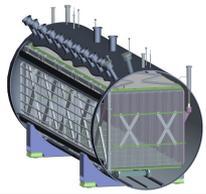


Comparison of Space Charge Calibration to Prediction

**Michael Mooney (BNL),
Christoph Rudolf von Rohr (Bern)**

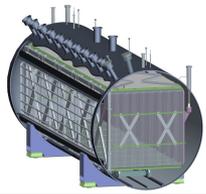
MicroBooNE Detector Physics Meeting

July 10th, 2015



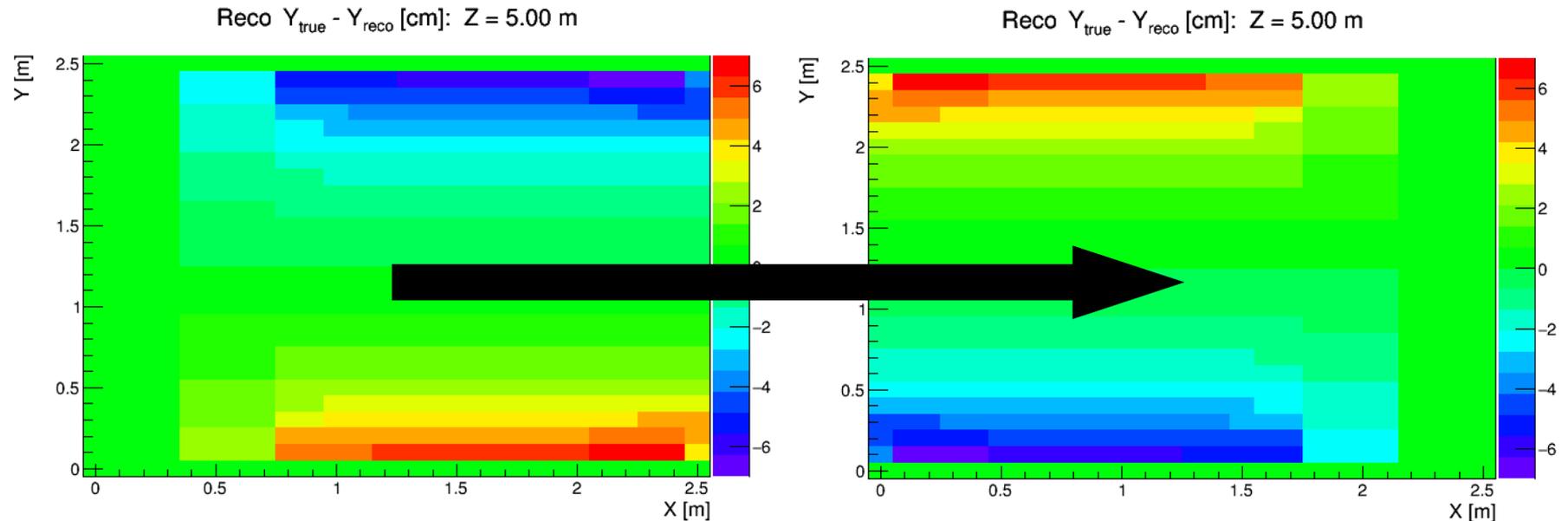
Introduction

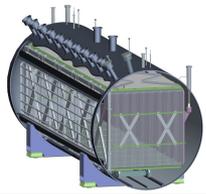
- ◆ Quick progress report today showing **comparison** of **CRvR's space charge calibration** results to **MM's simulated space charge prediction**
- ◆ Calibration makes use of single track lasers as well as sets of two laser tracks that intersect (or nearly do)
 - Use Delaunay Triangulation in 3D (CGAL library) for interpolation between calibration points
 - Stand-alone now, but will be imported into LArSoft module
 - See MicroBooNE Doc DB #3925, #4437
- ◆ Simulation makes use of Fourier series solution to Poisson's equation for E fields at grid points
 - E field interpolation with RBF's (ALGLIB library), ray-tracing with RKF45 method for spatial distortions of drift electrons
 - See MicroBooNE Doc DB #3983, #4138



Coordinate System

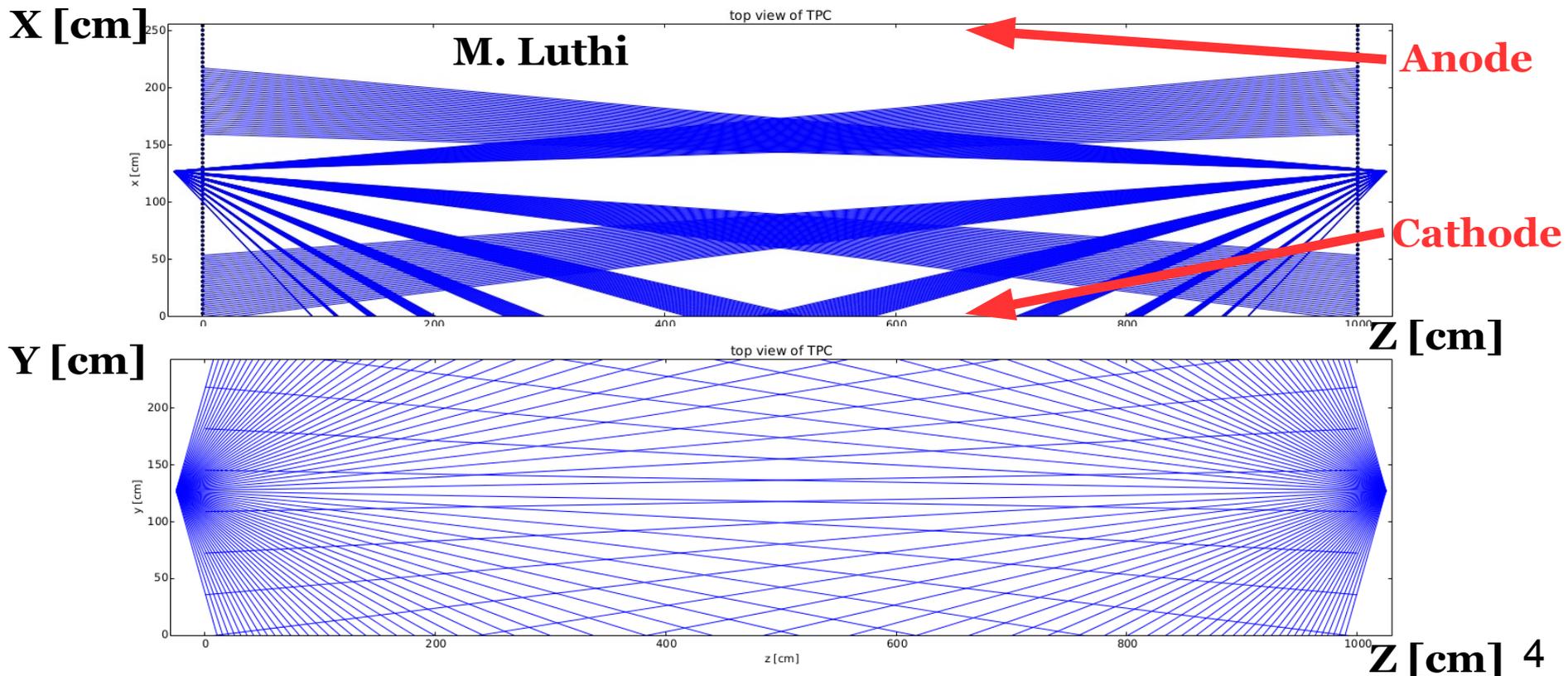
- ◆ MM's coordinate system is similar to, but not identical to MicroBooNE coordinate system in LArSoft :(
 - Dimensions are 2.5m X 2.5m X 10m, cathode at 0m, anode at 2.5m
- ◆ But CRvR obliges and makes $\{x,y,z\}$ transformation :)
- ◆ However, one remainder issue: currently need to flip both X and Y coordinates for CRvR's results (see example below)

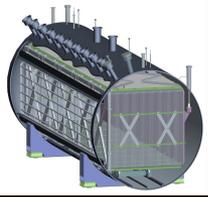




Laser Map

- ◆ Matthias Luthi provided a laser map demonstrating one possible set of laser trajectories given assumptions about the mirror position w.r.t. the field cage
- ◆ Distort laser tracks, give to CRvR as input for calibration

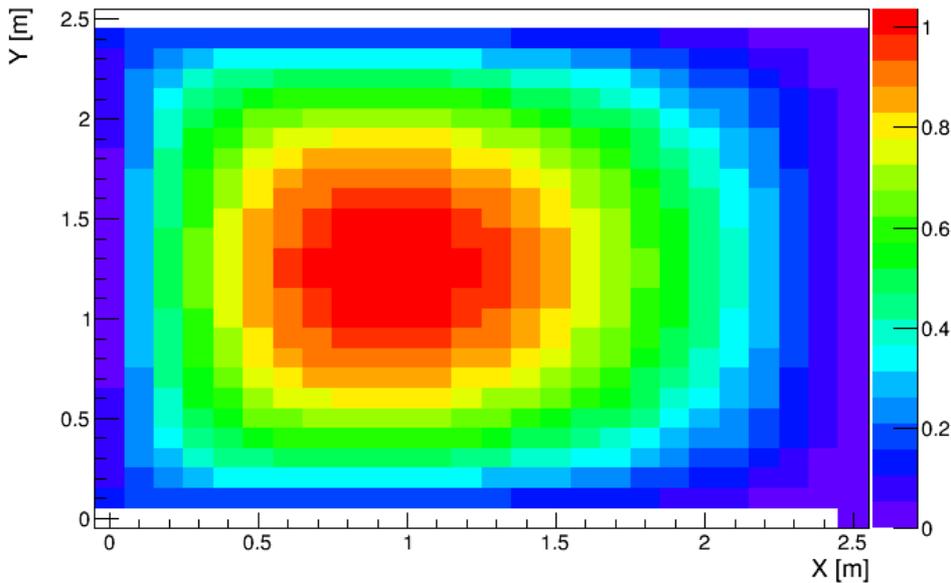




Comparison: ΔX ($Z = 5$ m)

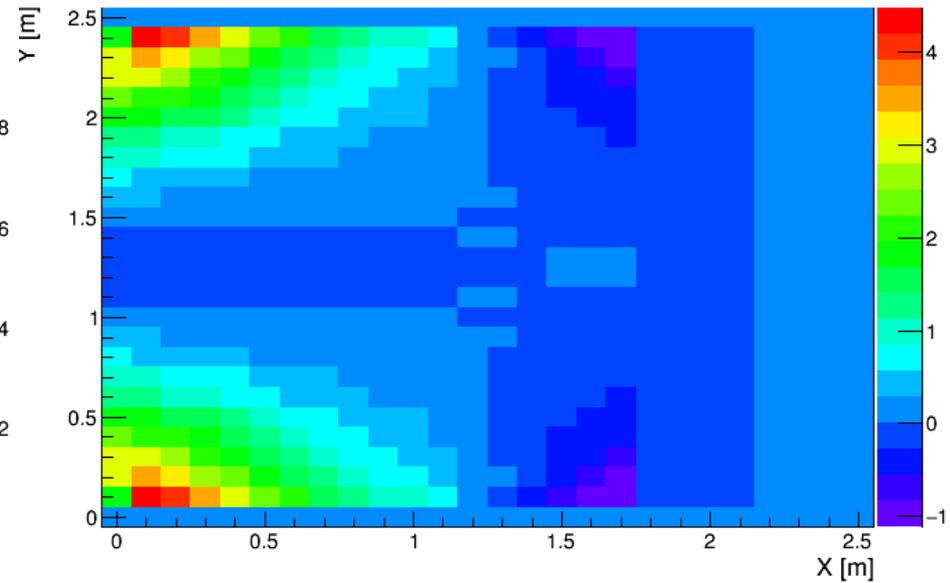
Simulation

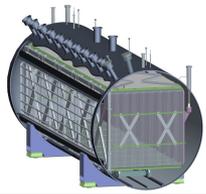
Actual $X_{\text{true}} - X_{\text{reco}}$ [cm]: $Z = 5.00$ m



Calibration

Reco $X_{\text{true}} - X_{\text{reco}}$ [cm]: $Z = 5.00$ m

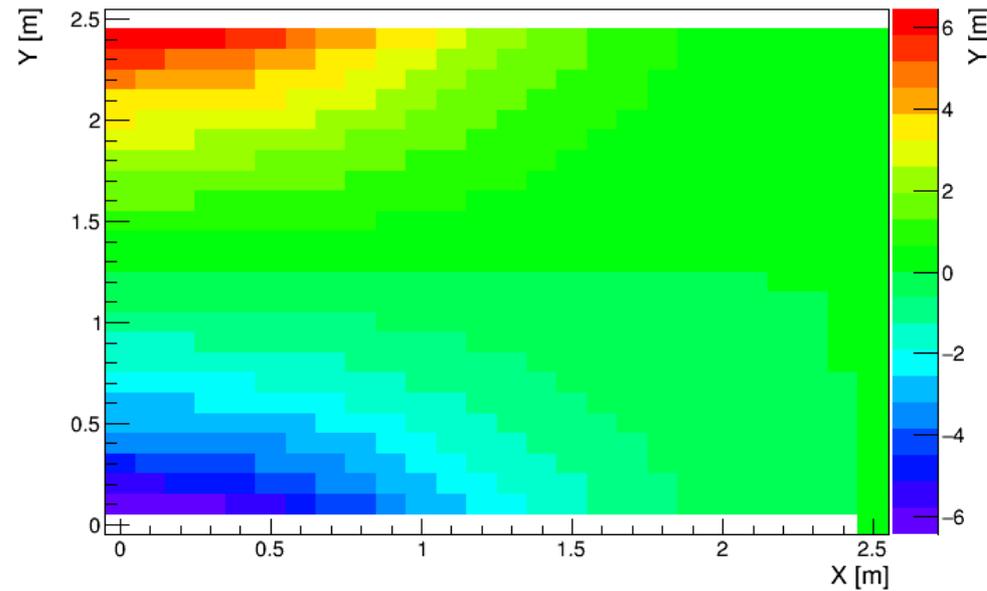




Comparison: ΔY ($Z = 5$ m)

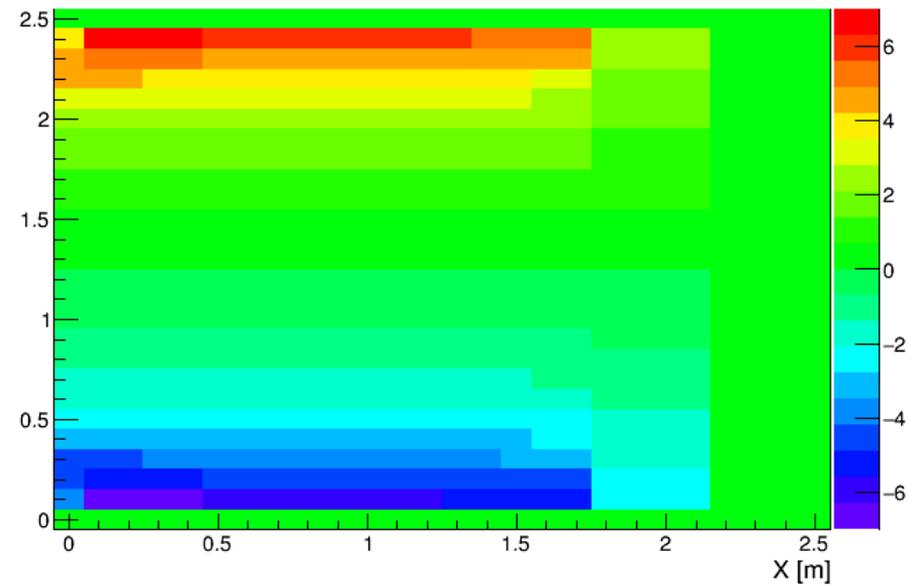
Simulation

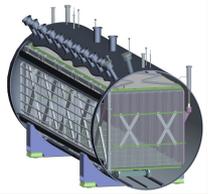
Actual $Y_{\text{true}} - Y_{\text{reco}}$ [cm]: $Z = 5.00$ m



Calibration

Reco $Y_{\text{true}} - Y_{\text{reco}}$ [cm]: $Z = 5.00$ m

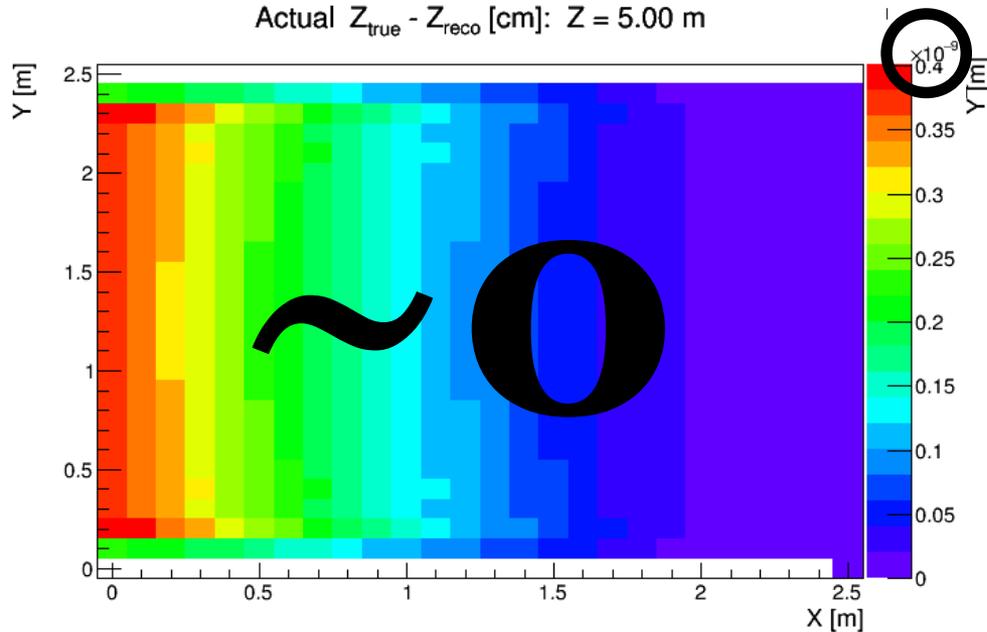




Comparison: ΔZ ($Z = 5$ m)

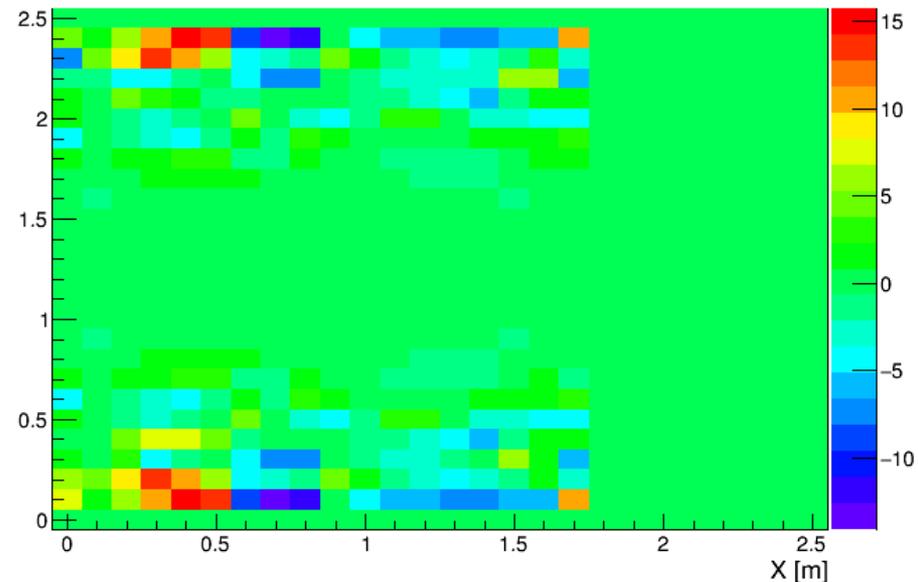
Simulation

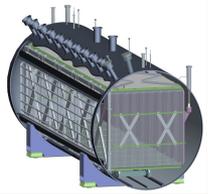
Actual $Z_{\text{true}} - Z_{\text{reco}}$ [cm]: $Z = 5.00$ m



Calibration

Reco $Z_{\text{true}} - Z_{\text{reco}}$ [cm]: $Z = 5.00$ m

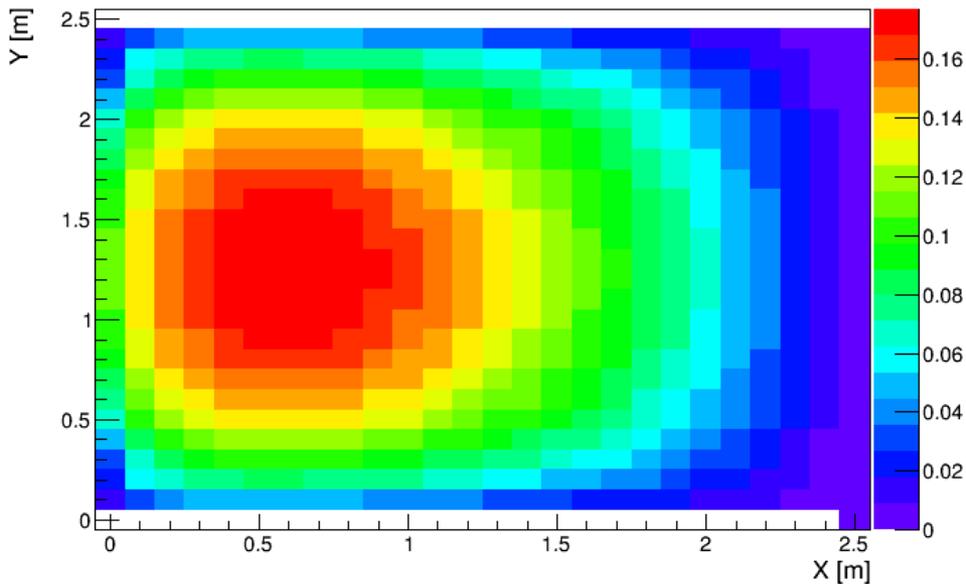




Comparison: ΔX ($Z = 0.1$ m)

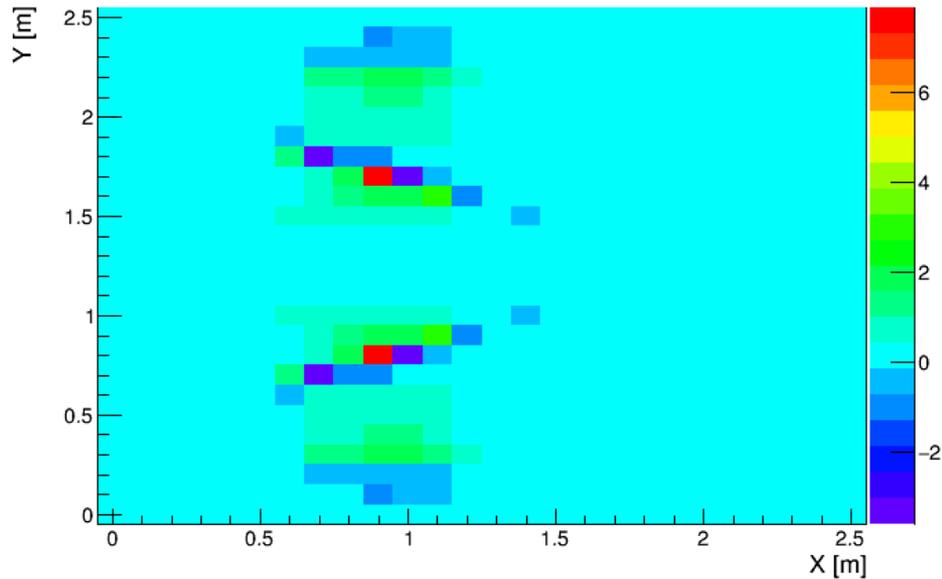
Simulation

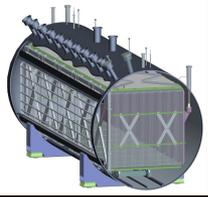
Actual $X_{\text{true}} - X_{\text{reco}}$ [cm]: $Z = 0.10$ m



Calibration

Reco $X_{\text{true}} - X_{\text{reco}}$ [cm]: $Z = 0.10$ m

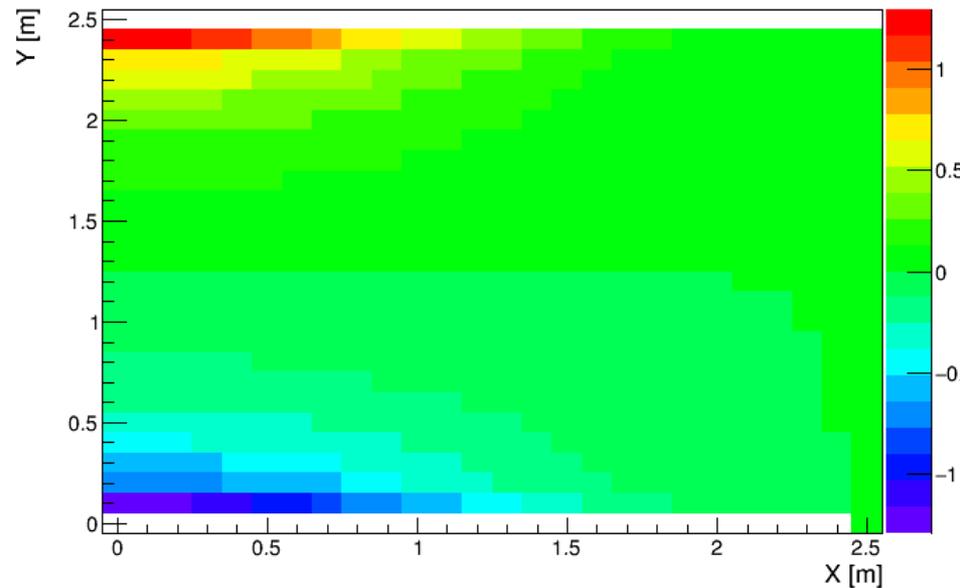




Comparison: ΔY ($Z = 0.1$ m)

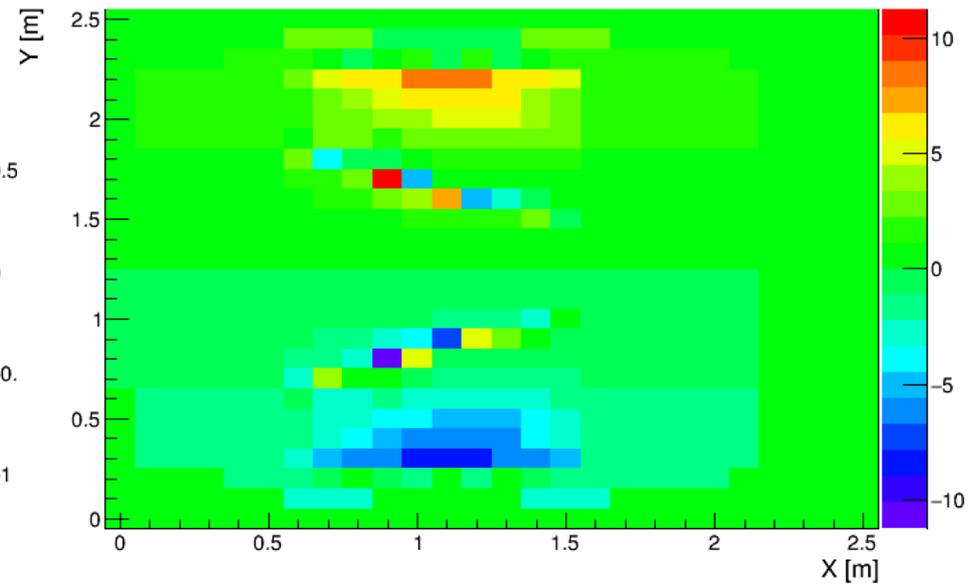
Simulation

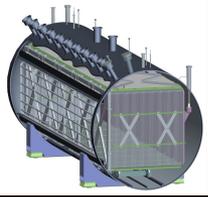
Actual $Y_{\text{true}} - Y_{\text{reco}}$ [cm]: $Z = 0.10$ m



Calibration

Reco $Y_{\text{true}} - Y_{\text{reco}}$ [cm]: $Z = 0.10$ m

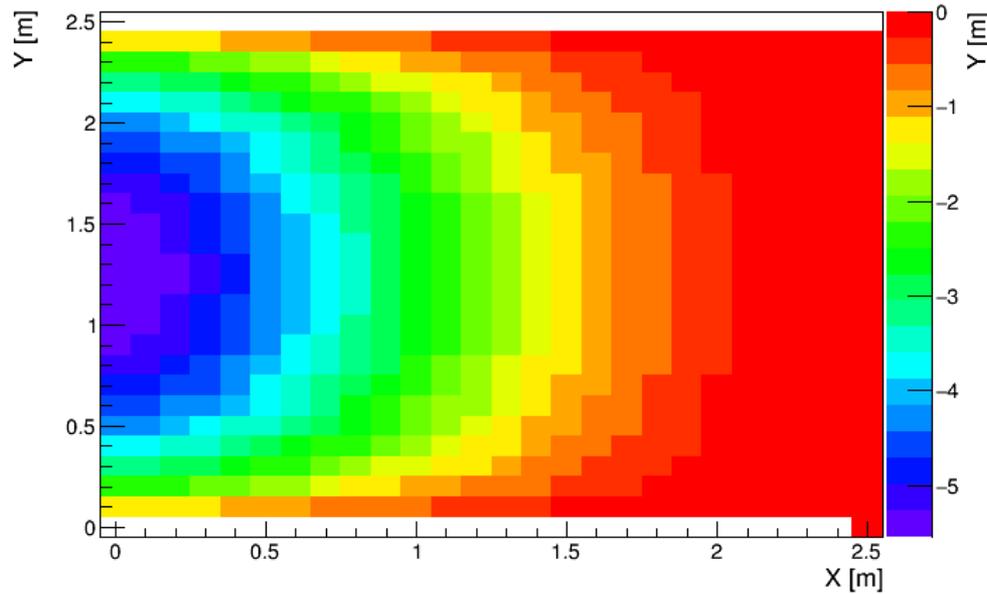




Comparison: ΔZ ($Z = 0.1$ m)

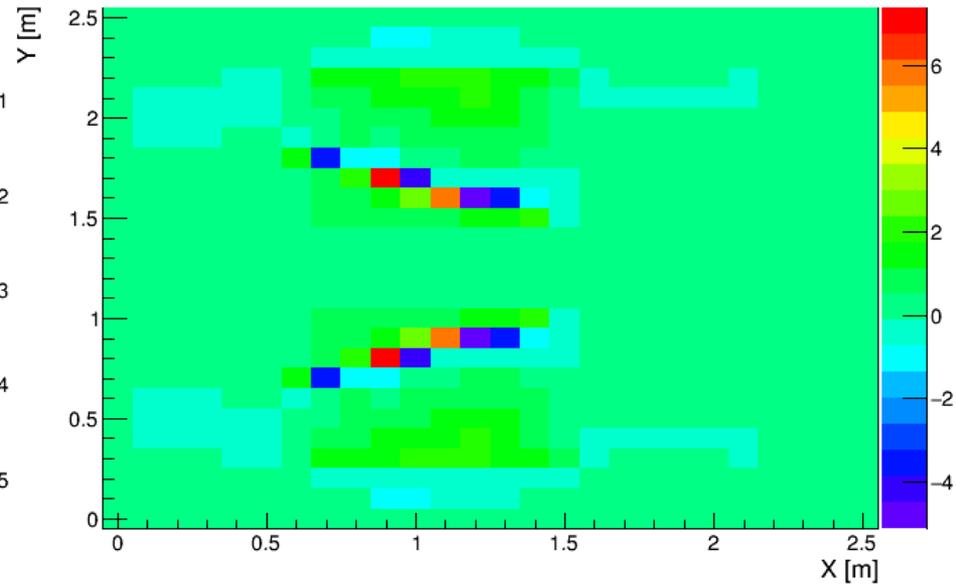
Simulation

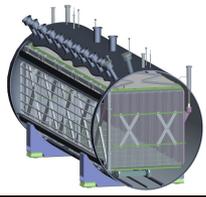
Actual $Z_{\text{true}} - Z_{\text{reco}}$ [cm]: $Z = 0.10$ m



Calibration

Reco $Z_{\text{true}} - Z_{\text{reco}}$ [cm]: $Z = 0.10$ m

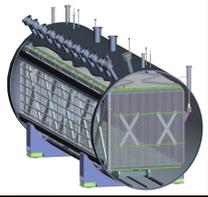




Moving Forward

- ◆ Some checks are in the pipeline:
 - Compare raw calibration with post-interpolation results (CRvR)
 - Modify calibration scheme by using muons to fill in gaps in laser map (MM)

- ◆ Christoph now tells me he found a sign error in his code
 - This is great news – we expect the results to improve by a lot!
 - Found very last minute unfortunately – stay tuned for updates



BACKUP SLIDES