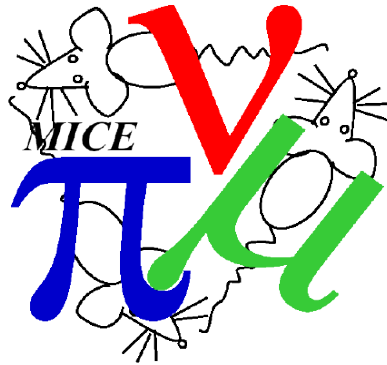


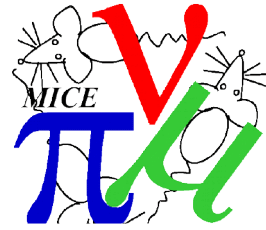


Emittance evolution update



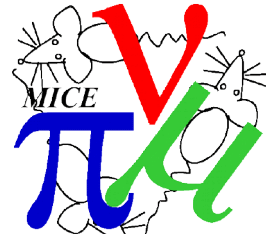
C. Rogers, ISIS Intense Beams Group
Rutherford Appleton Laboratory

Status of Publications



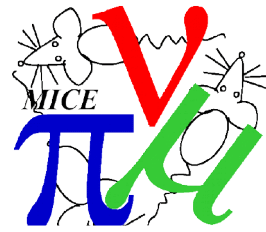
- Emittance measurement paper has now been submitted to EPJC
 - Awaiting journal referee's response
- MAUS paper is ready to submit to journal
- Scattering paper is still hung up on unfolding issues
- System performance paper – almost to 0th draft
 - Tracker section is complete
 - Waiting on systematics for energy loss analysis
- Wedge and emittance exchange
 - Reverse emittance exchange analysis looks encouraging
 - Picking up again beam selection routines to select for dispersion
- Emittance evolution “Rapid Communication” paper
 - Second referee's meeting Friday 30th Nov
 - Cleared most low level issues
 - Now addressing issues in amplitude and systematics treatment

Analysis Workshop



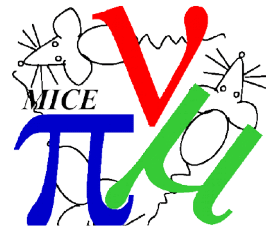
- Productive analysis workshop in Sheffield last week
 - Thanks to Chris Booth, Joe Langlands, Viktor Pec and Scott Wilbur for hosting
- Next analysis workshop will be
 - **Afternoon Jan 24th to morning Jan 25th**
 - **Imperial College, London**
 - Indico page to follow

Status of Publications



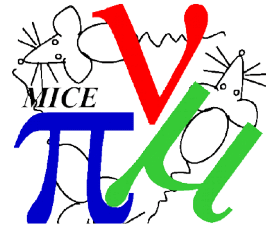
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Emittance Evolution Paper



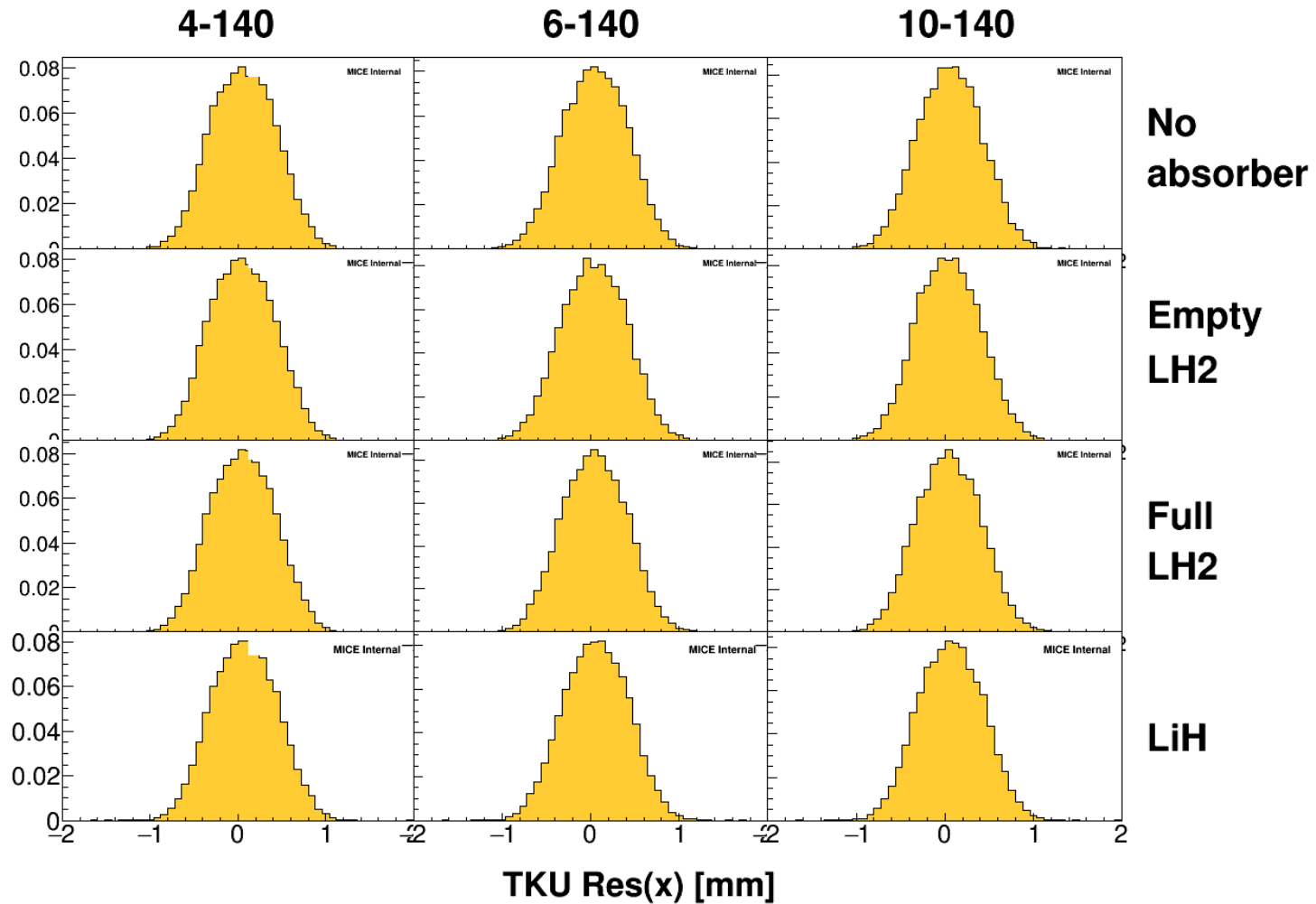
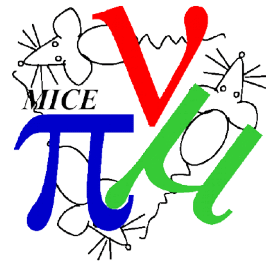
- Studies/fixes
 - New reconstruction routines to include TOF in combined fit
 - Study of effect of Si/uncertainty in glue density in Tracker
 - Study cluster finding in MC/data
 - New “performance systematic” to account for uncertainty in channel performance (principally in MC)
- Issues
 - Issues at MeV/c level in momentum determination
 - Handled in systematics
 - Unexplained small bump in amplitude resolution in 10-140
 - Overestimate of data performance as compared to MC
 - At the level of systematic uncertainty

Combined TOF/Tracker Recon

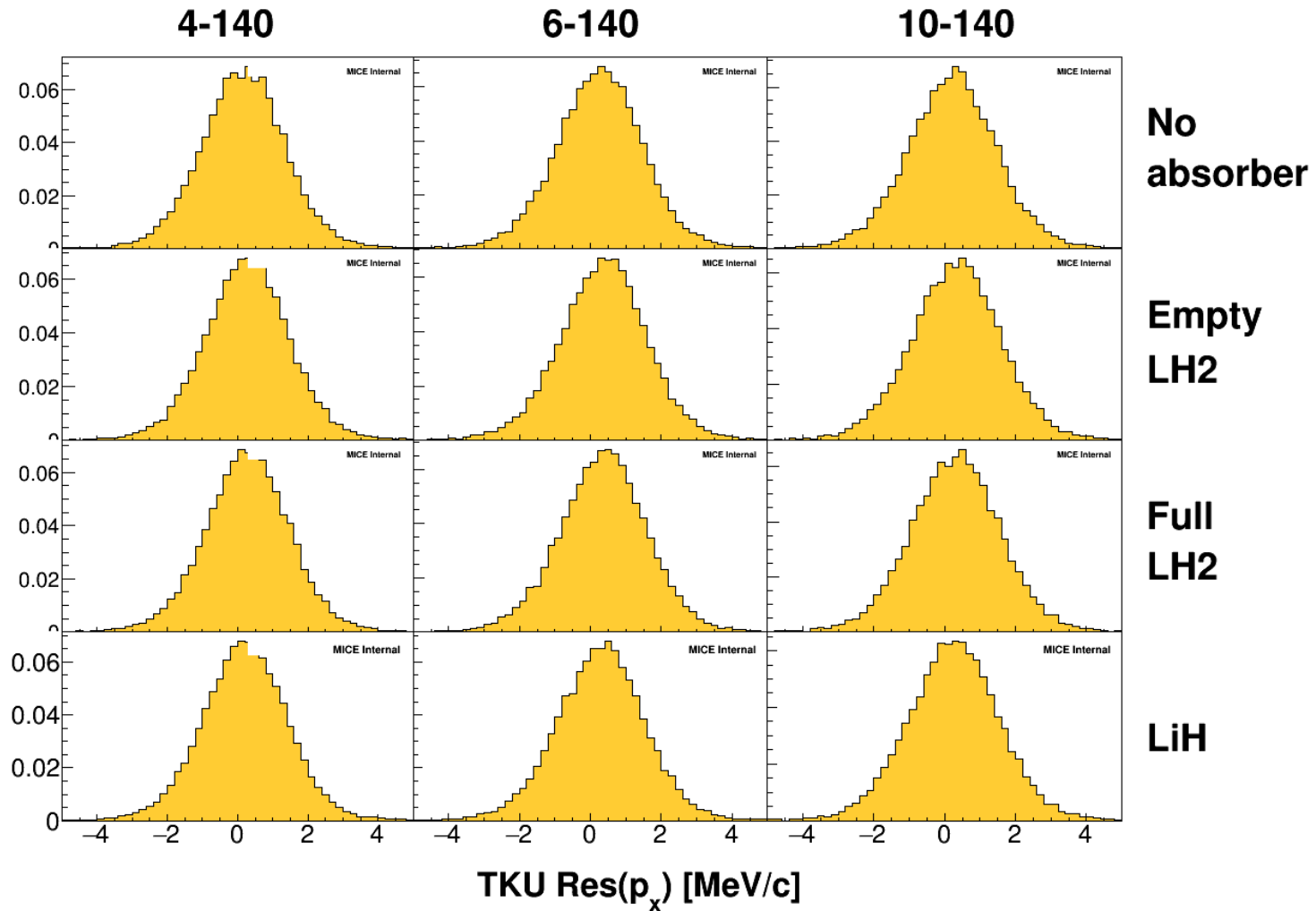
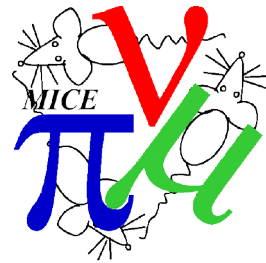


- In order to improve efficiency, moved to combined TOF/Tracker reconstruction
 - Use TOF01 → TKU to do p_z estimation in TKU for low p_t tracks
 - Use TKU → TKD to do p_z estimation in TKD for low p_t tracks
- Small amount of bias in transverse momentum, but better
- Still some inefficiency at low p_t , but better

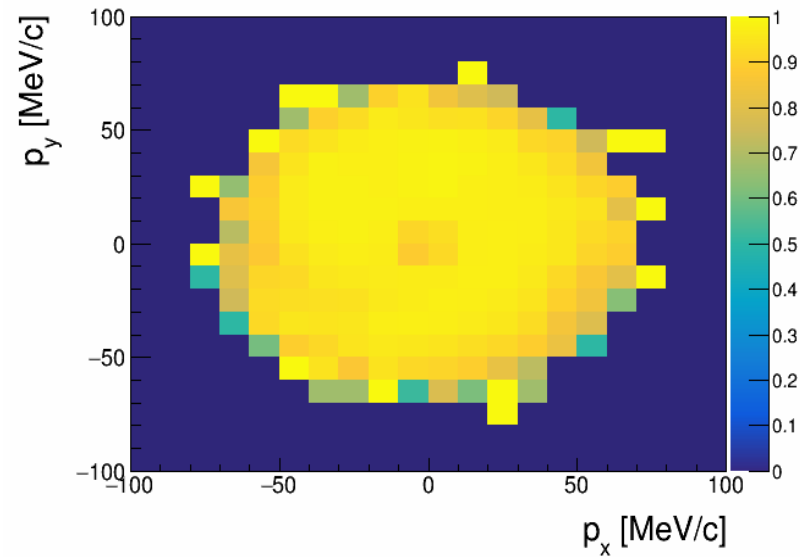
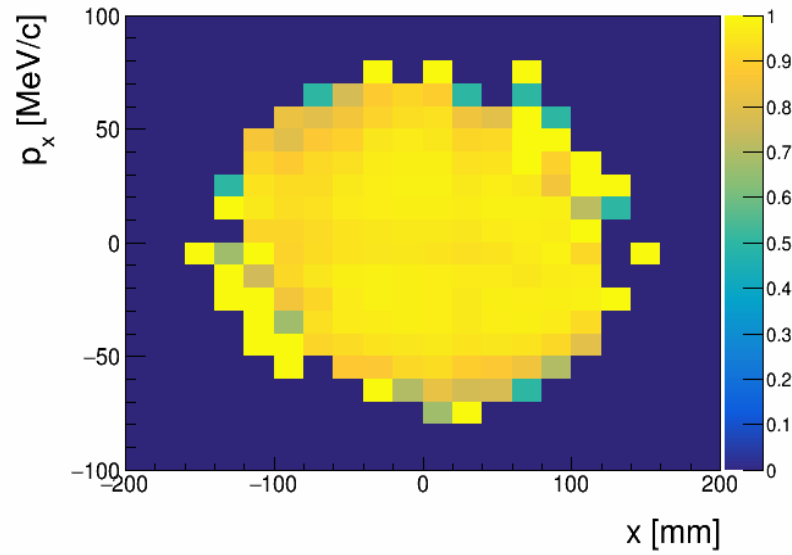
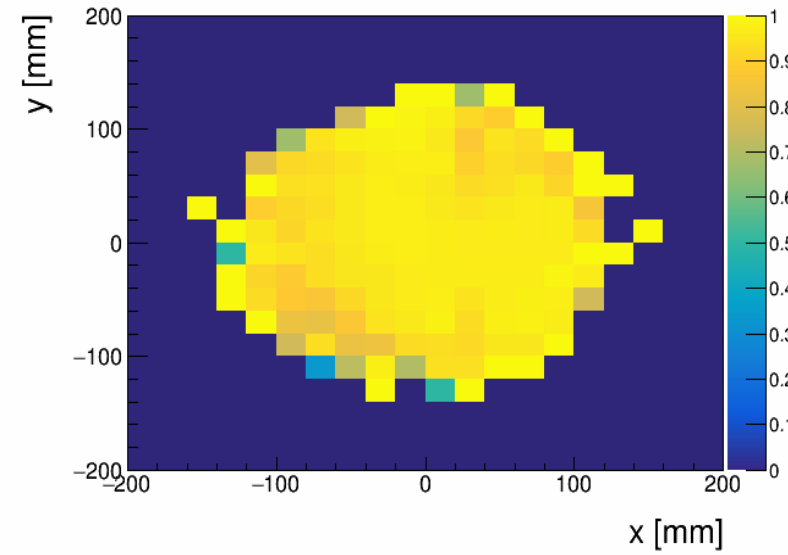
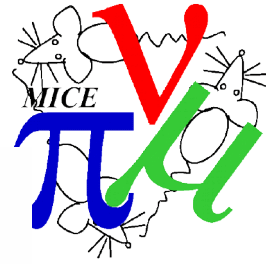
Position Residuals



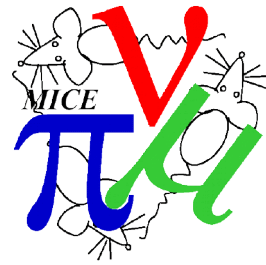
Position Residuals



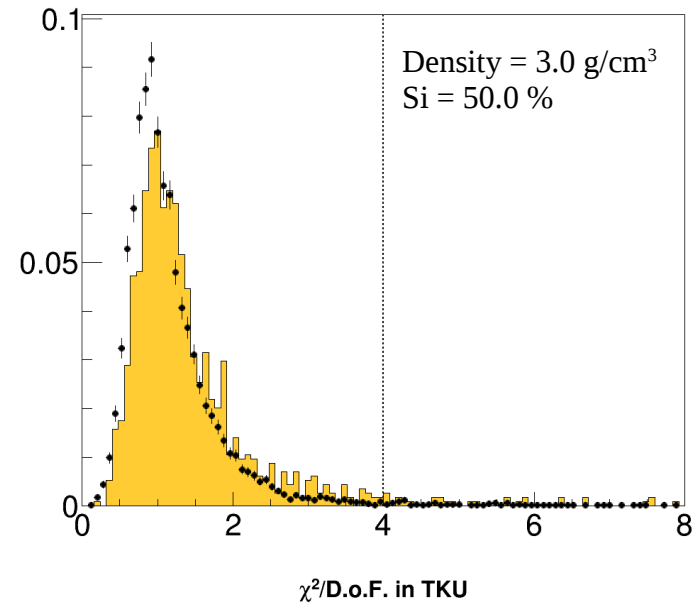
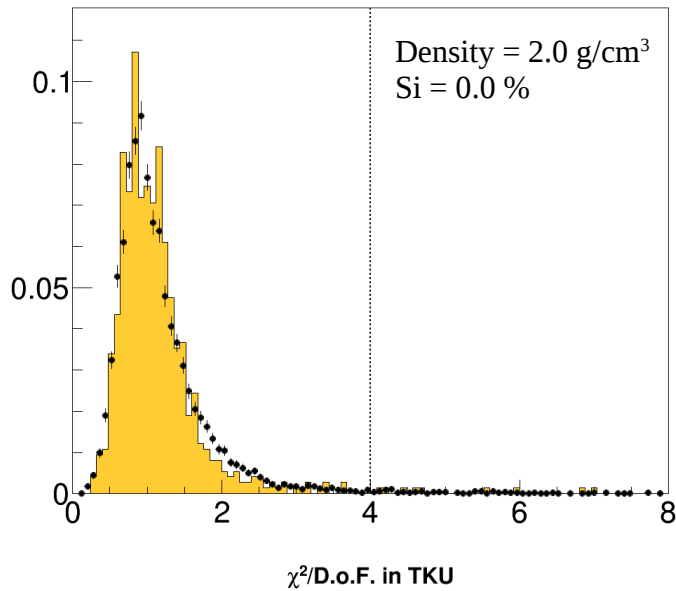
Efficiency (4-140)



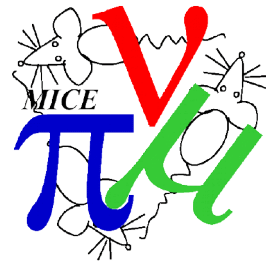
Tracker Density



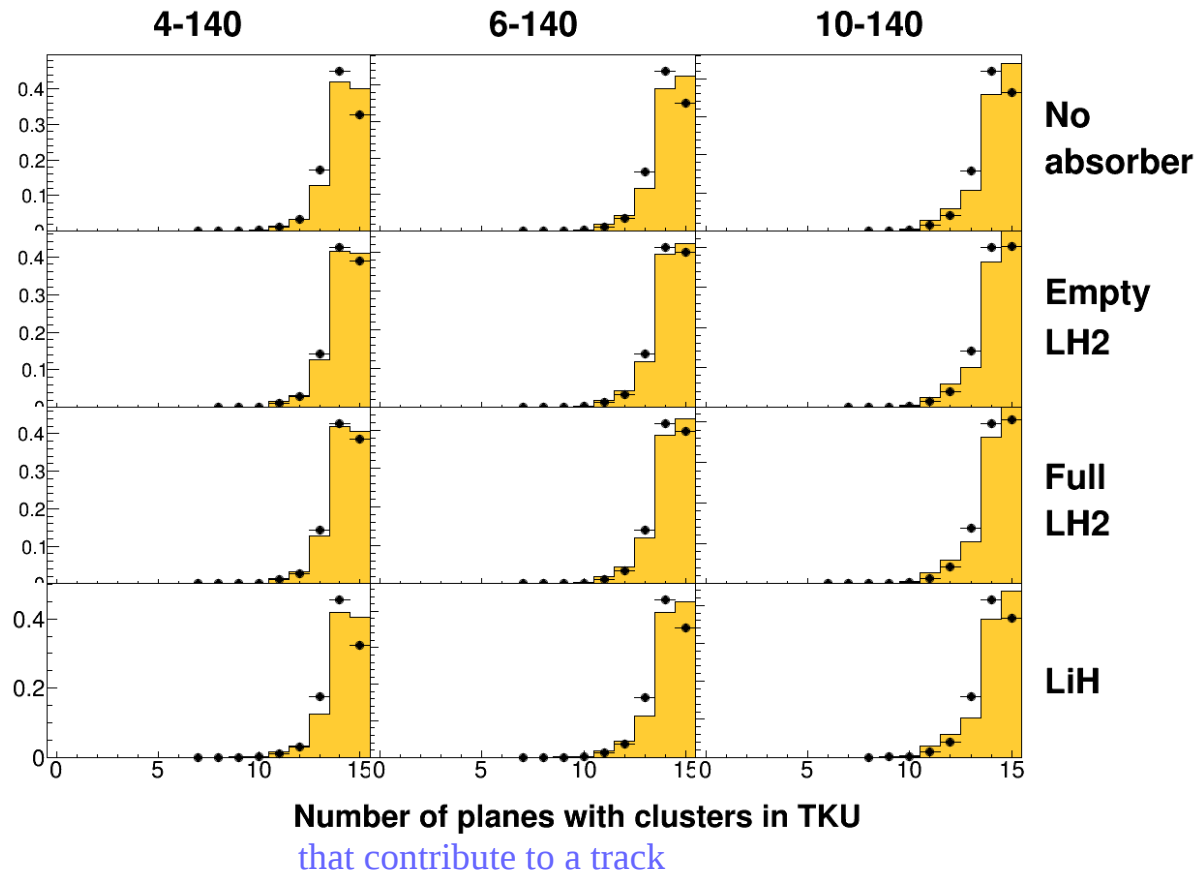
- Plan is to measure tracker density and Si content
- Check in MC shows not too much sensitivity...



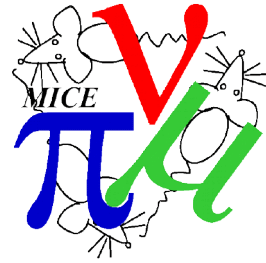
Tracker Clusters



- Understood source of excess TK clusters in data
 - Insufficient noise in MC
 - Noise does not contribute much to resolution
 - Working to fix MC noise anyway for later publications

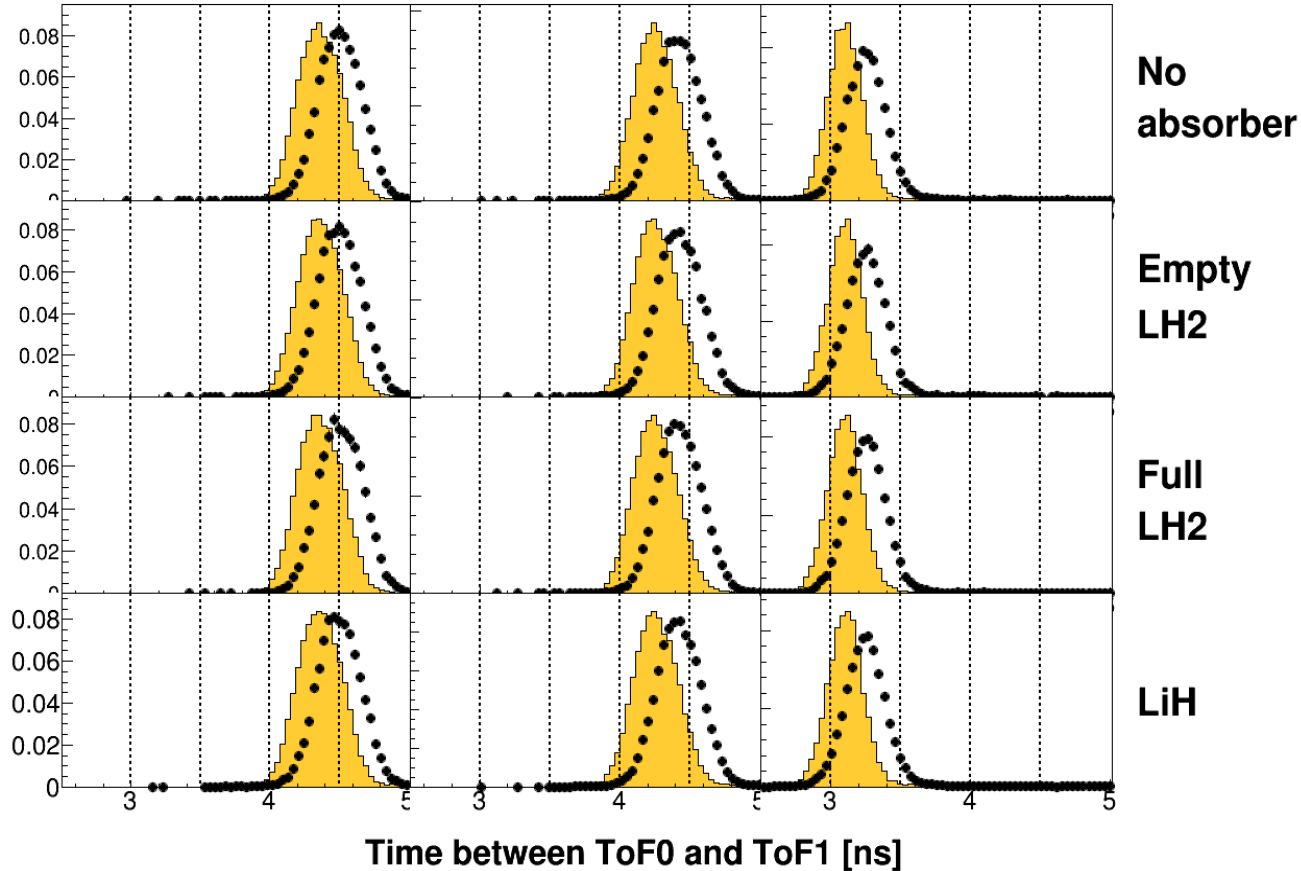


TOF01

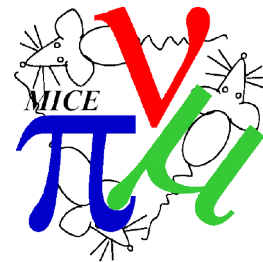


- Systematic TOF offset in MC (100 ps ~ 1 MeV/c)

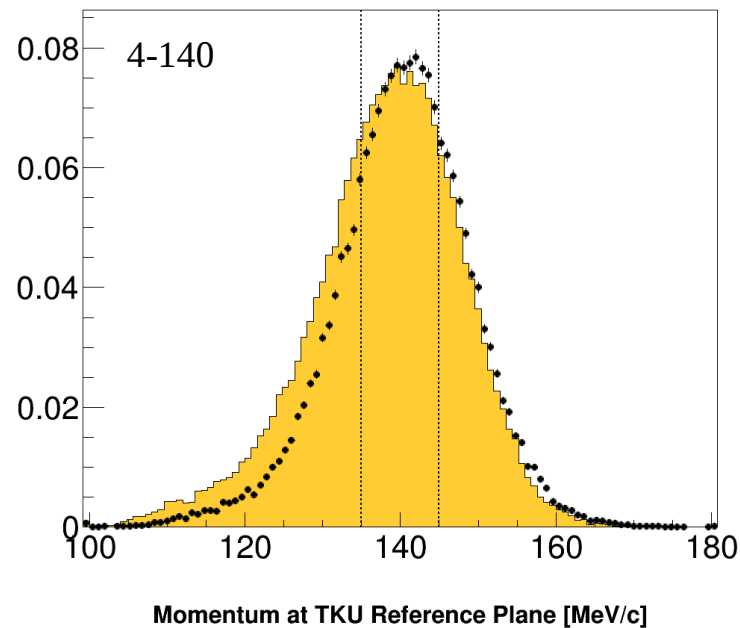
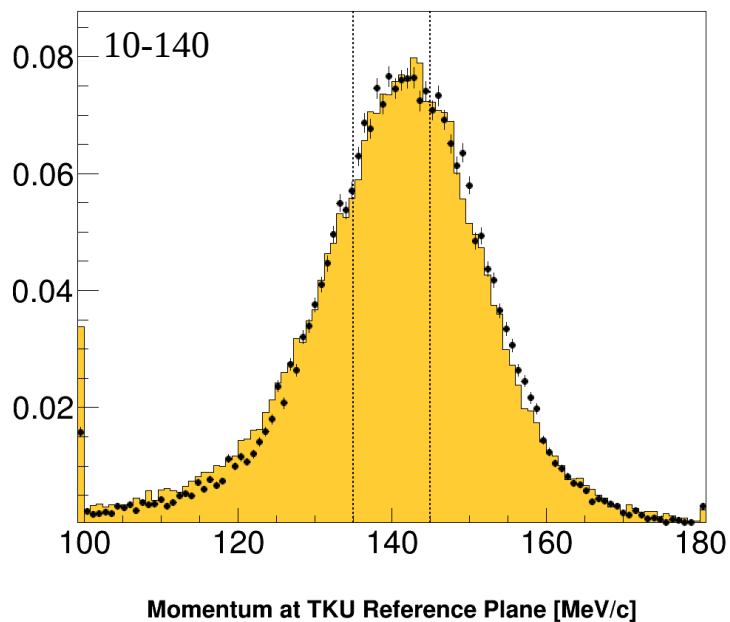
Data: Mean: 4.51 ns	Data: Mean: 4.43 ns	Data: Mean: 3.25 ns
MC: Mean: 4.37 ns	MC: Mean: 4.26 ns	MC: Mean: 3.10 ns
RMS: 0.16 ns	RMS: 0.16 ns	RMS: 0.16 ns
4-140	6-140	10-140



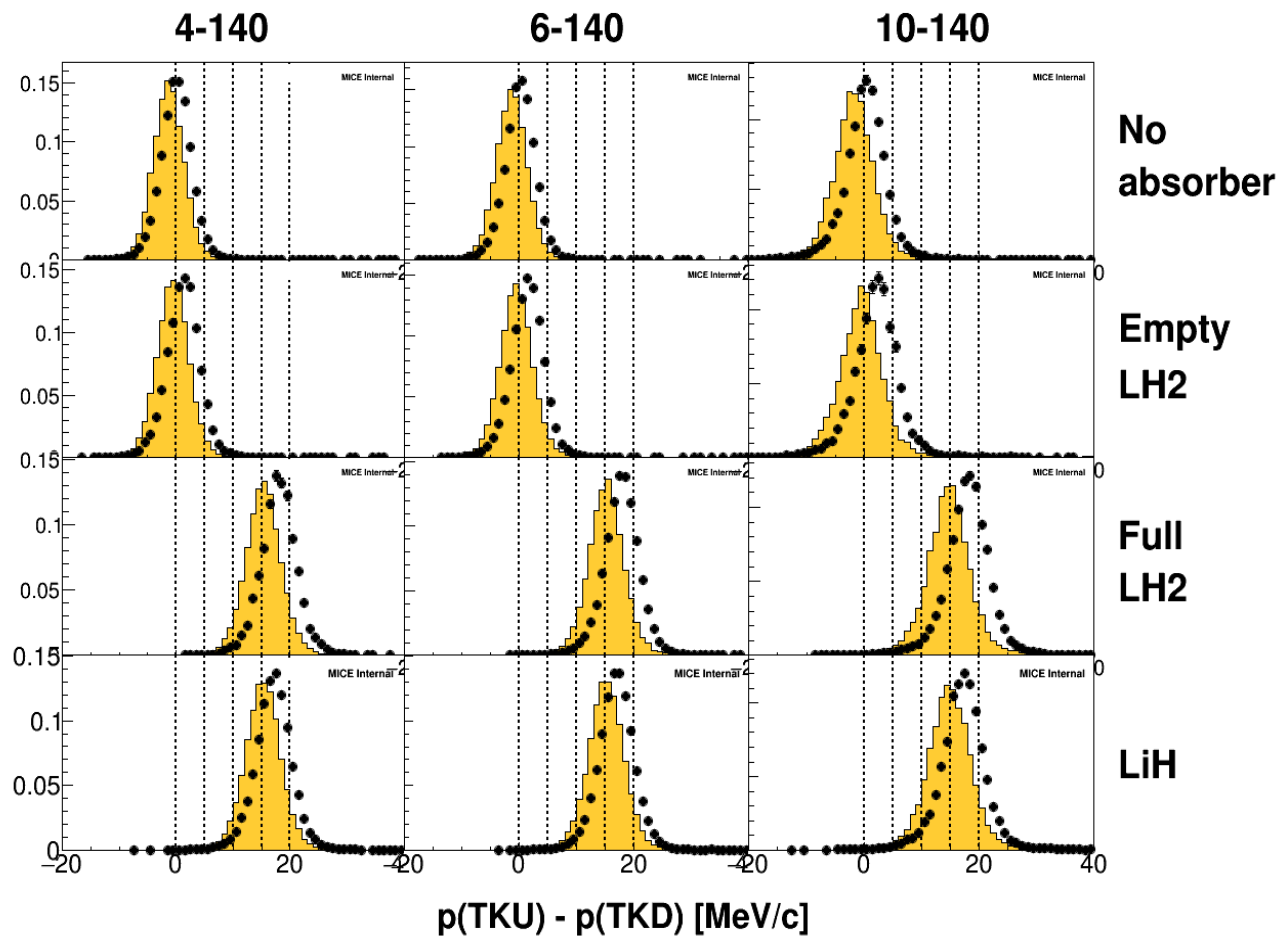
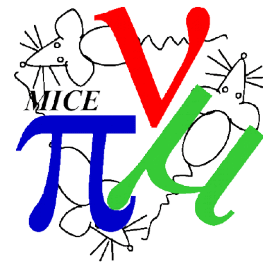
Beam Momentum



- Low momentum excess in MC
 - Worst for 4-140 setting

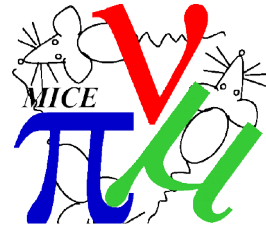


Beam Momentum



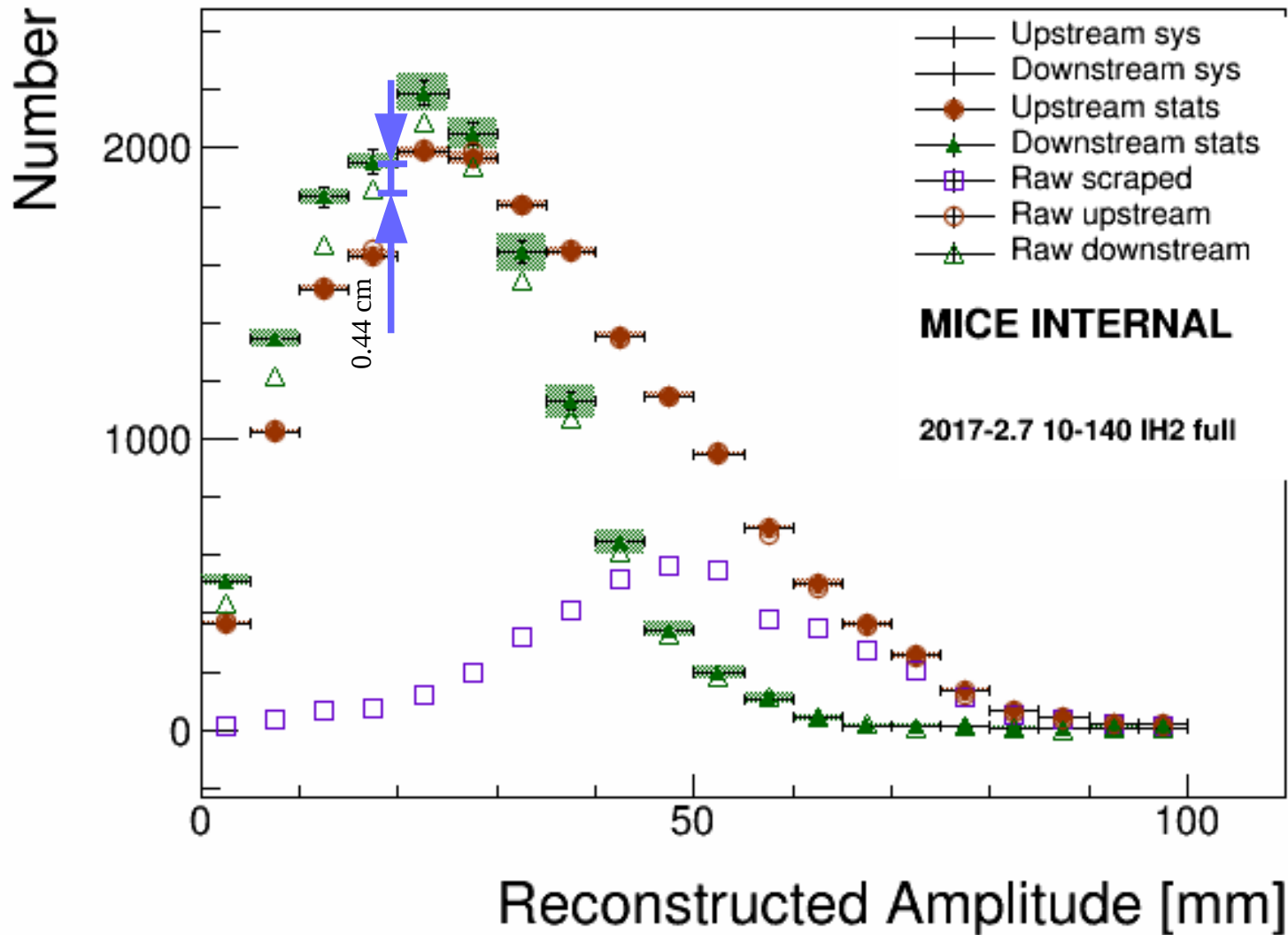
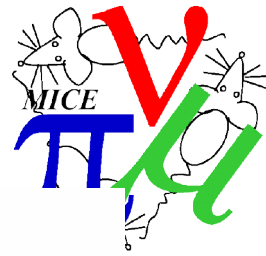
140 MeV/c Muons lose 0.7 MeV/cm in Al
3.0 MeV/cm in LiH

Amplitude

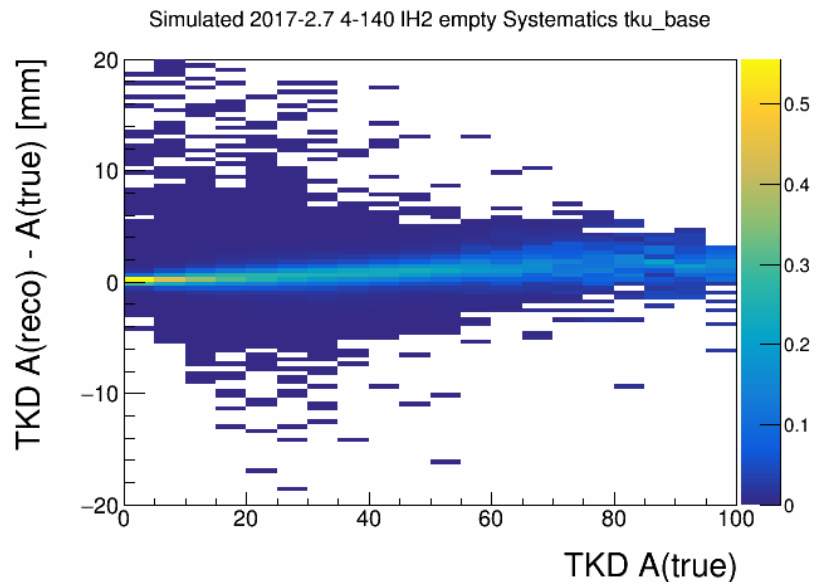
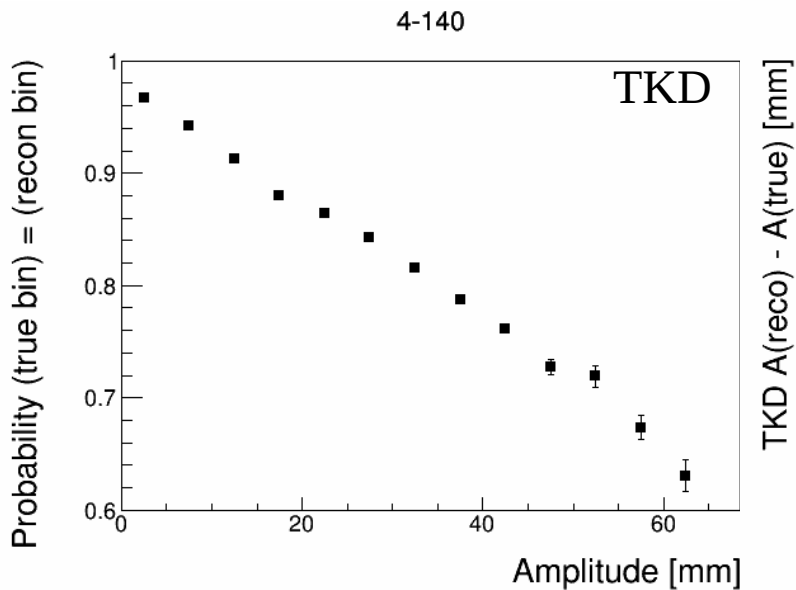
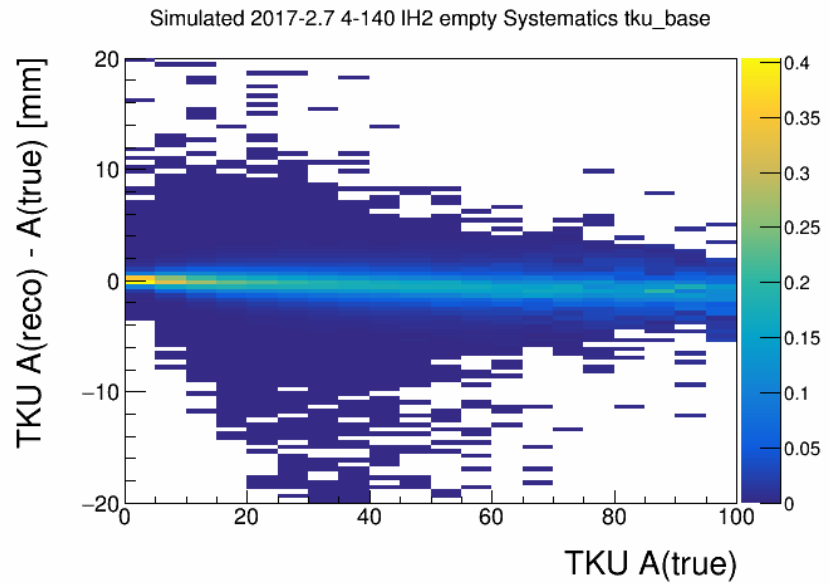
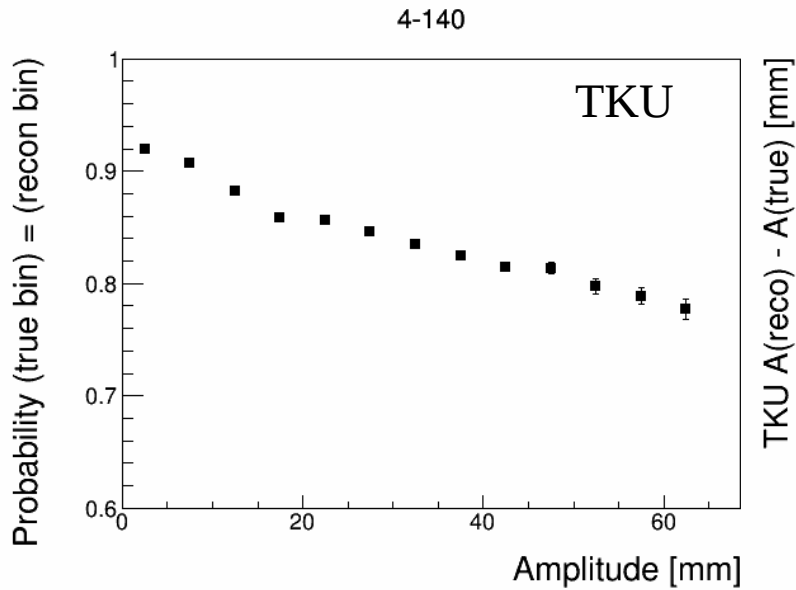


- A few outstanding issues
 - Few % “bump” in amplitude resolution for 10-140 setting
 - Not clear what is the origin
 - It is a small effect (few % feature in $\sim 5\%$ correction)
 - Low amplitude correction seems too much in data
 - But okay for MC
- Introduced new class of systematic uncertainties
 - Uncertainty in cooling channel performance
- Seek to include Francois's density analysis

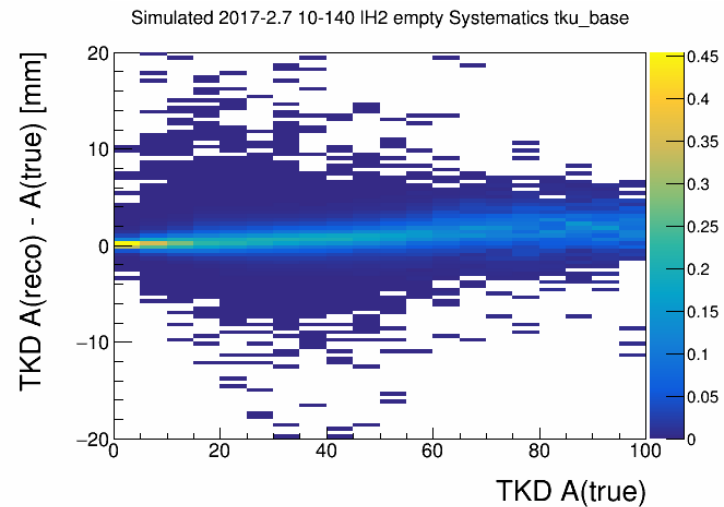
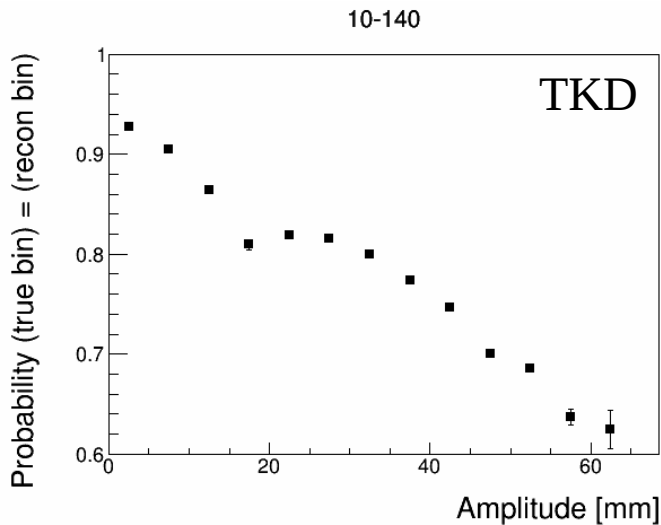
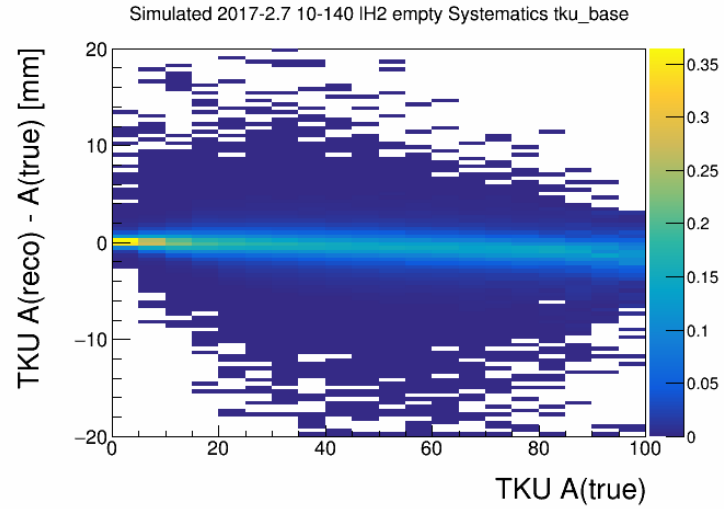
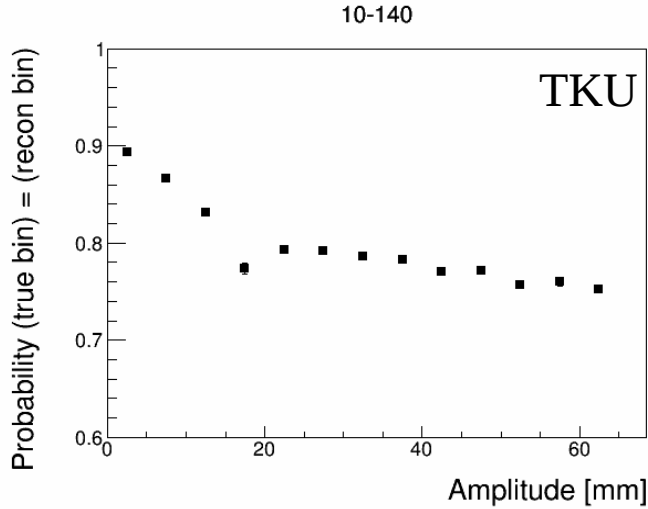
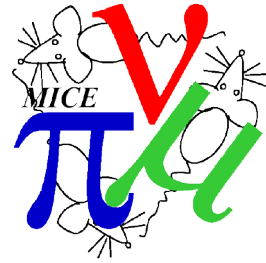
Example pdf



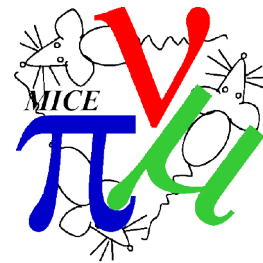
Amplitude resolution: 4-140



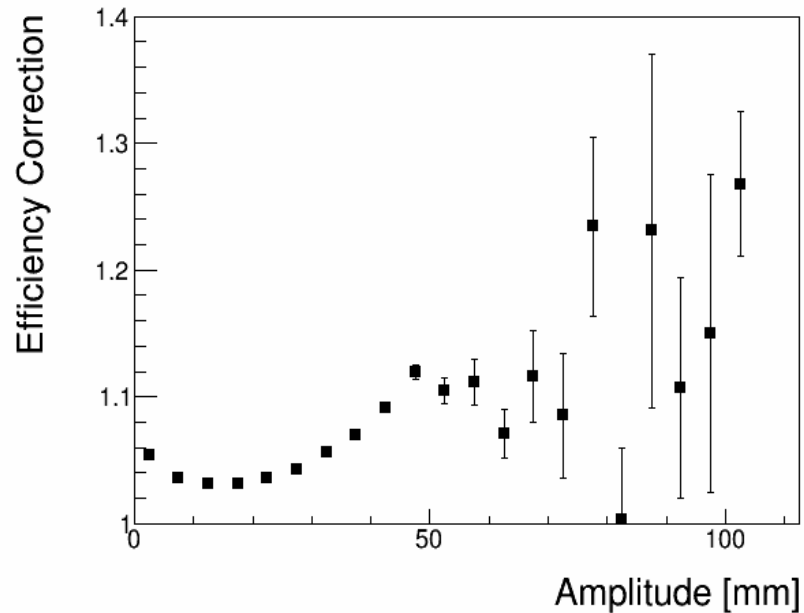
Amplitude resolution: 10-140



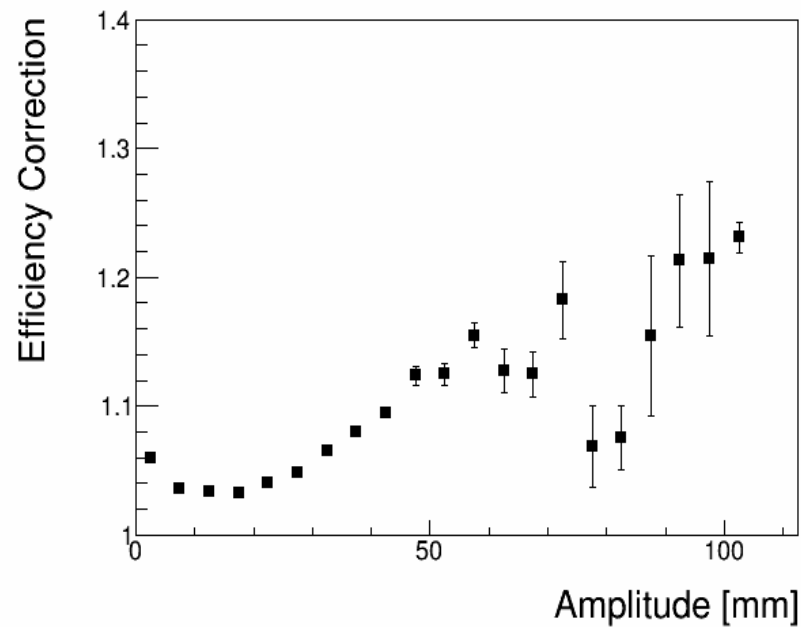
Amplitude efficiency correction



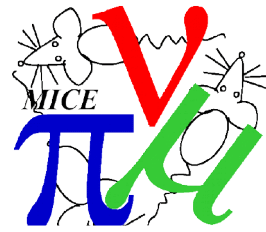
4-140



10-140



Detector Systematic Correction

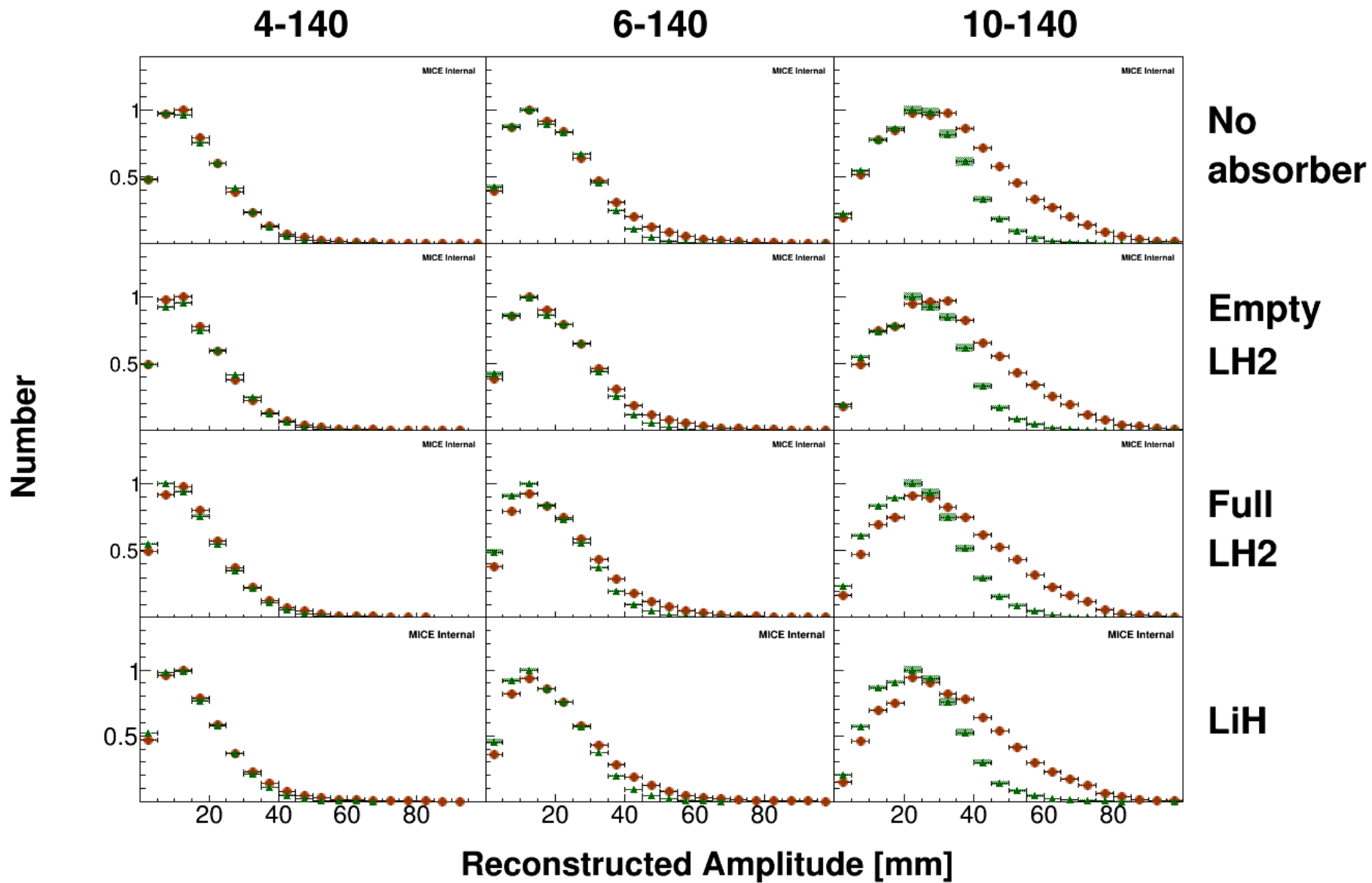


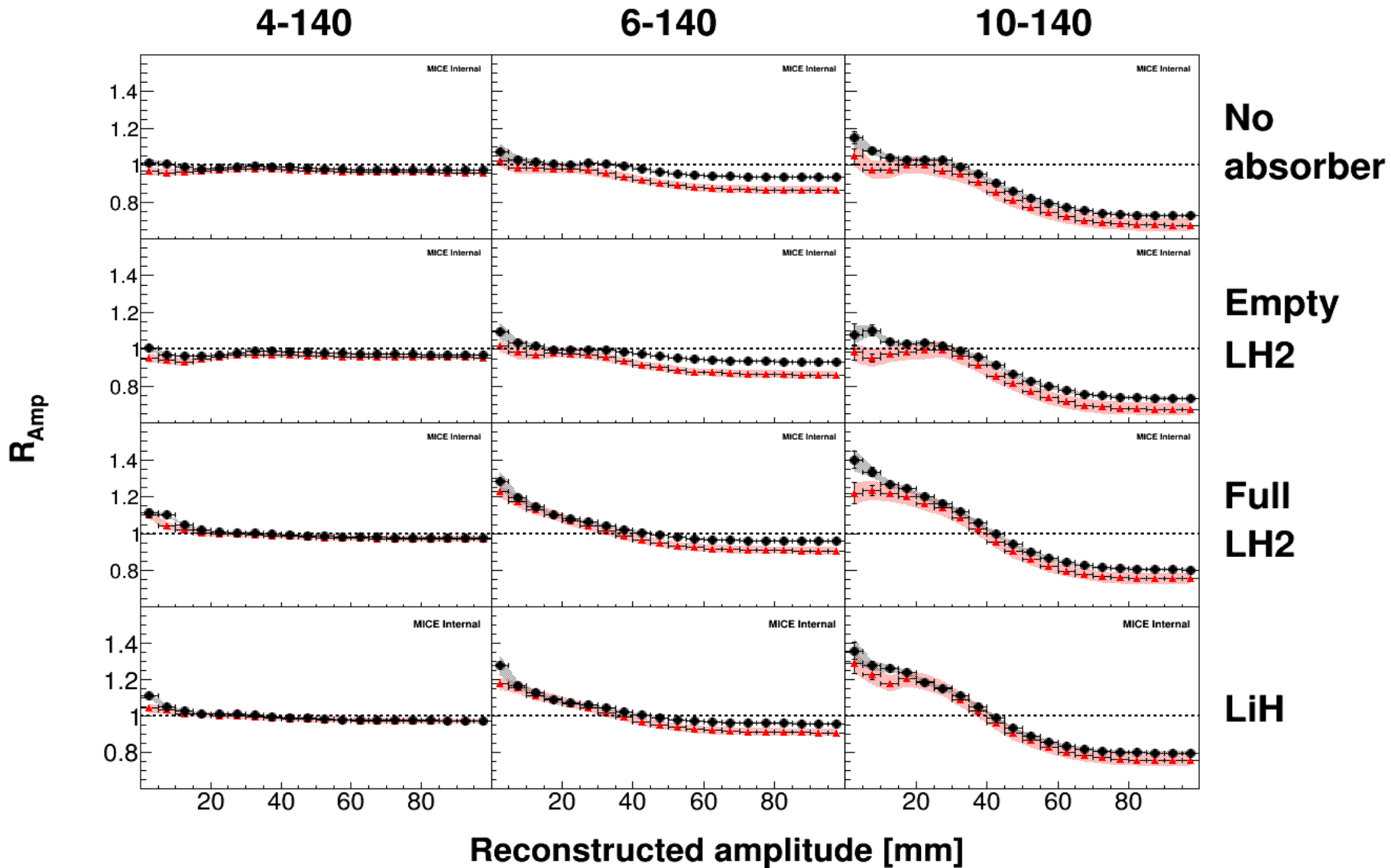
- Correct for detector inefficiency and resolution
- Detector systematics → uncertainty on these corrections
- For each of TKU and TKD reconstruction
 - 3 mm position offset
 - 3 mrad rotation
 - 3 % increase in E1 scale
 - 5 % increase in CC scale
 - 3 % increase in E2 scale
 - 50 % increase in glue density
- Look at effect on “correction” matrices and apply

Performance Systematic Correction



- Add a new class of systematic uncertainty - “performance” systematic
- E.g. say we underestimate the absorber thickness
 - → underestimate the migration towards the beam core
 - → Overestimate the number of events in high amplitude bins
 - → Underestimate the number of events in low amplitude bins
- Can consider the effect on number of events in each bin in TKD
 - but they are correlated
- Instead consider uncertainty on migration between bins
- Sources of systematic uncertainty on performance
 - For MC
 - SSU M1 and M2 misplayed by 1 %
 - FC misplayed by 1 %
 - SSD M2 misplayed by 1 %
 - beam offset by 3 mm in x, y and 3 MeV/c in p_x , p_y , p_z
 - absorber thickness increase from 0.0704 to 0.0728
 - For recon
 - χ^2 cut in TKD from 4 to 4.3
 - fiducial radius in TKD from 150 to 148



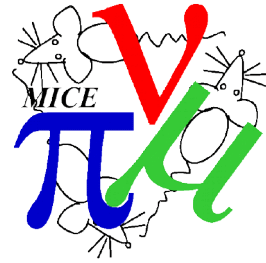


Overestimate in data/1st bin?

Leads to systematically too-good performance in data?



To Do



- All of the problems are covered by systematic uncertainties
 - Need a bit more detail here
- Investigate inefficiency in first bin
 - Could it be inefficiency in MC but not data?
- Investigate amplitude resolution bump
 - This is sub % effect
- Waiting for Francois to add in his analysis
 - I don't want to get hung up on this