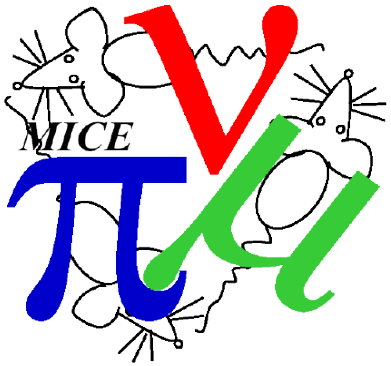
Emittance Evolution Update



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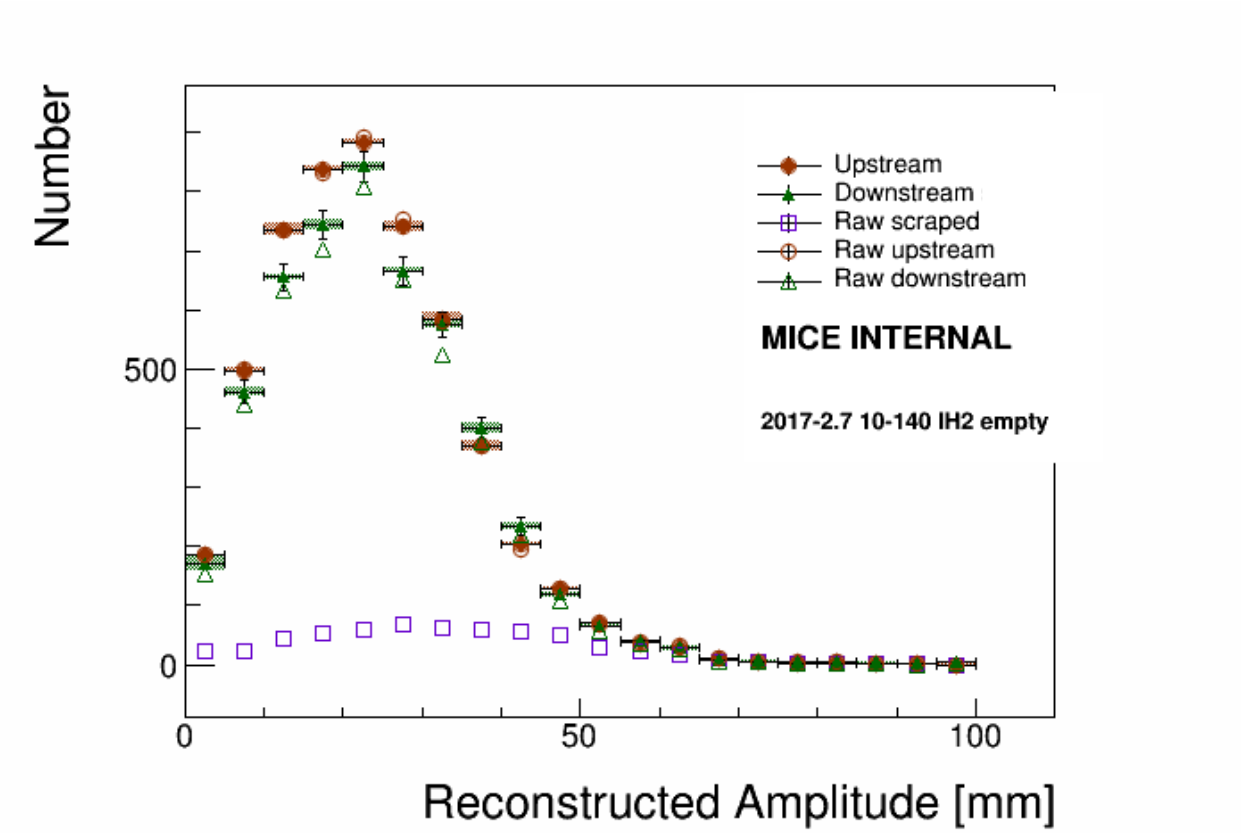
Overview

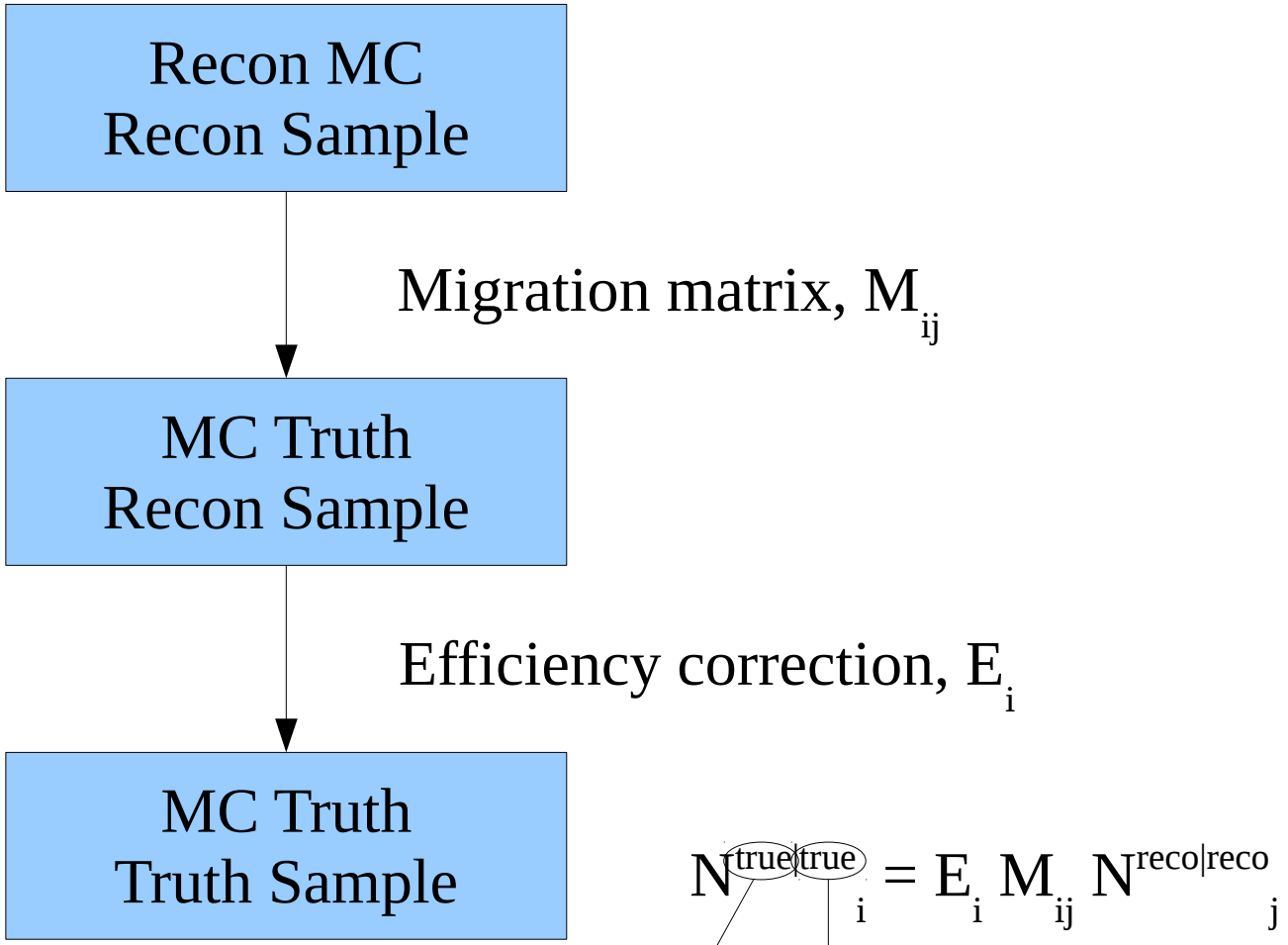
- A little more detail on systematic uncertainties
- Diffuser model update
- Max radius cut update
- TOF01 relative to e-

Reminder of the result

- Reminder – we are trying to measure amplitude
  - The number of muons at different “temperature”
  - Muons at low amplitude are “cooler”
  - We want to show we have more muons at low amplitude after the absorber



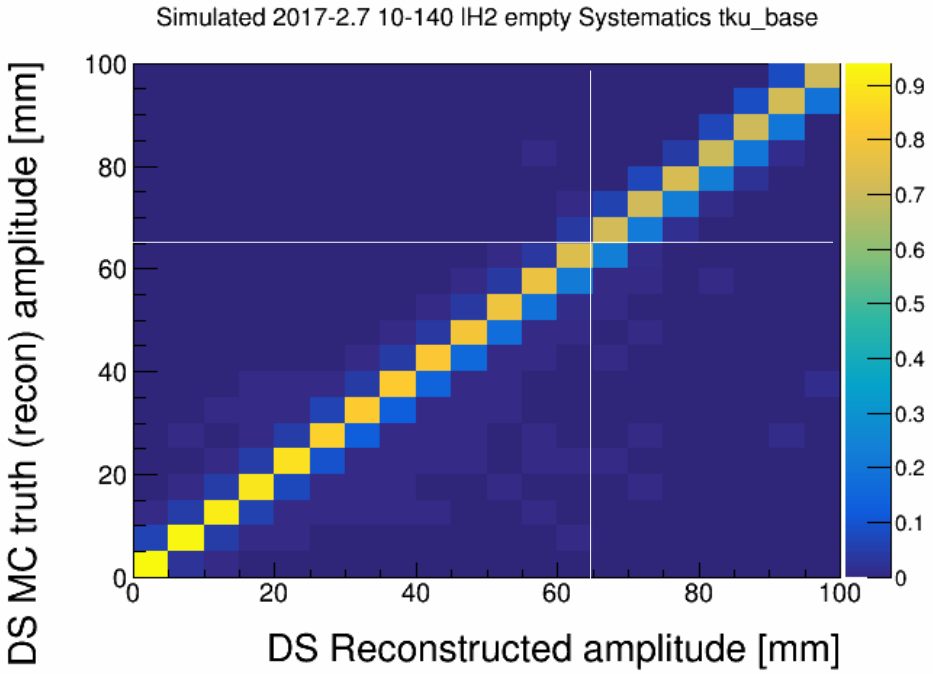
Reminder – correction routine

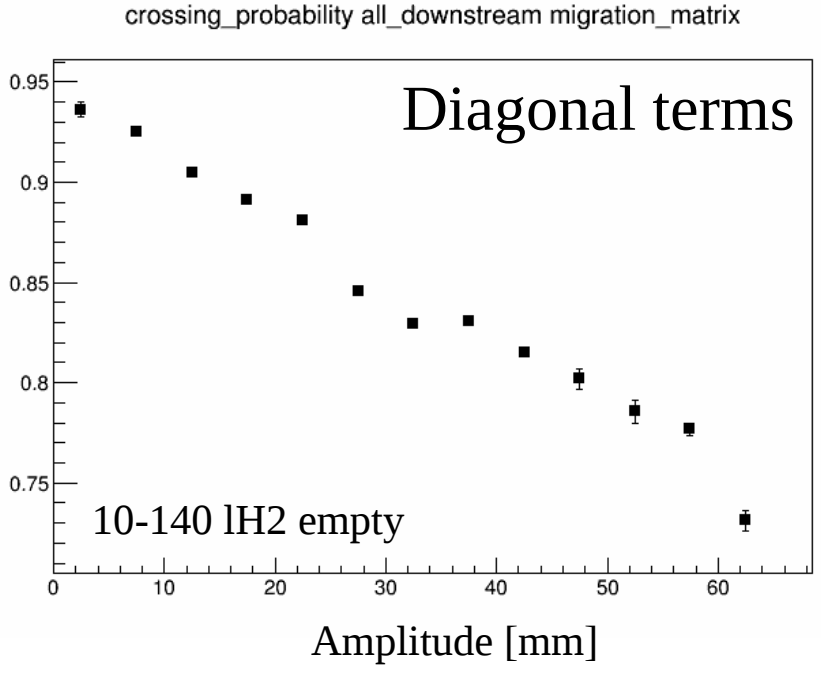


Mechanics of Calculation

- Record the upstream sample (~1e4 events) at TKU station 5
- Smear using KDE
- Sample ~1e6 events from resultant distribution
- Reapply following cuts:
  - TKU chi2 cut
  - TKU max radius cut
  - TKU p cut
  - All downstream cuts
- I did a MC production for 3-140, 6-140, 10-140 lH2 empty
  - No absorber data; no time
- Stats errors are generated by taking standard deviation of 10 subsamples / sqrt(10)

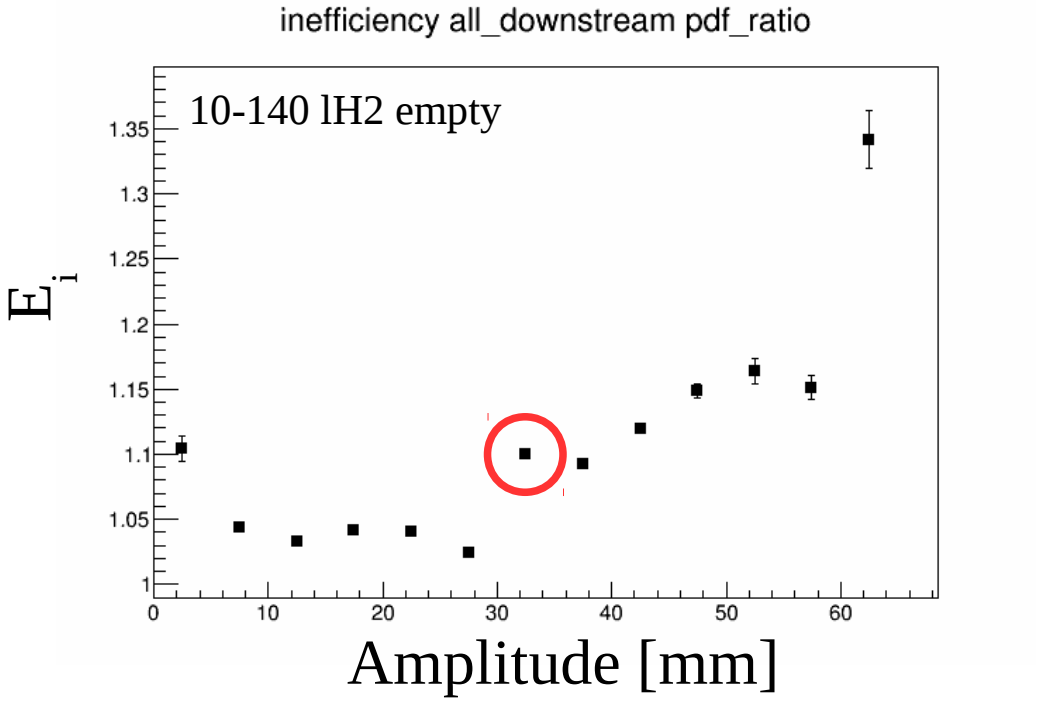
Migration matrix





- Detector resolution causes muons to migrate between bins
- Migration matrix technique to calculate and correct migration
- N_{ij} is number of events in ith bin in truth and jth bin in recon
  - Always considering the sample of events that was reconstructed
- Then Migration matrix is
  - $M_{ij} = N_{ij}/\mathrm{Sum}_j(N_{ij})$
  - So $N^{\mathrm{true|reco}}_{\ i} = M_{ij} N^{\mathrm{reco|reco}}_{\ j}$

Inefficiency

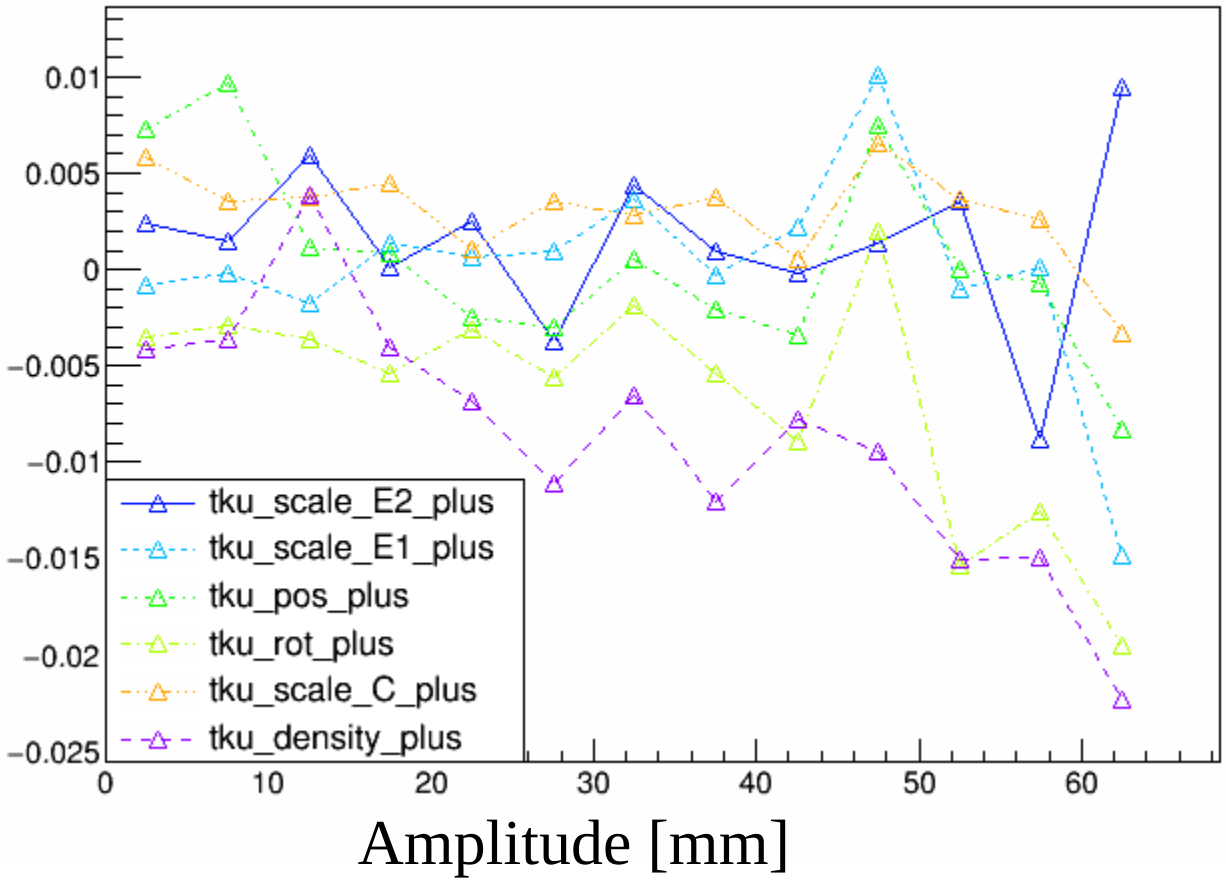


- Detector inefficiency causes muons to “disappear”
- Use MC to estimate the probability of disappearance
- $N^{true|reco}_i$ = number events in recon sample in bin i
- $N^{true|true}_i$ = number events in true sample in bin i
- Always use recon truth to calculate the amplitudes
- Efficiency correction, $E_i = N^{true|true}_i / N^{true|reco}_i$

Sources of Systematic uncertainty

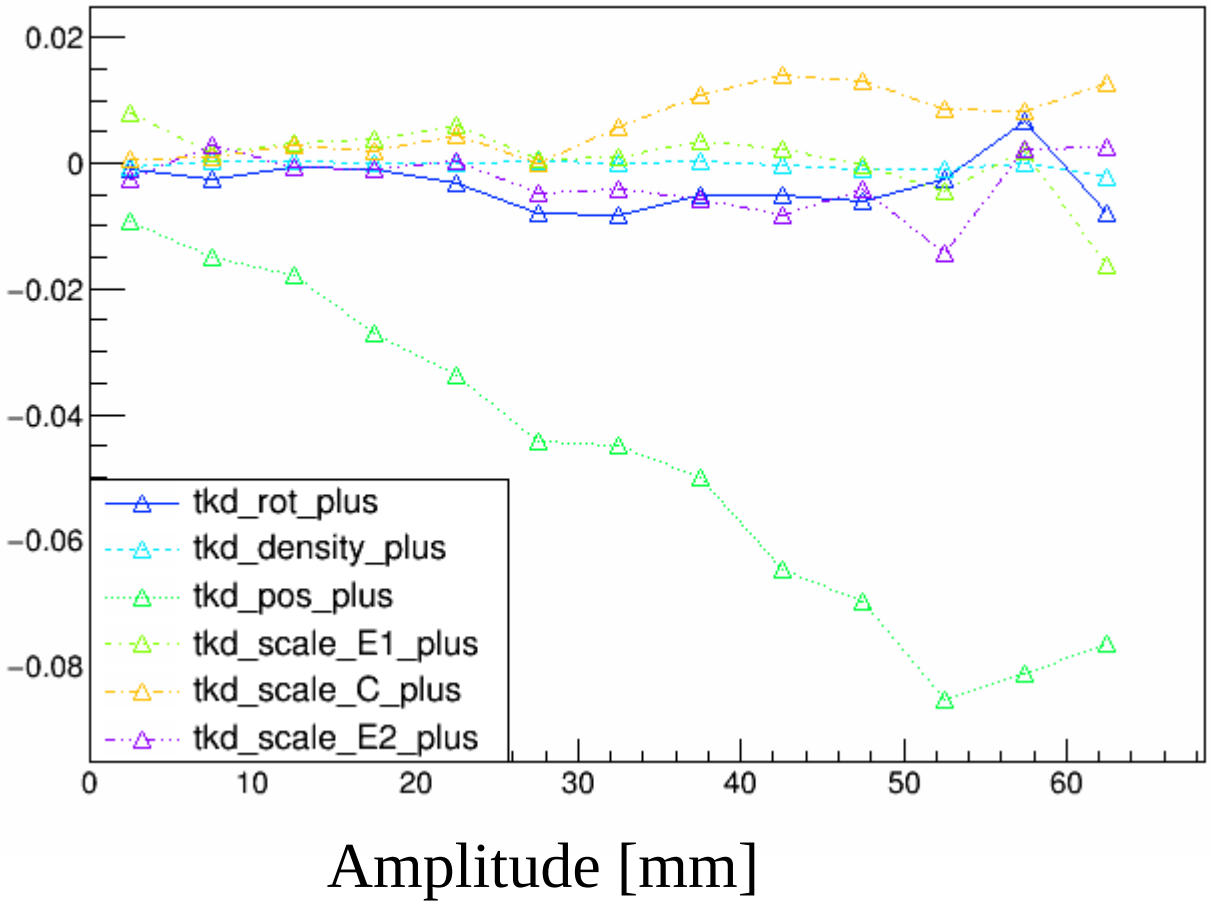
- Some systematic uncertainties arise because we don't quite know what was really installed in the hall
- Consider sources of systematic uncertainty (TKU and TKD)
  - Tracker position (1 mm)
  - Tracker tilt (1 mrad)
  - E1 scale (5 %)
  - E2 scale (5 %)
  - CC scale (1 %)
  - Tracker glue density (0.5 g/cm^3 ~ 25 %)
- Change each parameter; recalculate correction
  - How sensitive is the correction to different uncertainties?
  - Plot “modified correction” - “baseline correction” vs uncertainty
- Quoted uncertainties
  - Apply each correction in turn; calculate $N^{true|true}$
  - Calculate the difference between $N^{true|true}$ compared to the baseline
  - Add in quadrature

TKU – migration matrix



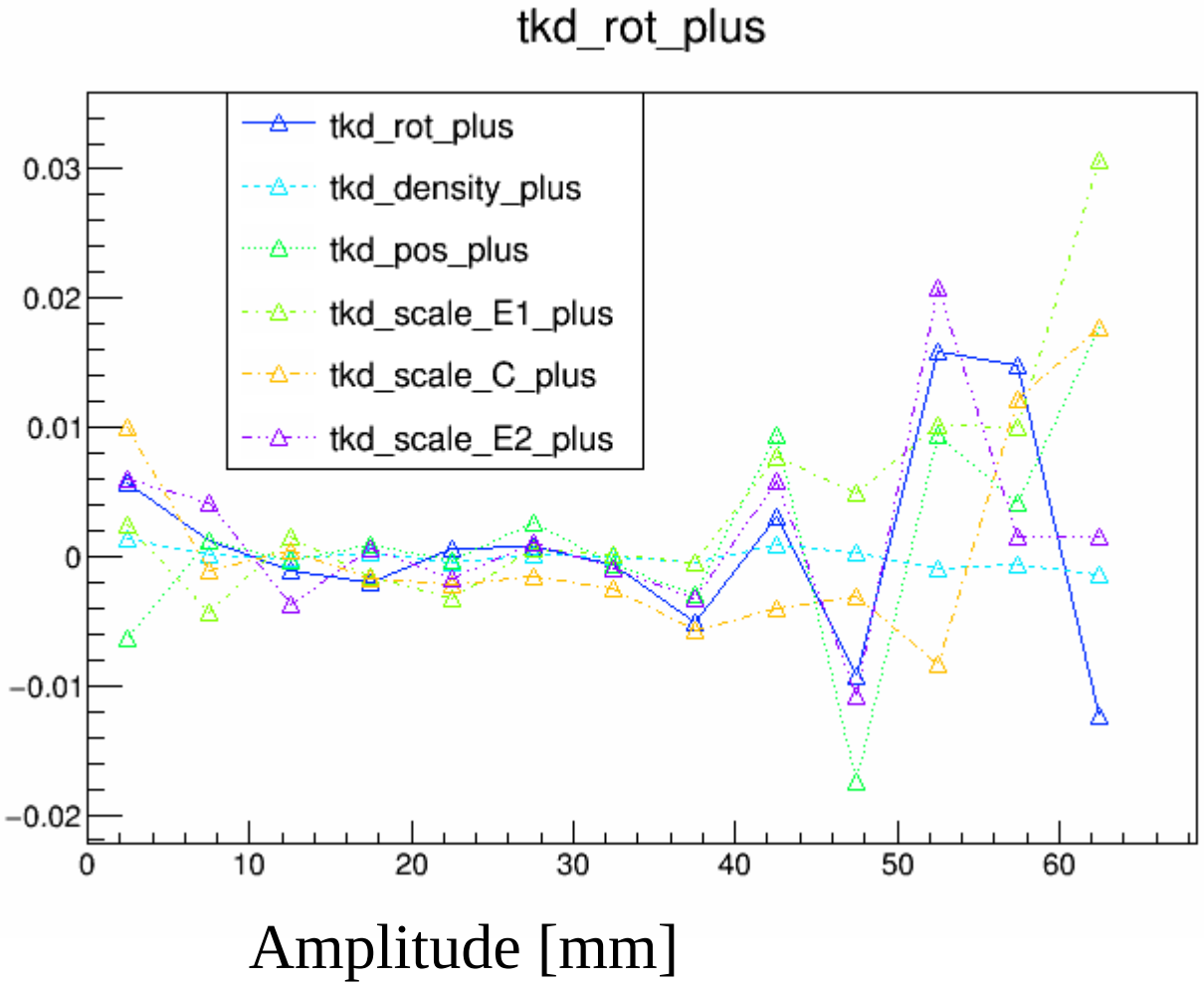
- Change in diagonal terms of migration matrix
  - Note that migration matrix makes a flow from one bin to another
  - So this is not a straight “uncertainty” on the bins
- Density uncertainty is dominant effect

TKD – migration matrix



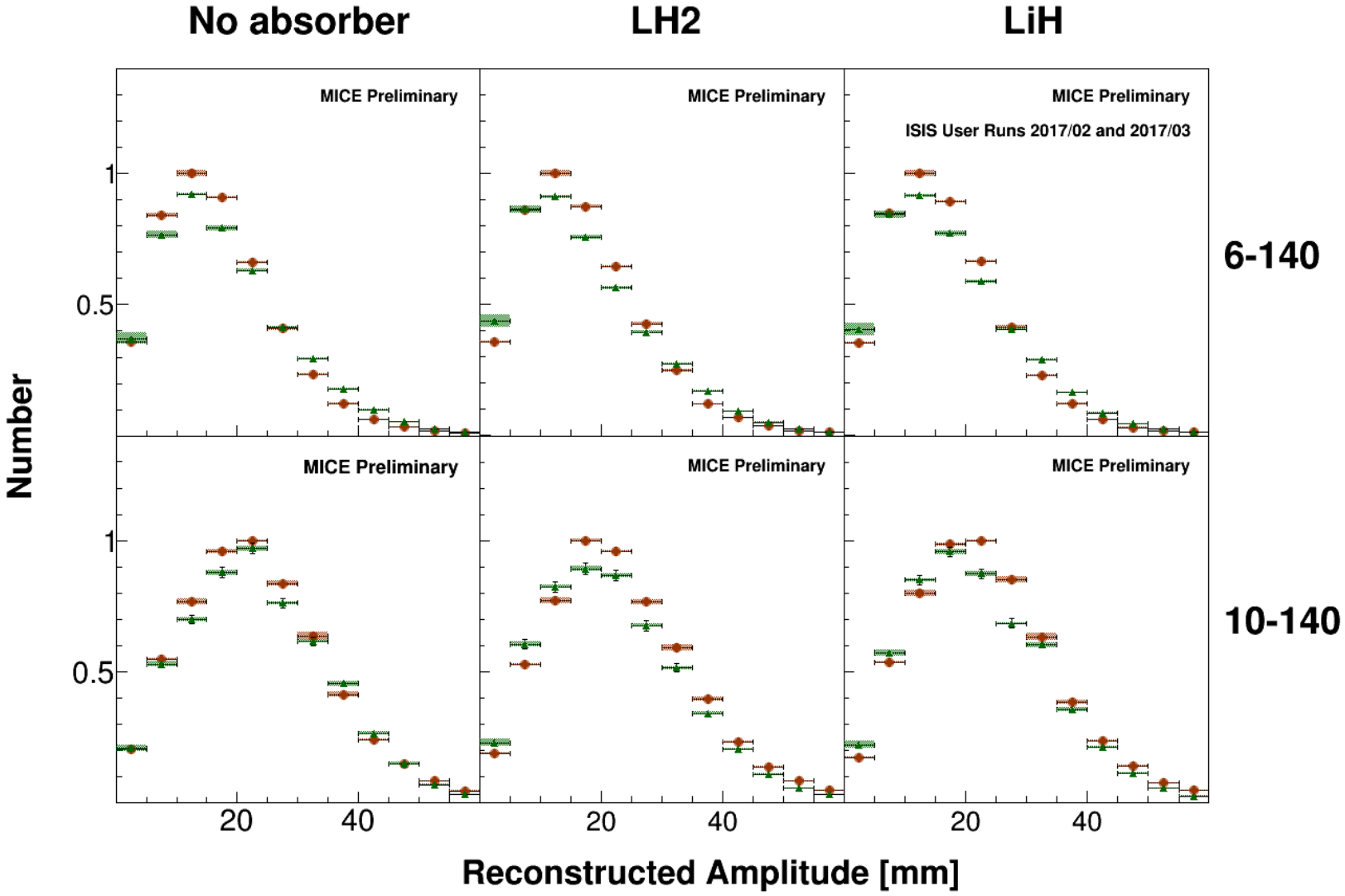
- TKD position uncertainty is dominant effect
  - Why is this a stronger effect for TKD than TKU?

TKD – efficiency

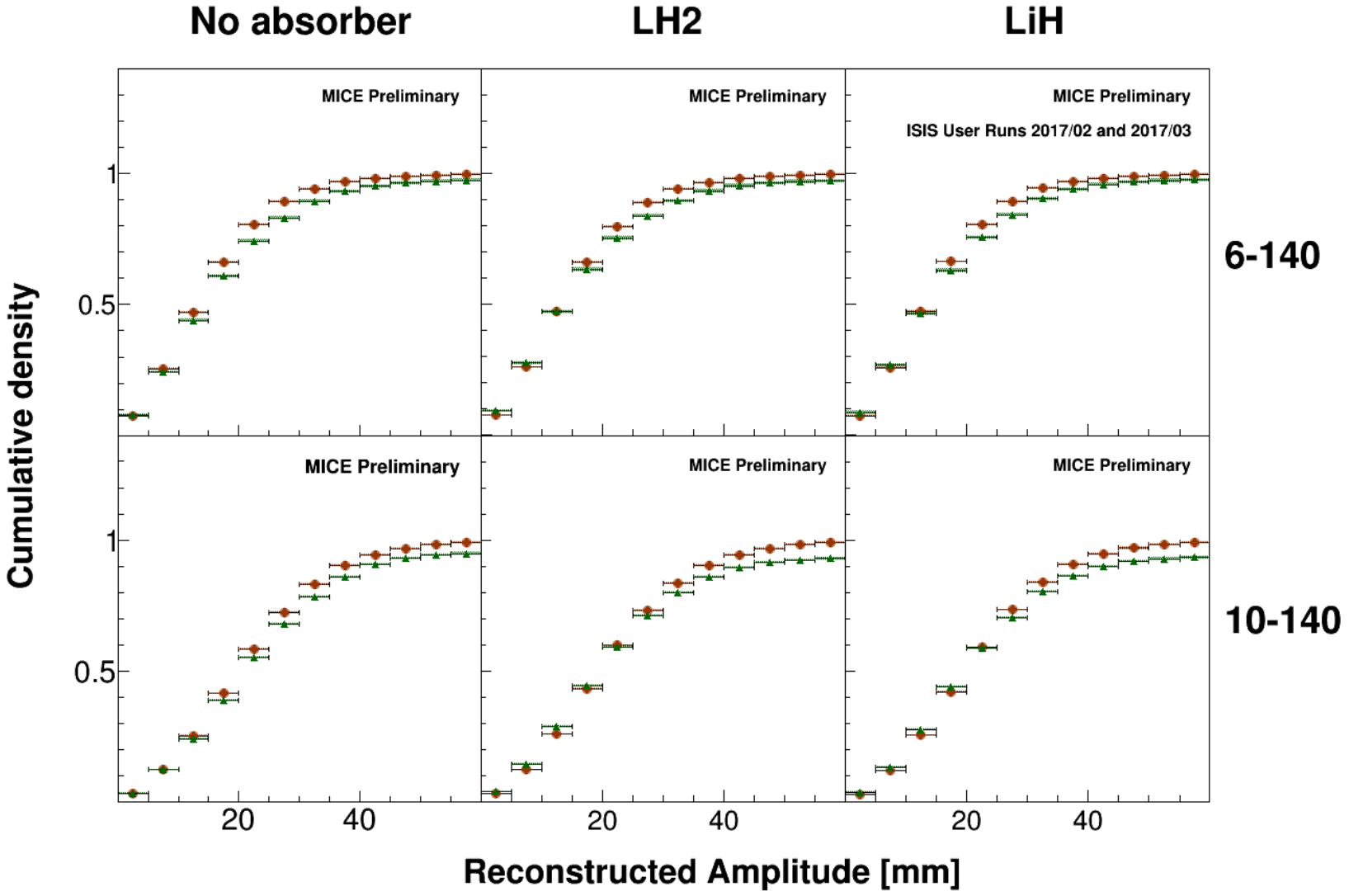


- Lots of significant factors

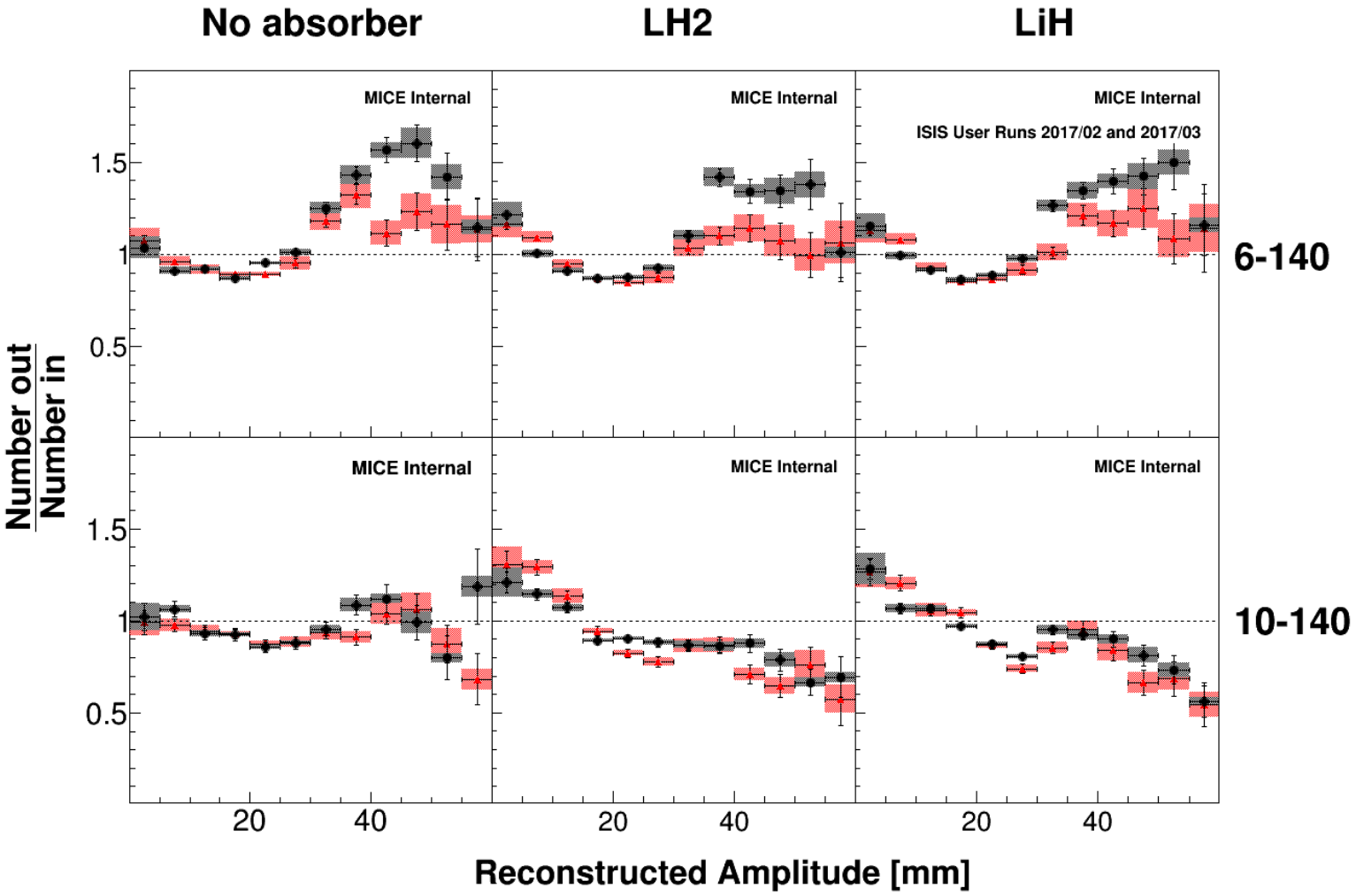
Results – amplitude pdf



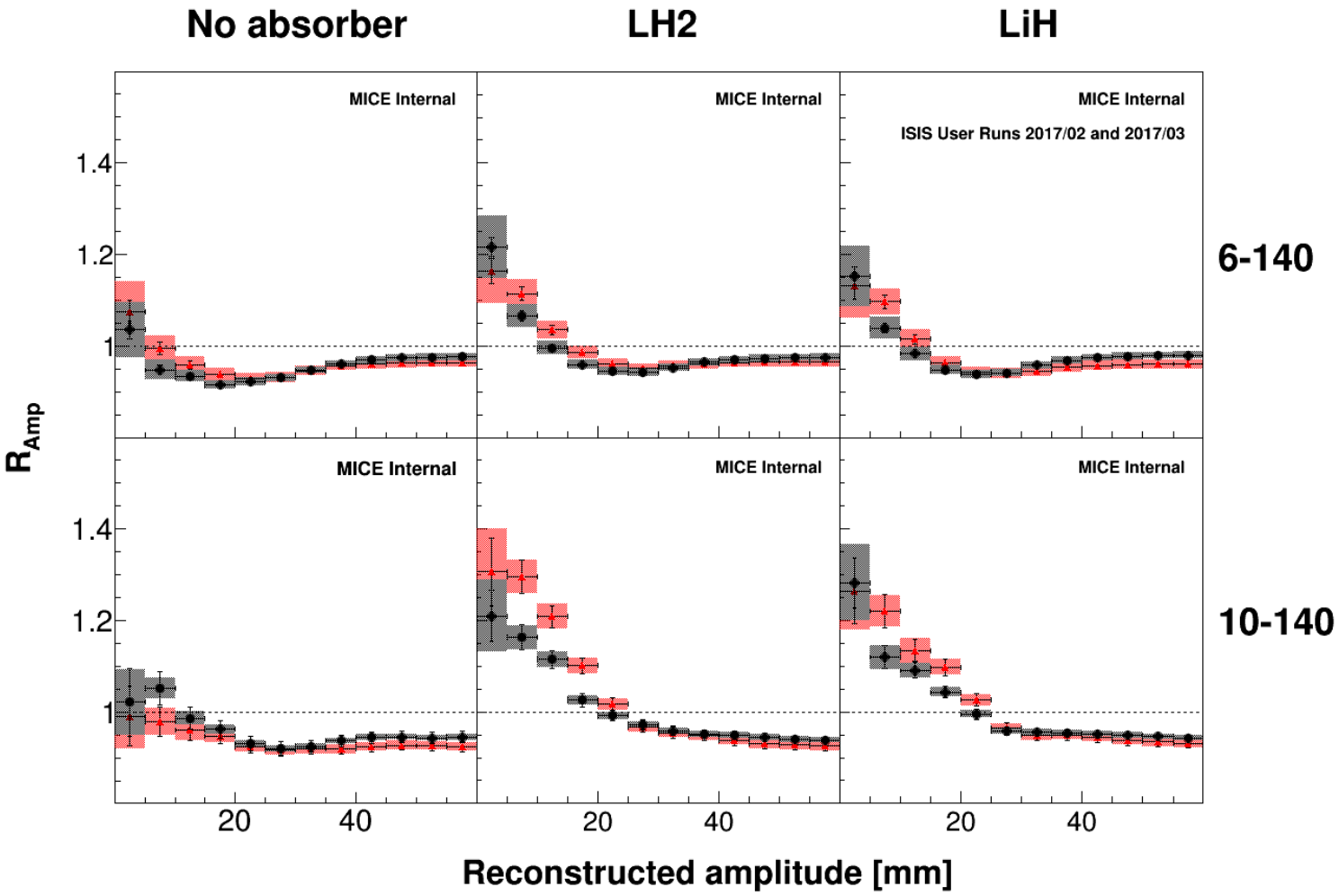
Results – amplitude cdf



Results – pdf ratio



Results – cdf ratio



Job List

- ~~Diffuser geometry~~
- ~~Max Radius Cut~~
- ~~TOF relative to e- peak~~
- 4 mm beam – processing in progress
- Understand Delta TOF01 issue
- More statistics in data & MC
- Systematic due to mis-PID
- Systematic due to downstream cuts
- Go over errors again
- Finish writing note
- Target end of May

Discussion – Long Emittance Paper

- Starting to think about long emittance paper
- Aim is to process all of the data sets
  - Some global fitting routine (TOF and tracker)
    - Fix low pt hole
  - Better TOF recon?
- Aim is to improve control of systematics
  - Tracker alignment (to solenoid)
  - Magnetic field in solenoid
  - Tracker material model
- Systematics of MC
  - The long paper should have a comparison with MC (the rapid communication may not)
  - What are the uncertainties/systematics in the MC?
- Other jobs?
- Who will do it?