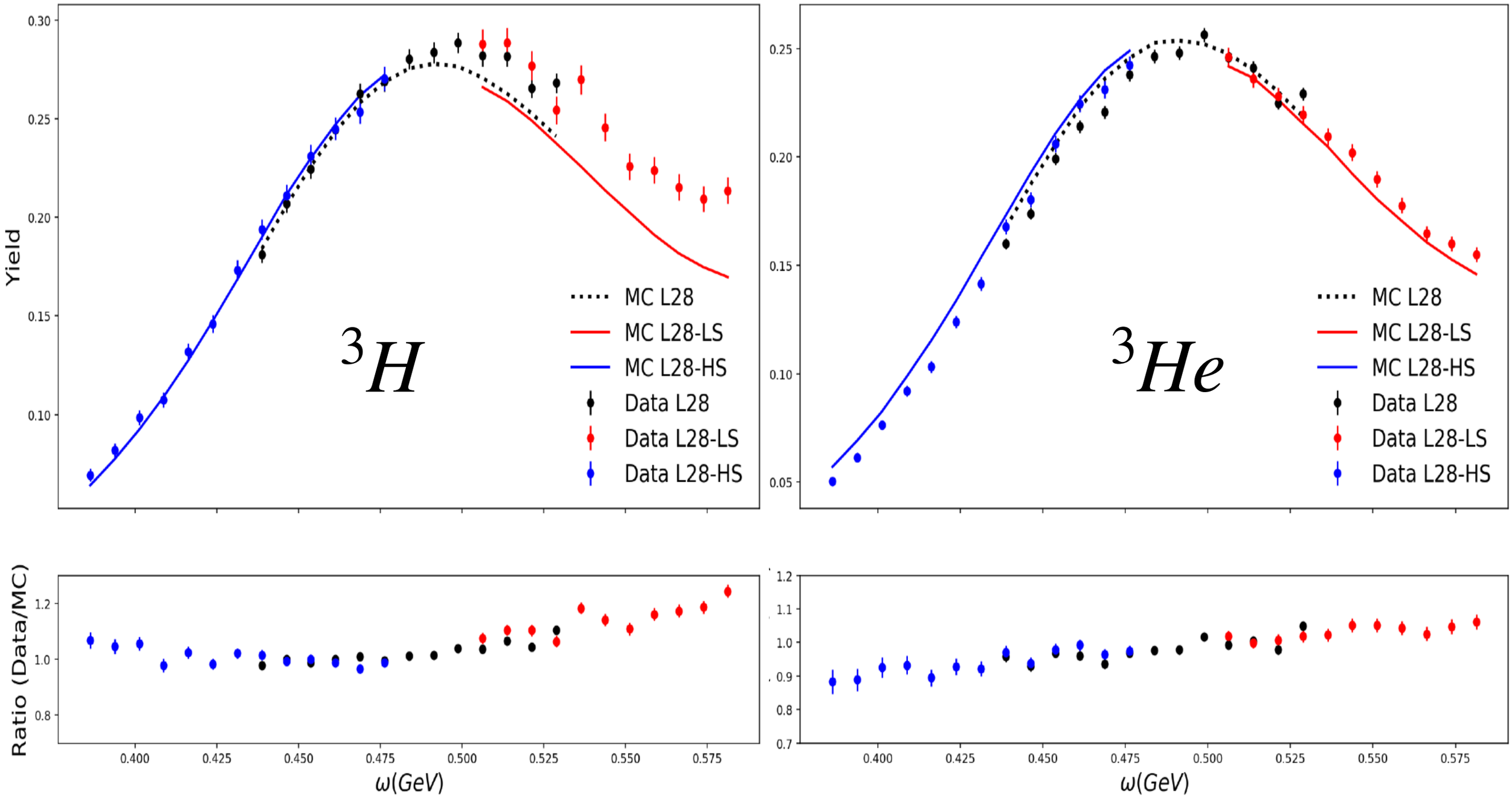




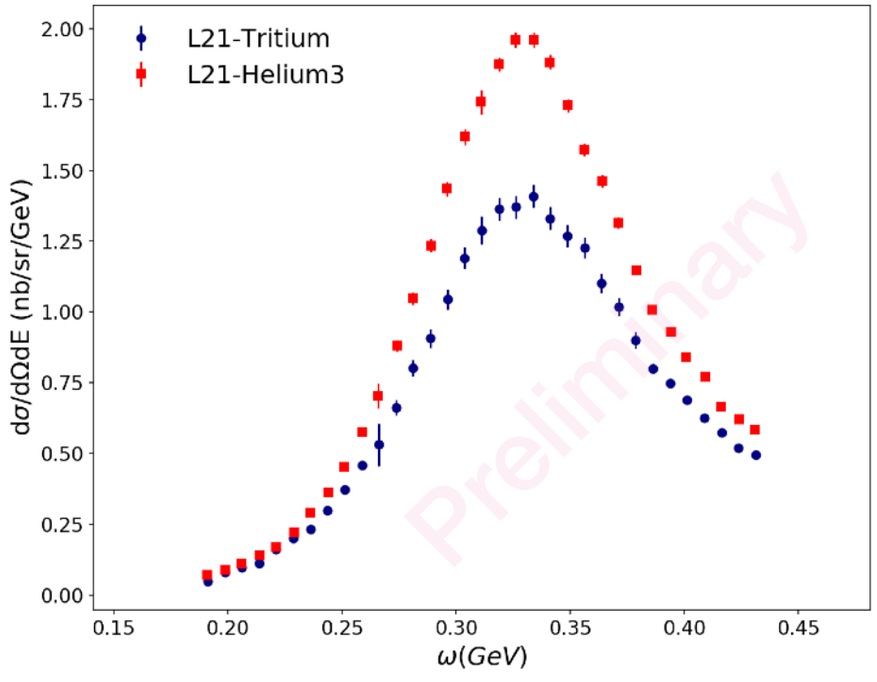


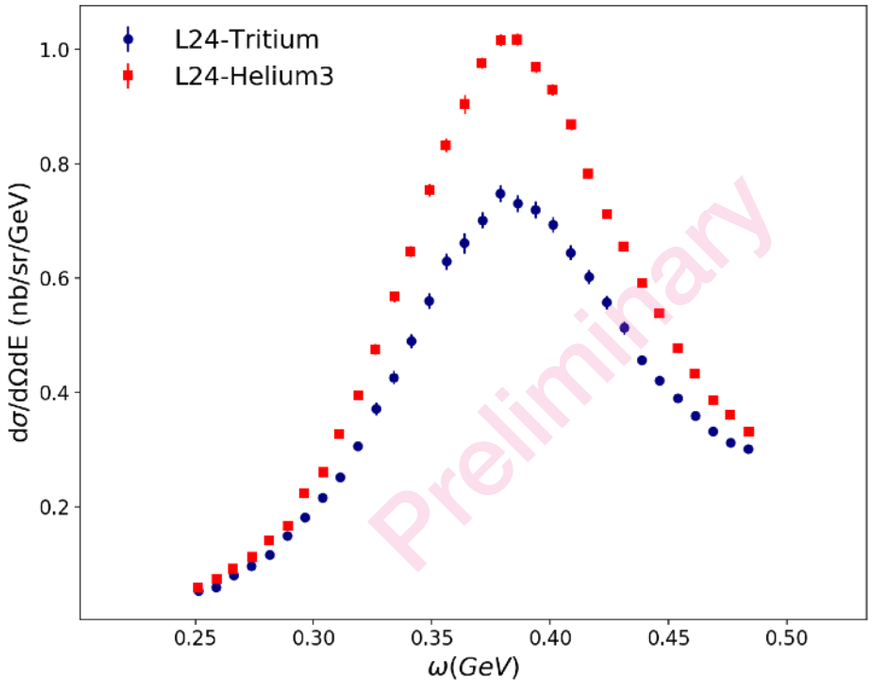


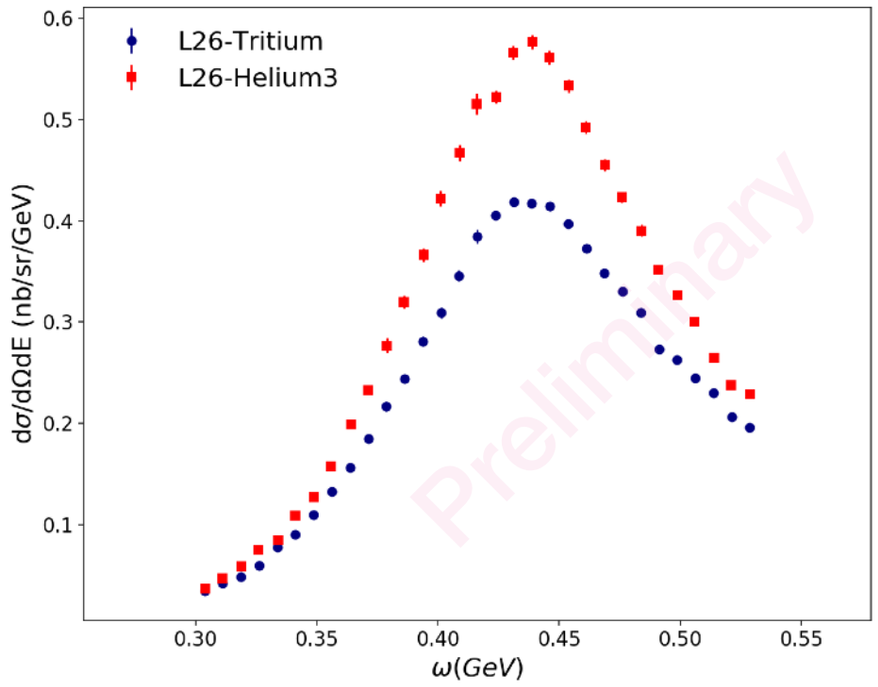
Data vs MonteCarlo

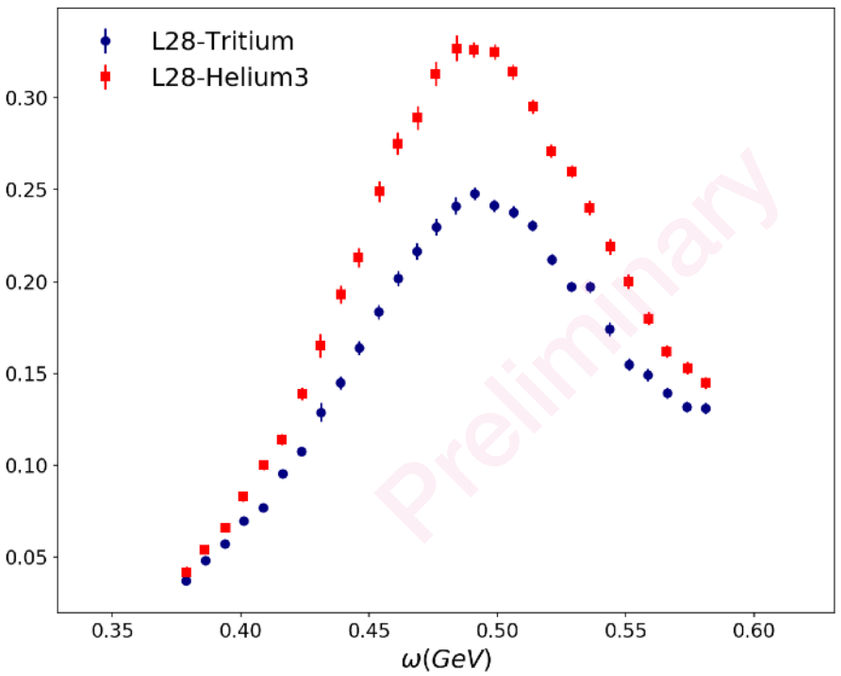


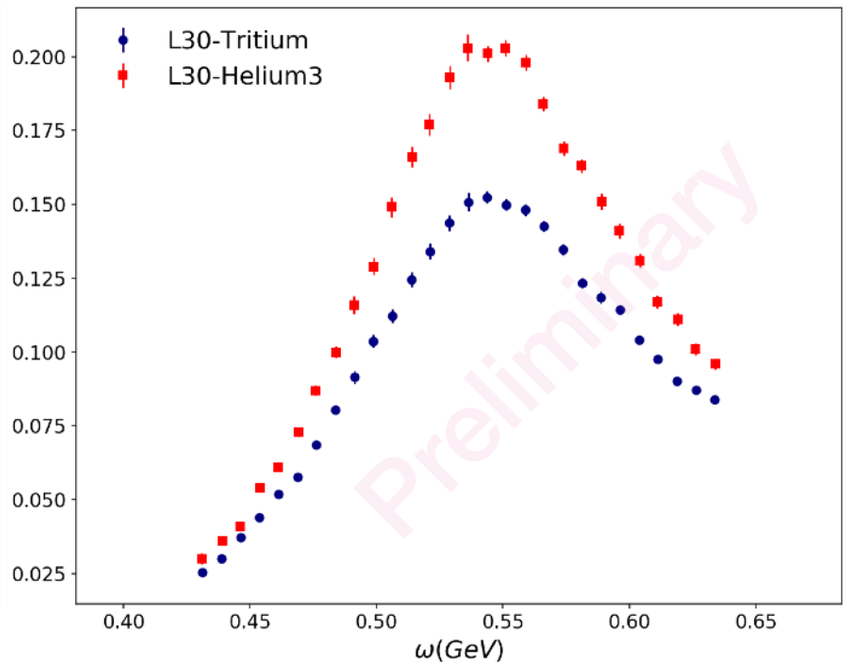
Preliminary Cross-Sections



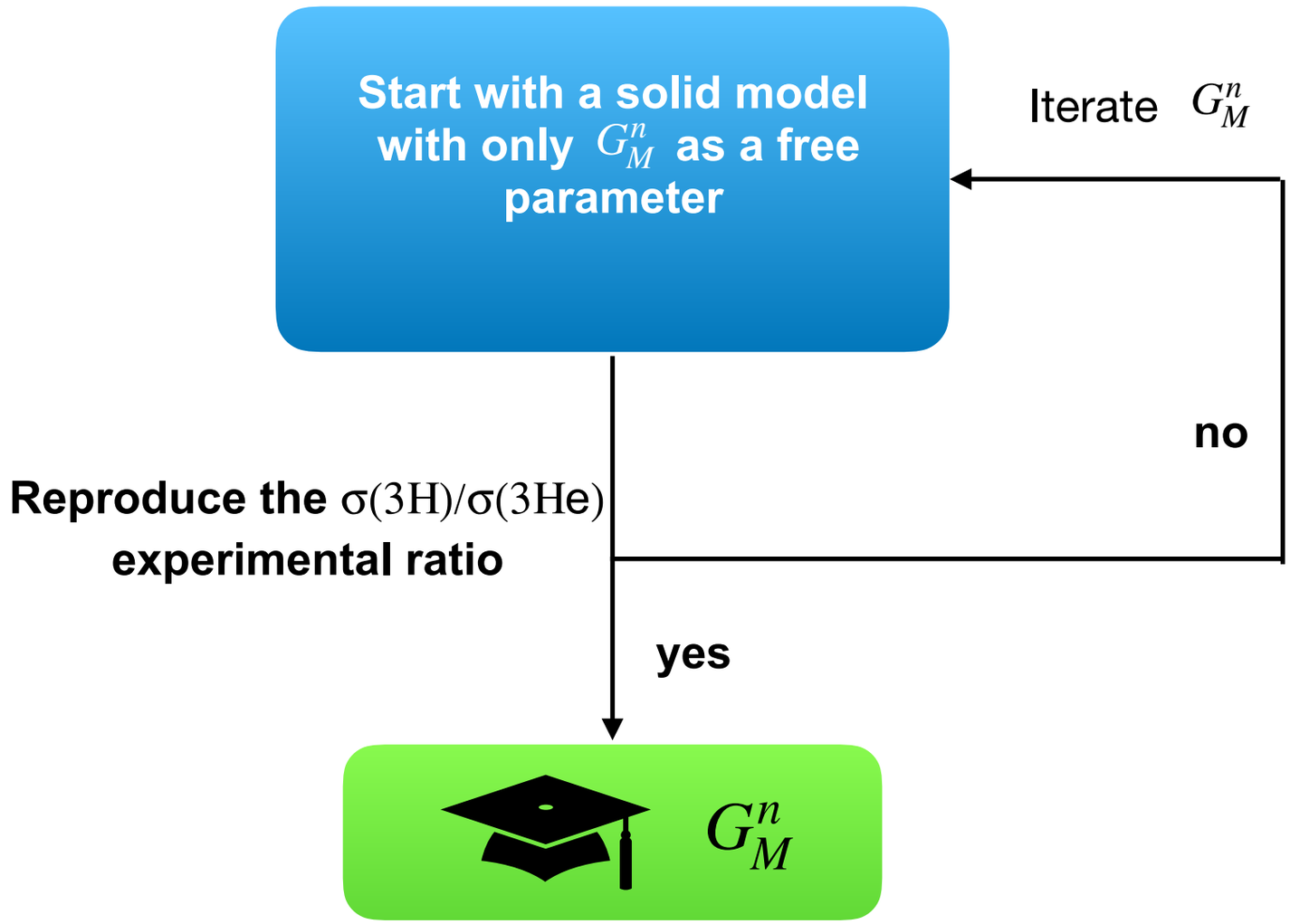






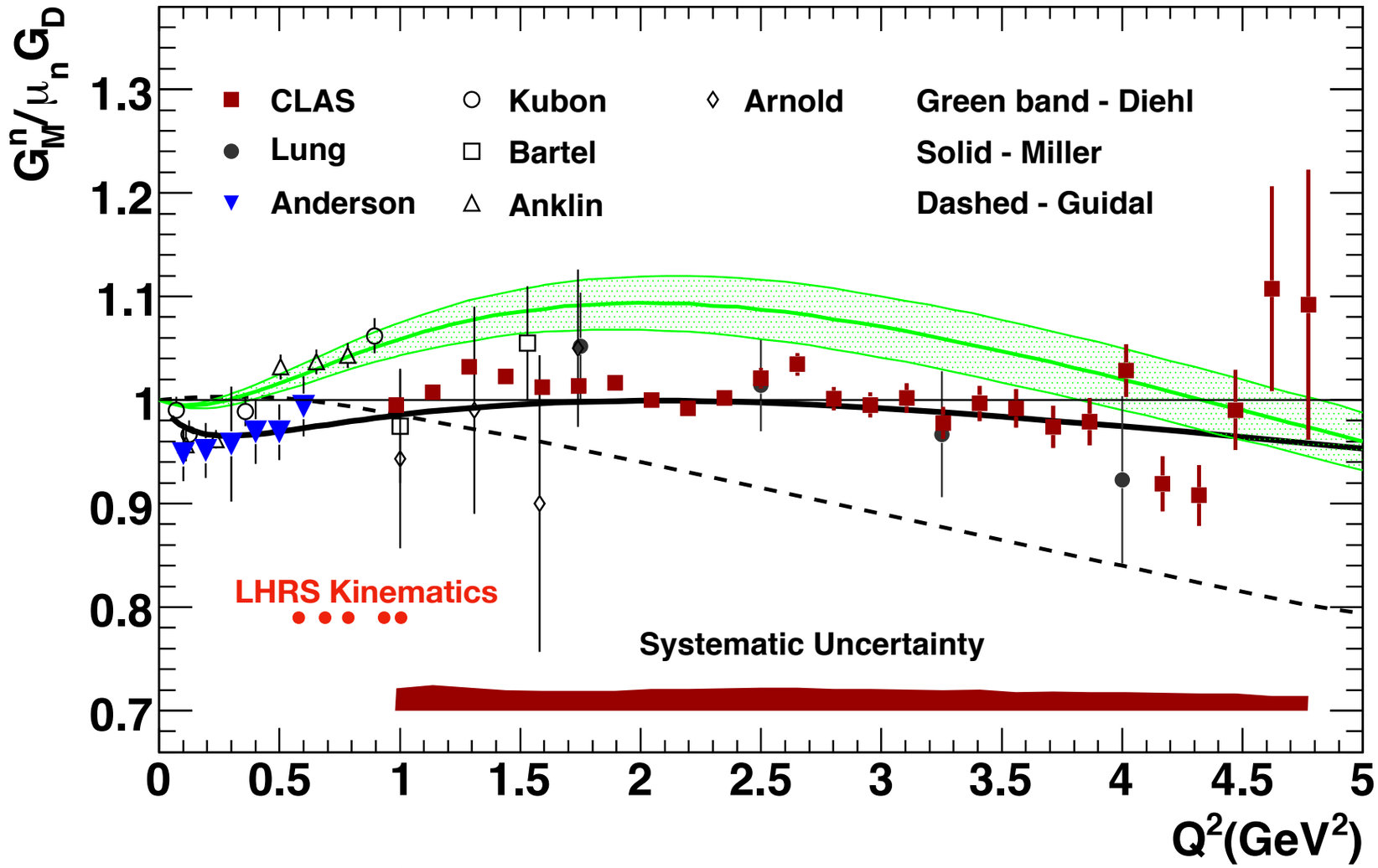


Possible path to get G_M^n form factor from cross-section ratios to the:



- **Need from theory friends**

Future Work:



- Pin down the systematics uncertainties of the measurement

- Find a good theory that can reproduce the cross-sections results
  - Noemi Rocco and Alessandro Lovato (Argonne National Lab) are already working on them.
  - Look into Saori Pastore (Washington University in St. Louis) work.

- Perform this careful analysis with the RHRS kinematic data available.