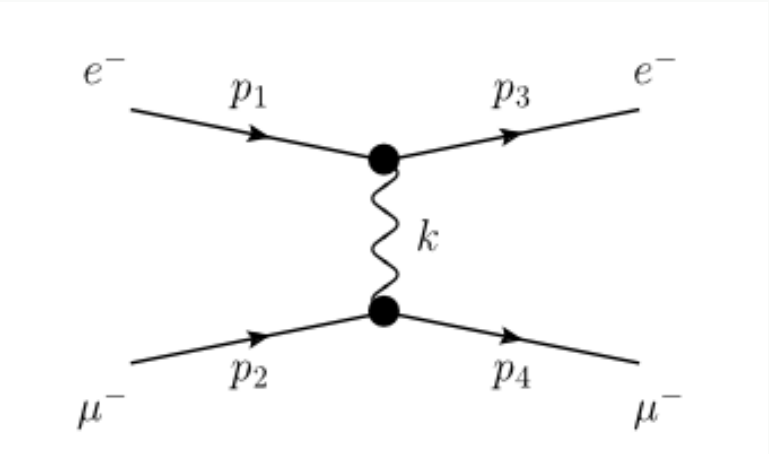
ANALYSIS OF SCATTERING DATA FOR MUONE DETECTOR CALIBRATION



Sena Ghobadi

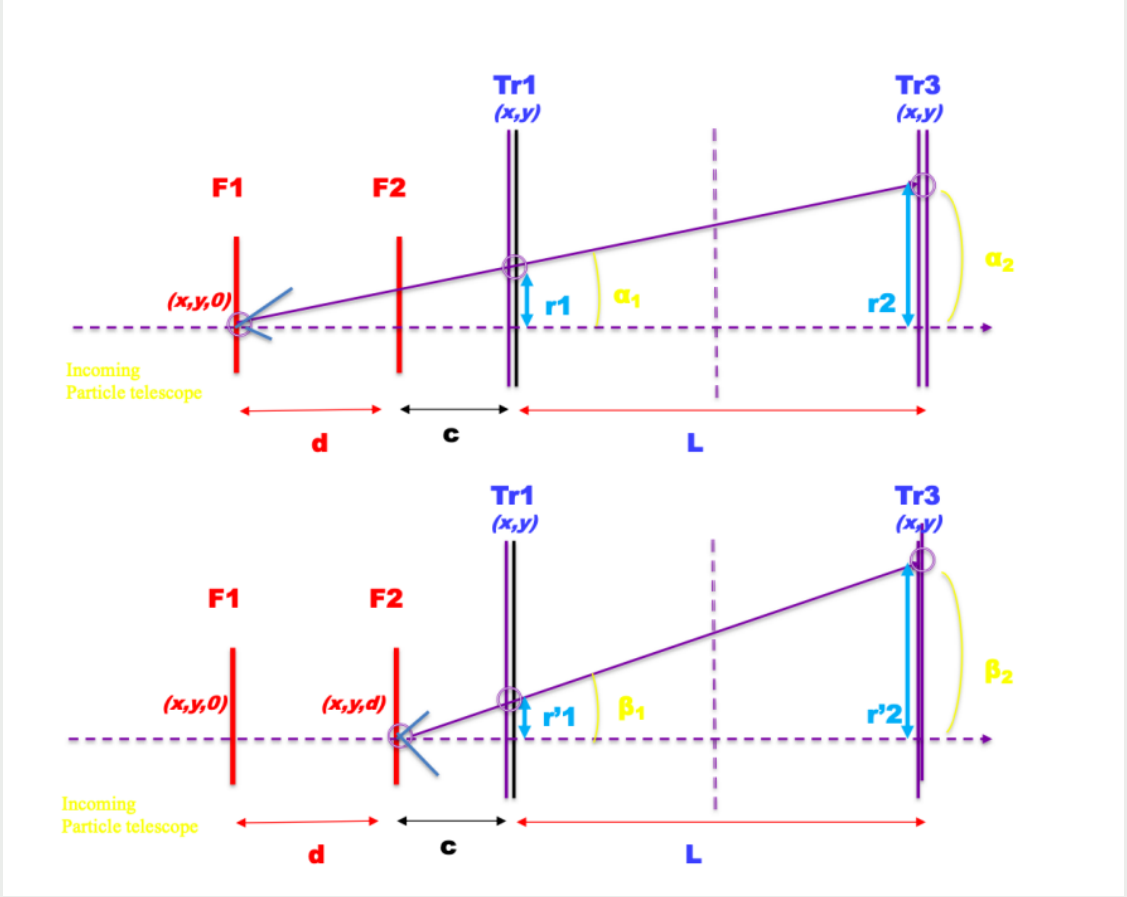
$$a_\mu^{\mathrm{SM}} = a_\mu^{\mathrm{QED}} + a_\mu^{\mathrm{EW}} + a_\mu^{\mathrm{HLO}} + a_\mu^{\mathrm{HHO}}$$

Recap

- MuonE experiment attempts to measure muon *g-2* anomaly to unprecedented precision
- Need extreme precision to measure the leading order hadronic contribution which cannot be computed analytically*
- Utilize *μe -> μe* scattering to measure the running coupling constant α(t) which can be used to compute *g*.

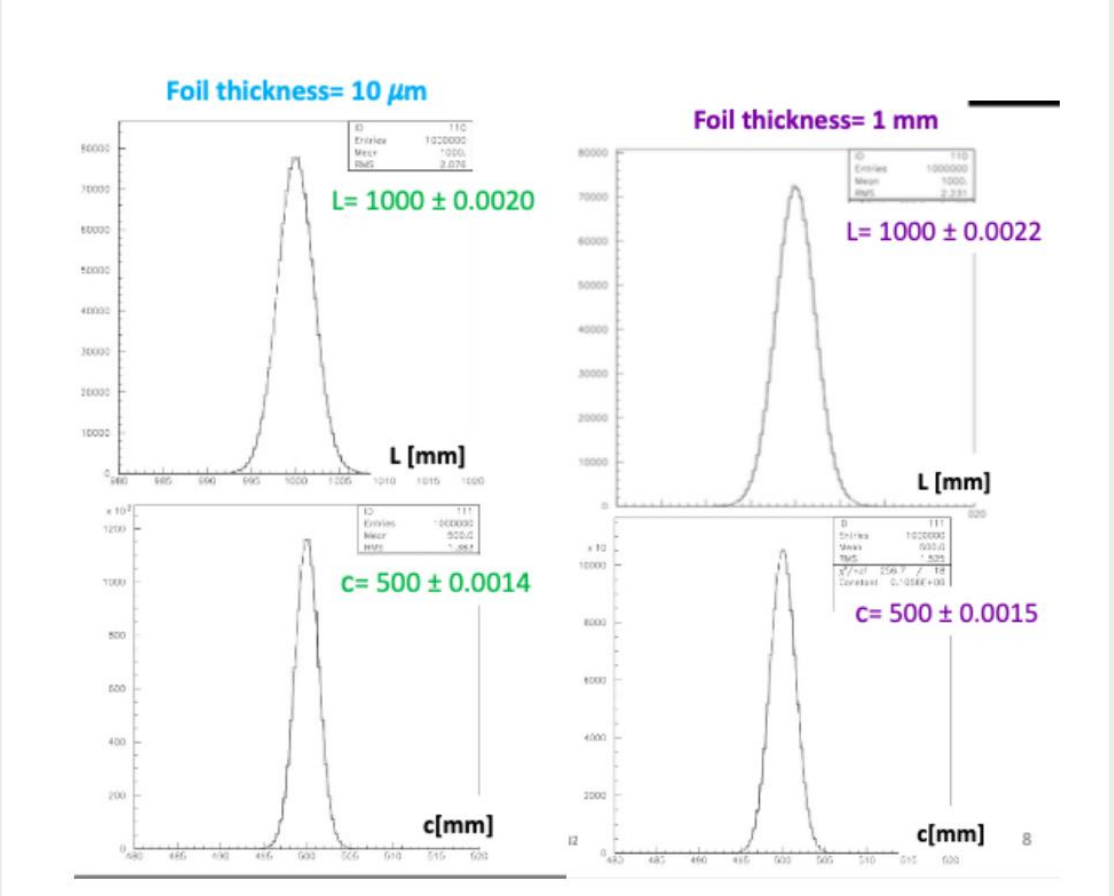
Analysis of 2023 Beam Data

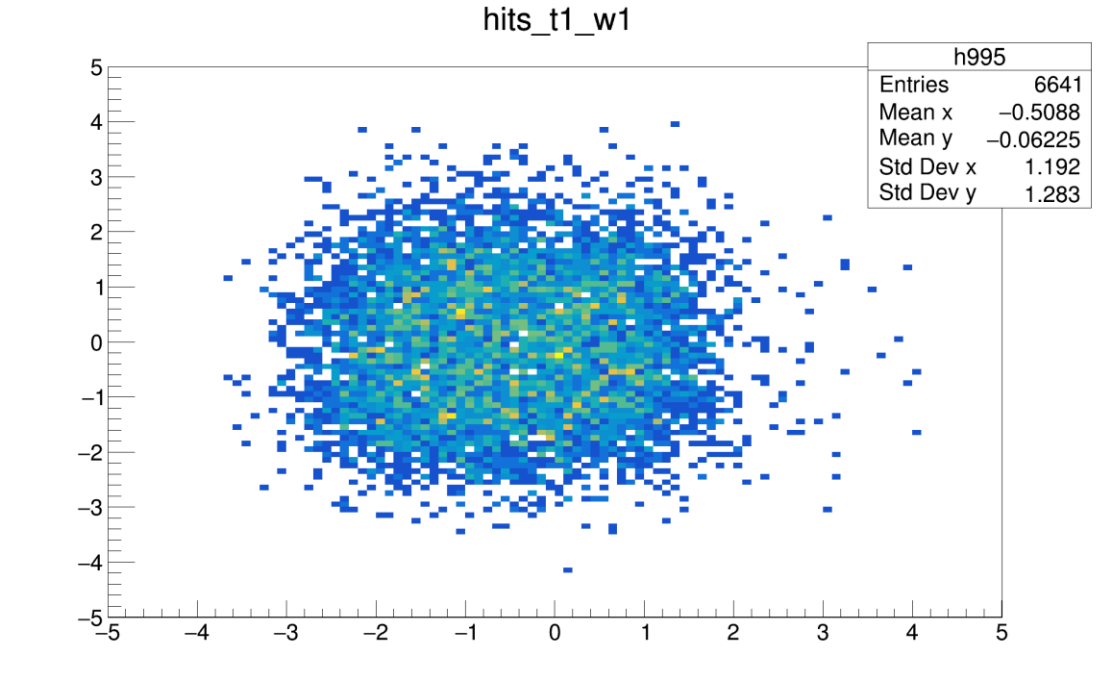
- Developing method to calibrate and optimize the distance between detectors to order O(1 μm)
- Etalon provided by engineers that has distance between two plates measured to extremely fine precision
- Reconstruct the tracks from the detector hit data
- Use geometry to construct distribution of the distances between the detectors based on reconstructed tracks

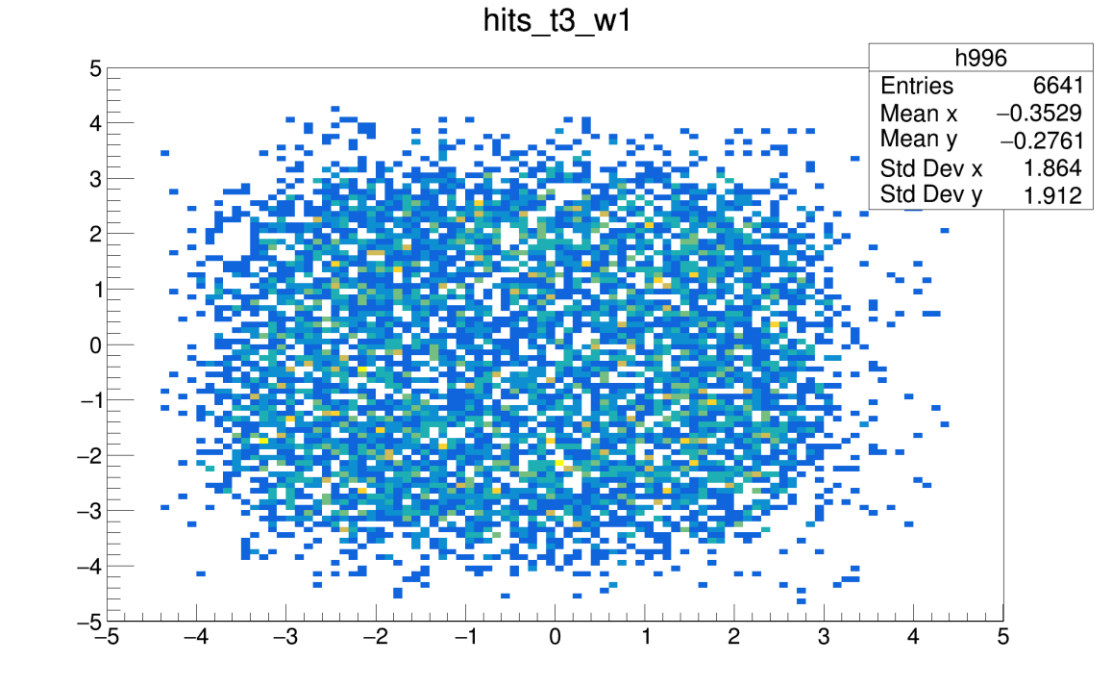


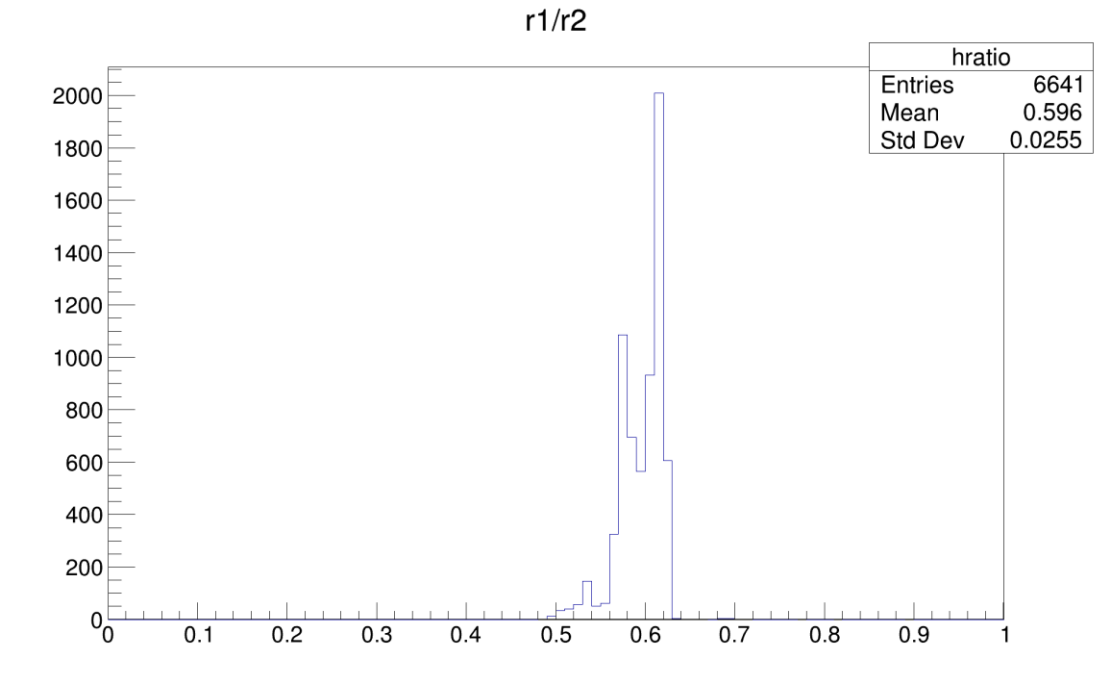
Analysis of 2023 Beam Data

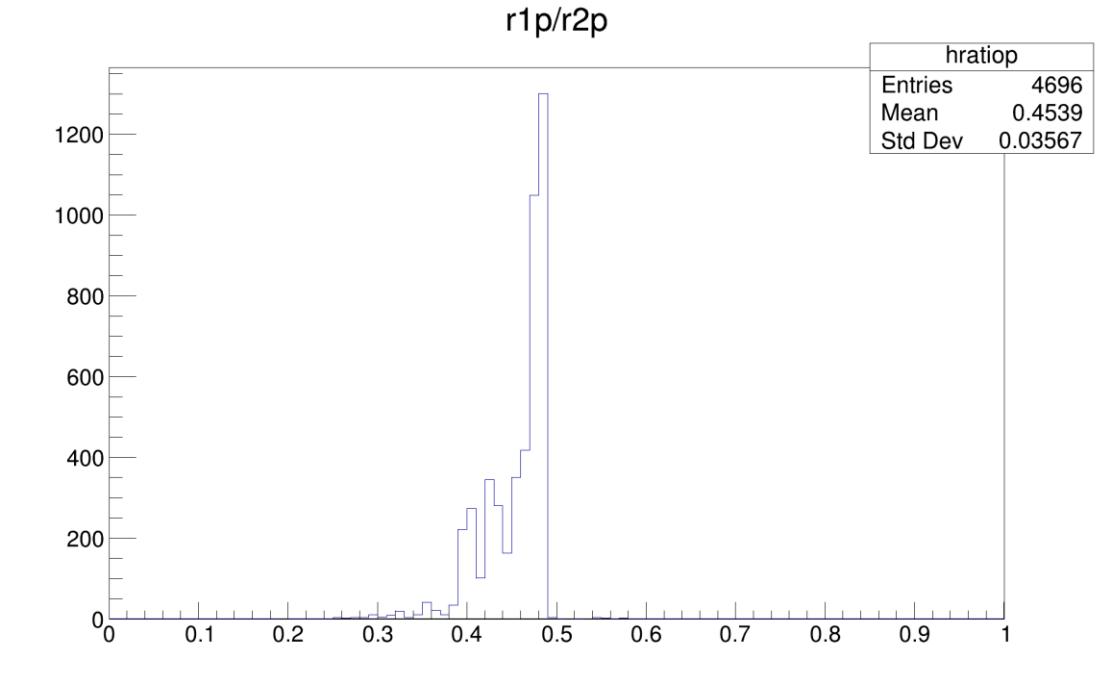
- Perform coordinate conversion to get distribution of hits
- Based on distribution of hits, compute distance between the planes using previously shown geometry
- Resulting distribution provides error in measurement which we attempt to minimize by recalibrating the targets



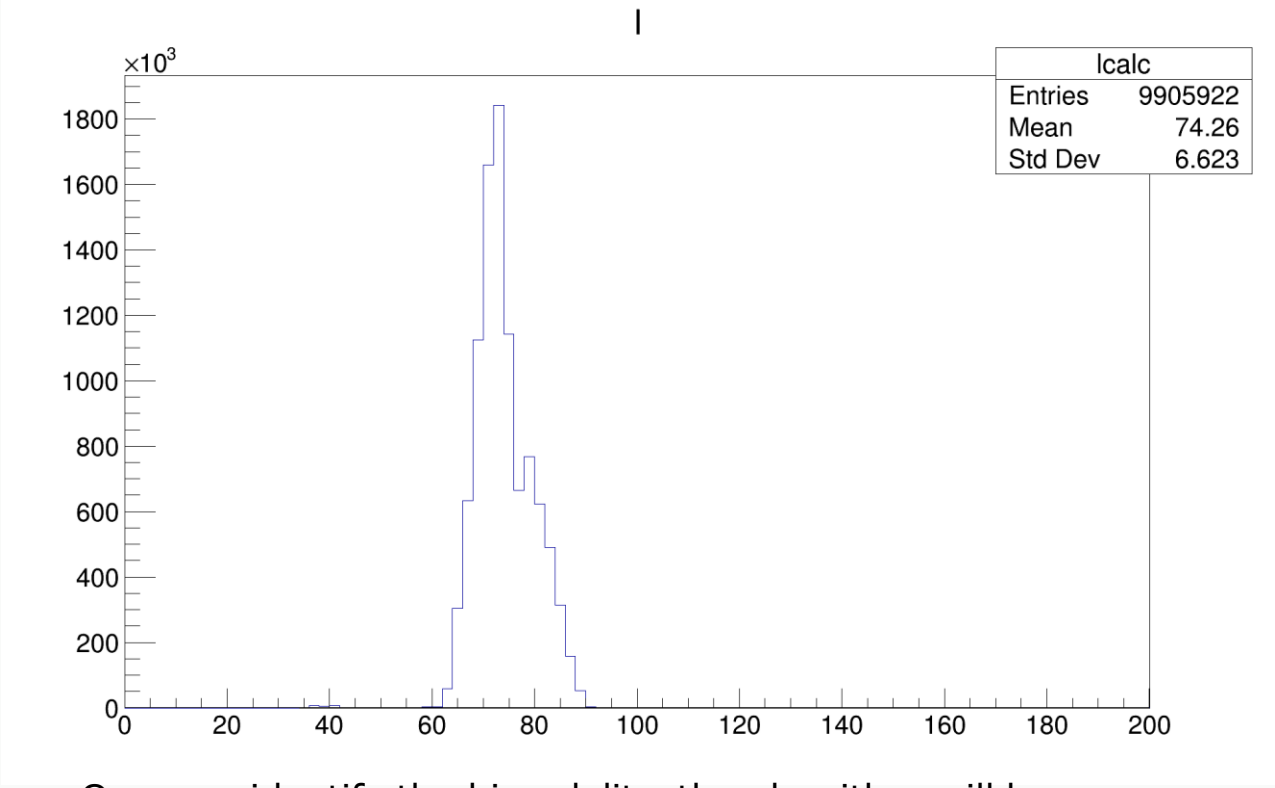

hits_t1_w1
h995
Entries 6641
Mean x −0.5088
Mean y −0.06225
Std Dev x 1.192
Std Dev y 1.283


hits_t3_w1
h996
Entries 6641
Mean x −0.3529
Mean y −0.2761
Std Dev x 1.864
Std Dev y 1.912


r1/r2
hratio
Entries 6641
Mean 0.596
Std Dev 0.0255
2000
1800
1600
1400
1200
1000
800
600
400
200
0
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1


r1p/r2p
hratiop
Entries 4696
Mean 0.4539
Std Dev 0.03567
1200
1000
800
600
400
200
0
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

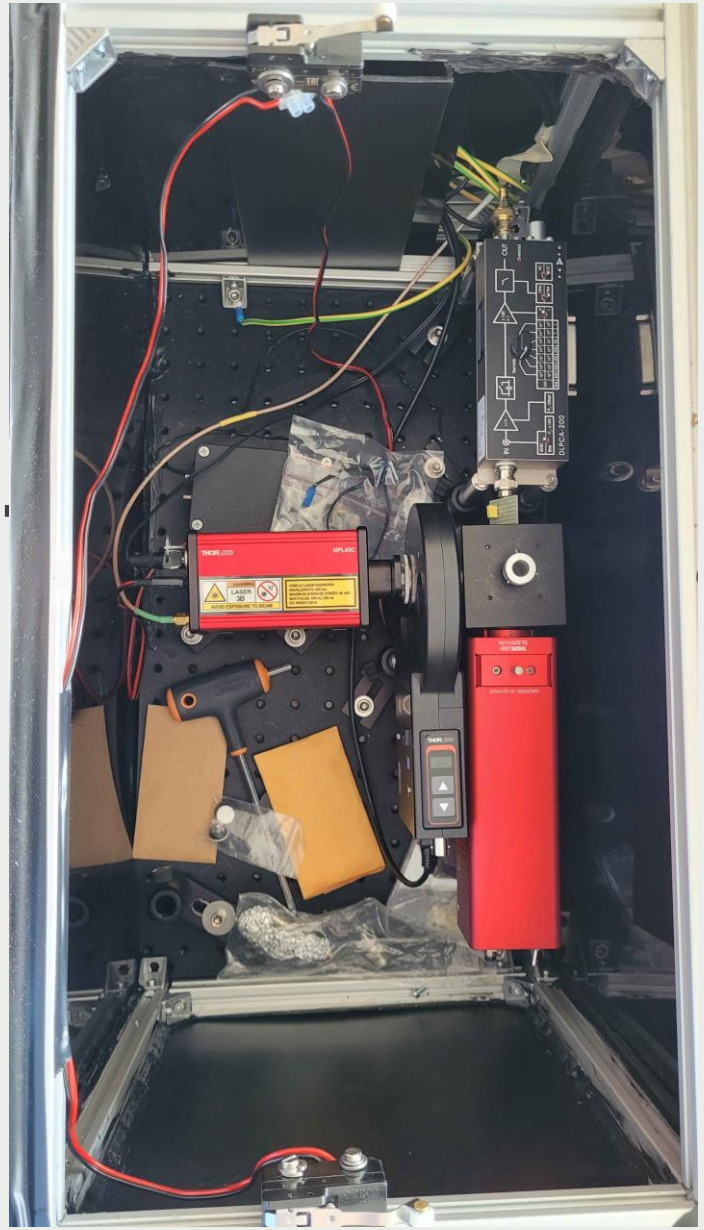
ALMOST...



- Once we identify the bimodality, the algorithm will be complete and ready for use in the real experiment
- Suspicion that the “entry” coordinates are converted incorrectly and will conduct test to identify whether this is the case

Test Beam 2024

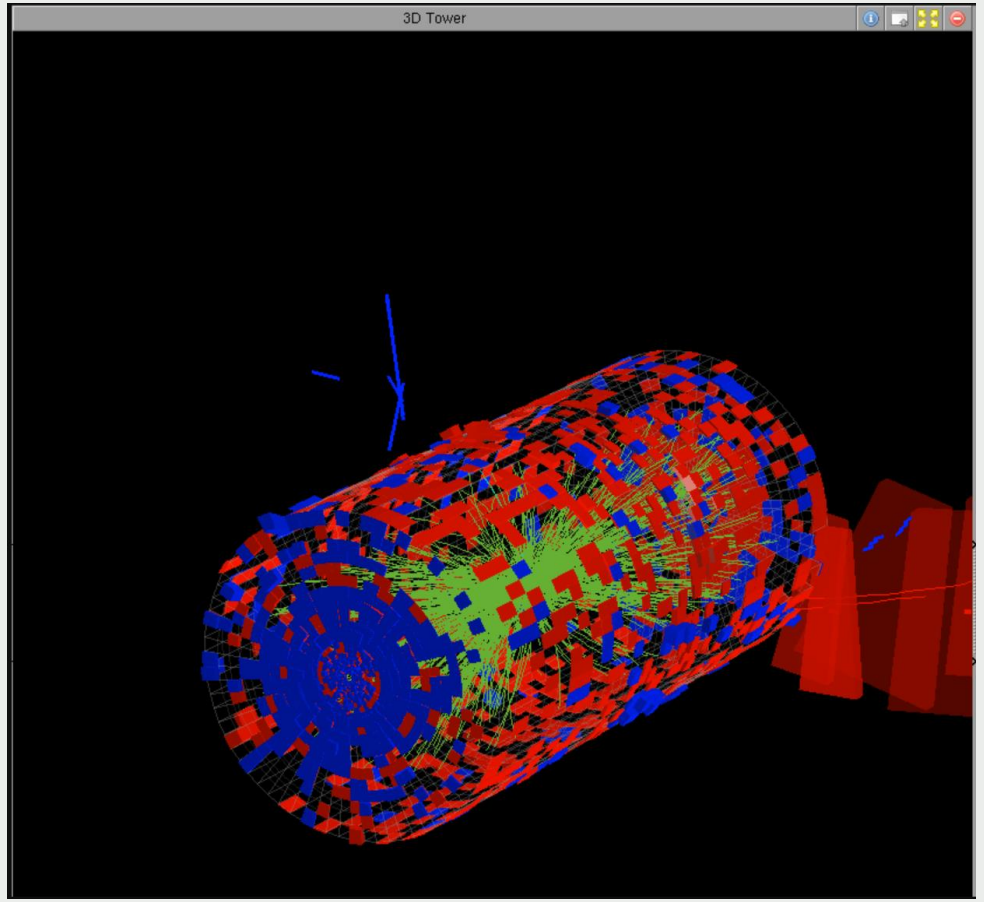
- Test beam was run last week to collect data and verify the functionality of the proposed experimental apparatus
- Principal objective was calibrating and testing the calorimeter
- Utilize previous *g-2* calorimeter from FermiLab comprised of a 5x5 array of crystals
- Part of my role was calibrating the calorimeter using this laser apparatus



- Use laser calibration system to correct for residual gain instabilities to very high precision during measurement period
- Necessary to monitor and stabilize the silicon photomultipliers of the calorimeter to ensure data is usable
- More details at https://lss.fnal.gov/archive/2019/pub/fermilab-pub-19-198-ppd.pdf

Summary

- Almost done with data analysis project (ostensibly)
- Despite issues with some of the calorimeter crystals going offline, sufficient data was collected and will probably analyzed by next summer's intern ☺
- Since data analysis project has been "done" for a while, we're now exploring a 3D graphical interface for the beam data



CERVEZA
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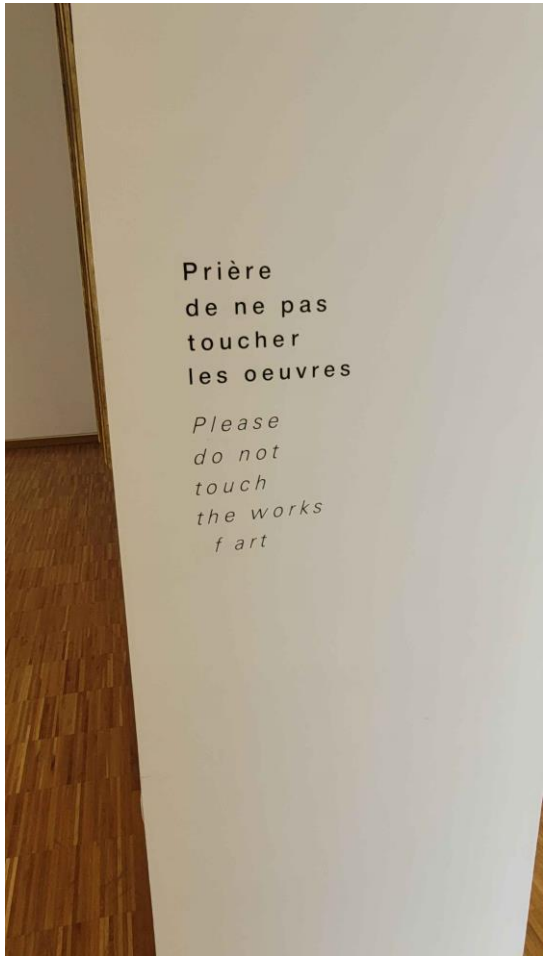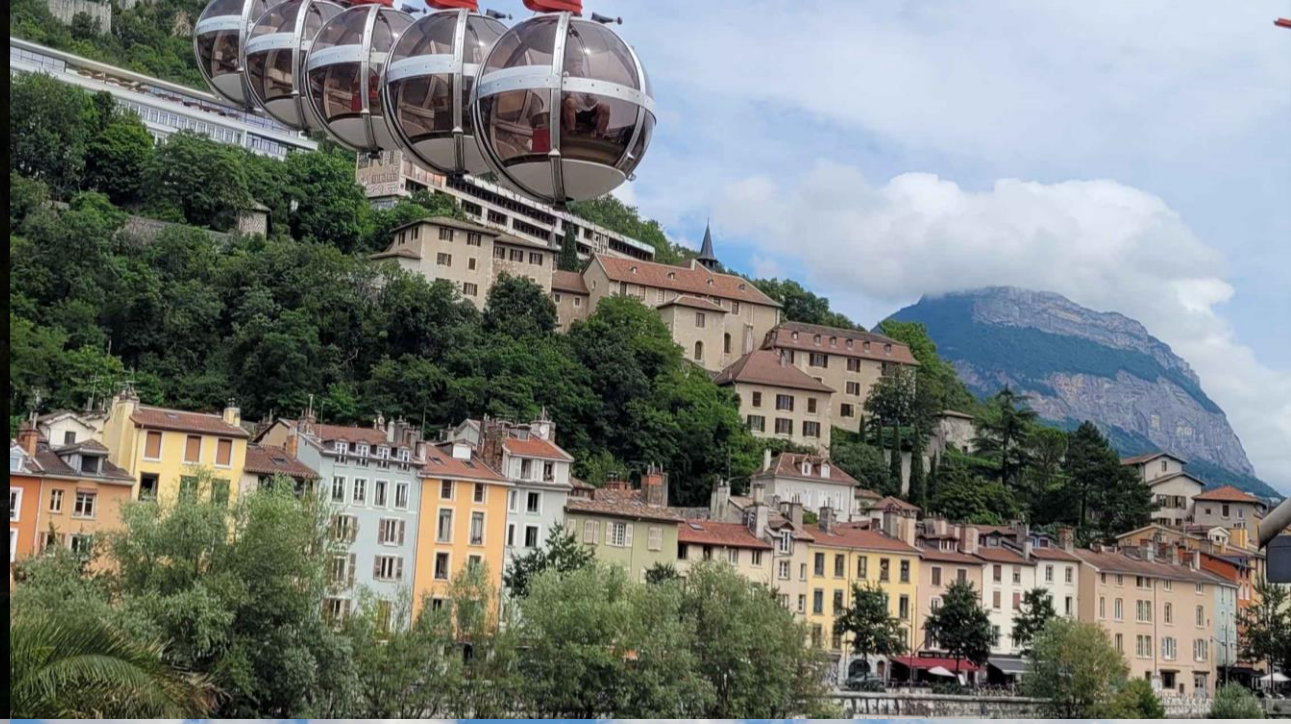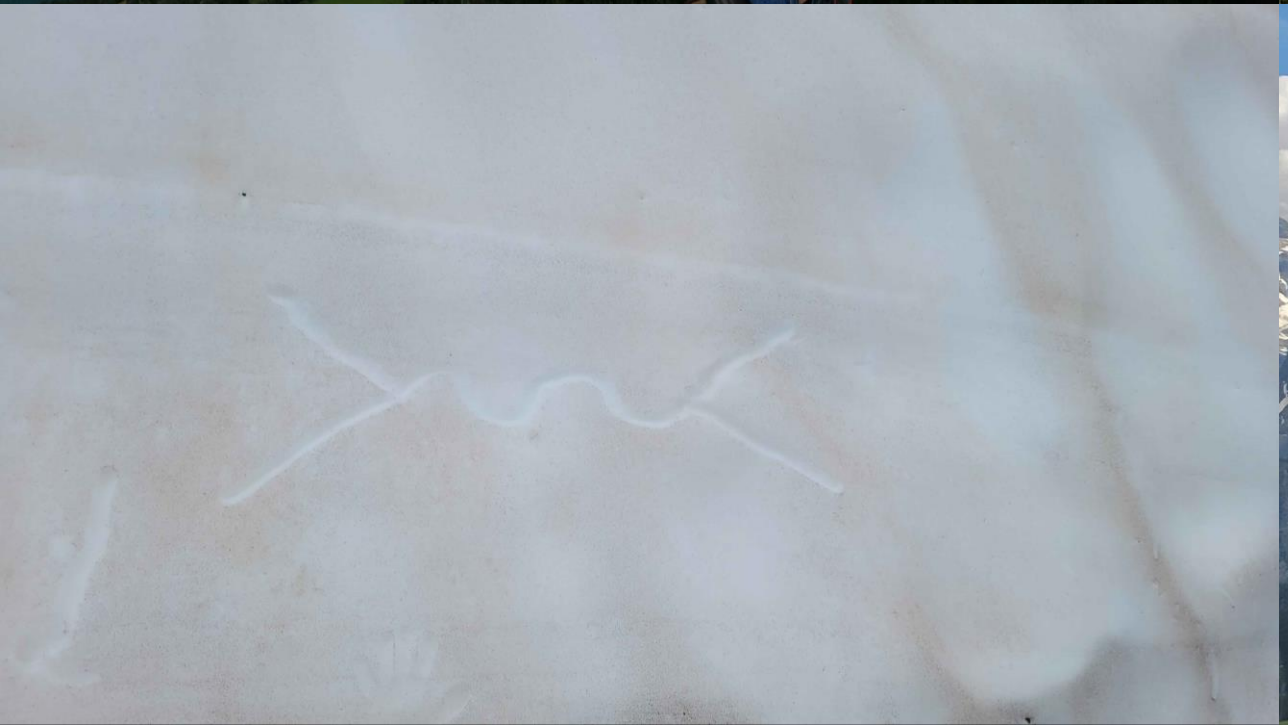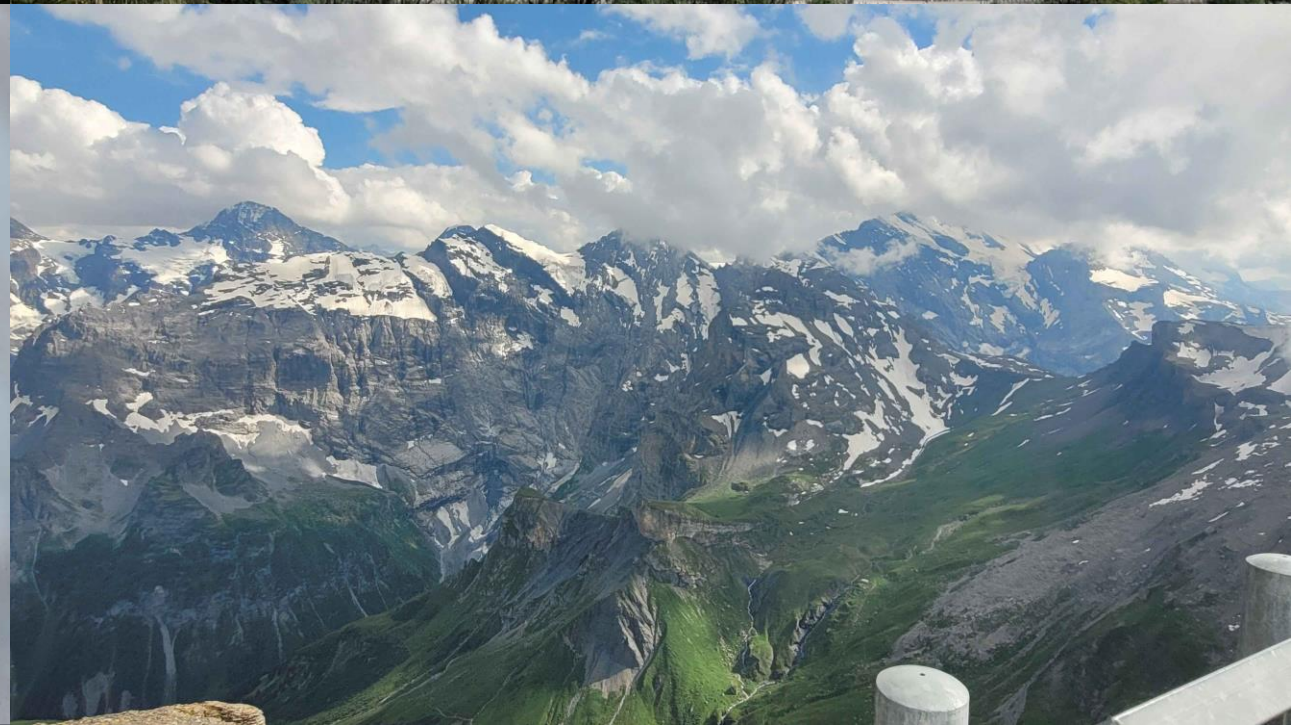
Prière
de ne pas
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do not
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f art