Update on the Long Emittance Paper

C Hunt

MICE CM53

21-02-2019

Imperial College
London

Goal Of The Paper

To provide a comprehensive analysis of the MICE data comparing the "cooling performance" of the LH2 and LiH absorbers, with the no-absorber scenario, across a range of beta functions and momenta.

Feel free to comment...

Current Status

- Most of the analysis techniques are ready - need to finalise a sub-emittance parameter to use,
- Found the missing data sets, just need to do a final pass to see if any are missed,
- Plotting routines are nearly finished and applied to all stages of analysis,
- Beamline Monte Carlo is now up and running, although Grid processing is being considered,
- Hybrid Monte Carlo routines are being well tested and ready to go.

The Data

Using data from 8 different channel settings: 2017-02-1 to 2017-02-8.

And $\approx$ 10 beamline settings,

which use 5 different diffuser settings, 0, 3, 4, 8 and 15,

producing 4 different nominal emittances, 3, 4, 6 and 10 mm.

Then there are the 4 different absorber settings:
LiH, LiH-empty, LH2 and LH2-empty

Upwards of 2000-3000 runs in total.

Will be combining, analysing and comparing all datasets.
Still need to add the last LiH datasets.

Full Simulation

Will split simulation into two phases: Beamline models and channel models.

- Require a beamline model to analyse the systematic uncertainties in the cuts for all beamline combinations, (TOF, banana-plots, chisq, diffuser radius, etc),
- We don't need to do this for all the channel settings - the different cooling channel settings all use the same beamline settings,
- Need to finish comparing the cuts-data from all the different channel settings to validate this assumption.

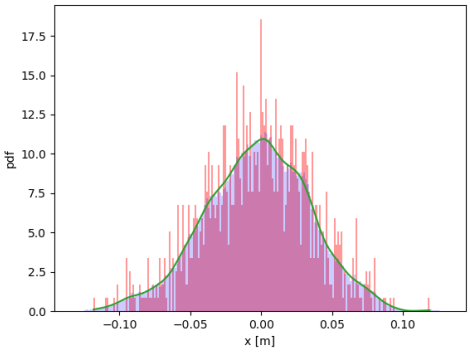
Hybrid Monte Carlo

For the cooling analyses, everything downstream of the cuts, we will use a hybrid Monte Carlo for a speed improvement.

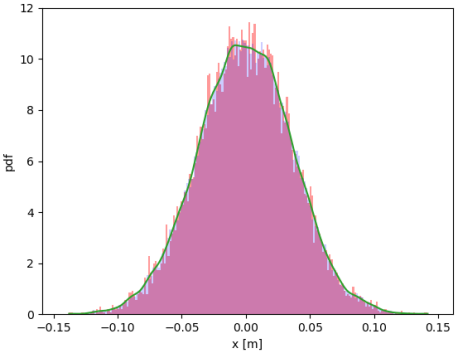
- Have KDE-based resampling algorithm to produce independent beams, with the same parameters as data for use in hybrid MC,
- Paul is currently looking at the systematic uncecrtainties in this method - there is some broadening of the distribution due to the KDE method, we are hoping to minimize this with the right choice of Kernel.
- Allows for the sampled beams from all cooling channel and absorber settings to be simulated more efficienctly

Beam Resampling - Paul Jurj

Take a real muon beam -> Fit with KDE -> Resample.



1k Muon-Parent



10k Muon-Parent

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The Analysis

I've selected plots from some of the settings to highlight the cuts and the selected beam distributions.

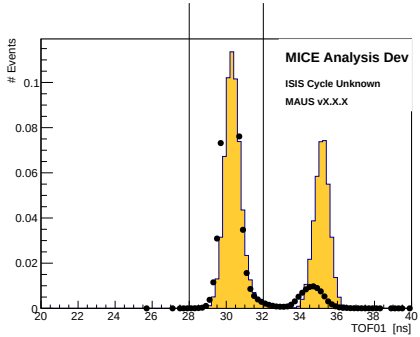
These are updated from the VC.
Using only 4 of the 74 current datasets.

I'm still working on the comparison matrix-plots we've seen before.

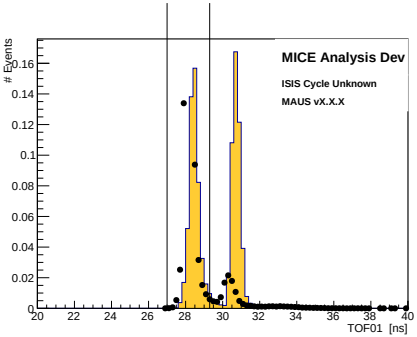
These are *very* fresh!
There are many incosistencies that will be chased up.
Now we get to see the scale of the work.

TOF01 Time

LH2 2017-02-1 3-140+M3-Test3



LH2 2017-02-2 3-200+M3-Test2



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TOF01 Time

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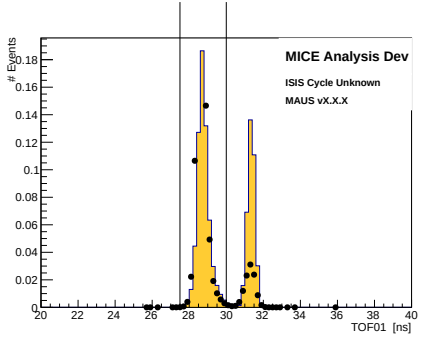
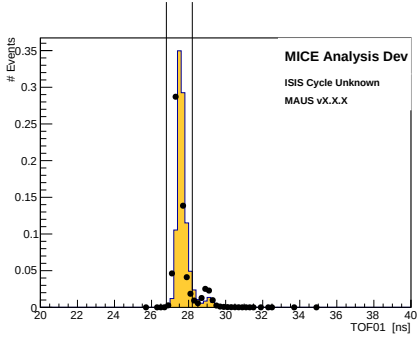


LH2 2017-02-2 10-200+M3-Test1



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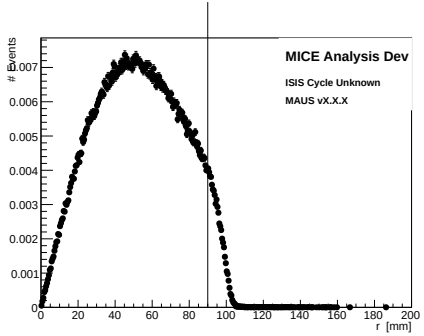
Diffuser Aperture

LH2 2017-02-1 3-140+M3-Test3



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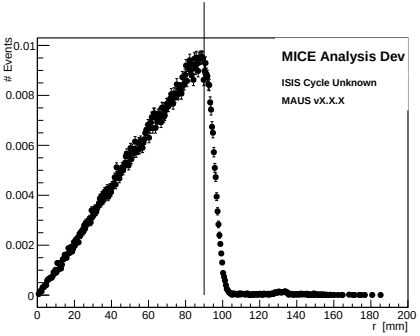

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Diffuser Aperture

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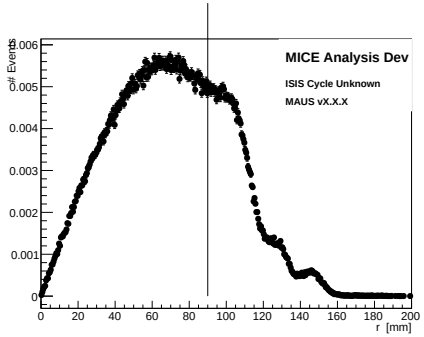
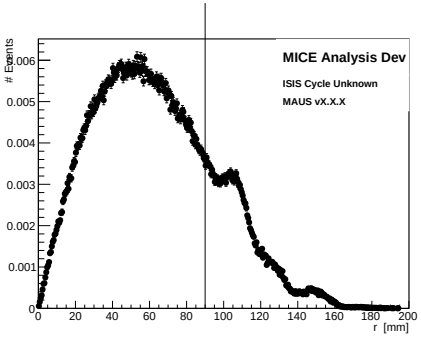


LH2 2017-02-2 10-200+M3-Test1



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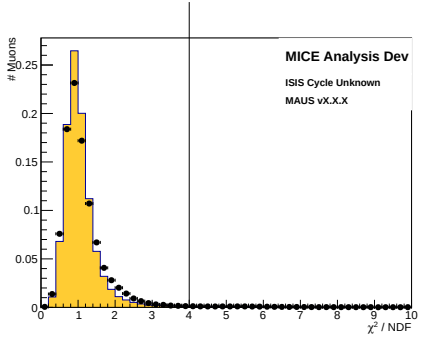
SciFi Chisquare

LH2 2017-02-1 3-140+M3-Test3



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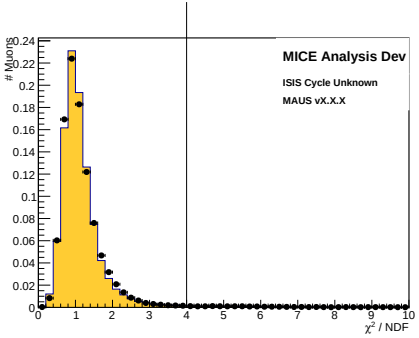

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SciFi Chisquare

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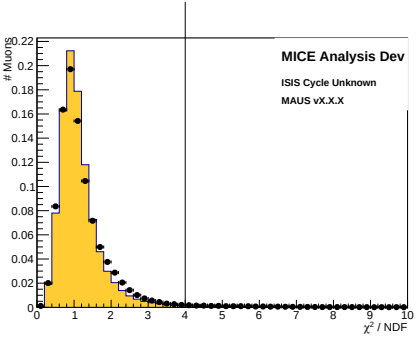
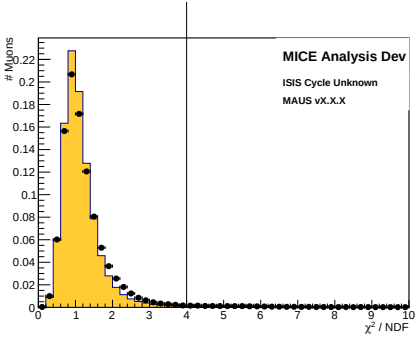


LH2 2017-02-2 10-200+M3-Test1



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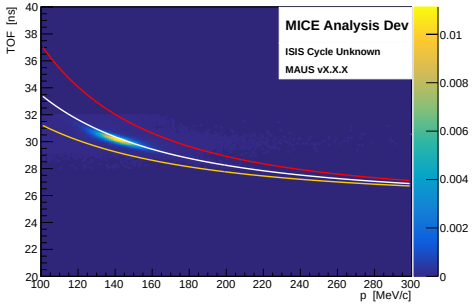
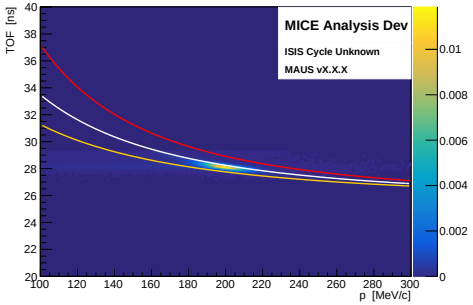
Banana Plots

LH2 2017-02-1 3-140+M3-Test3



LH2 2017-02-2 3-200+M3-Test2



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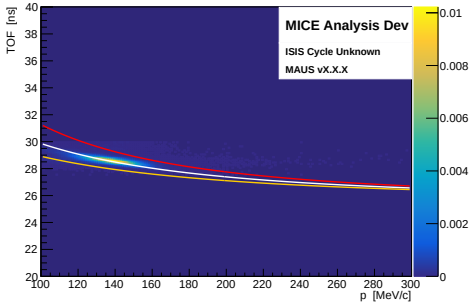
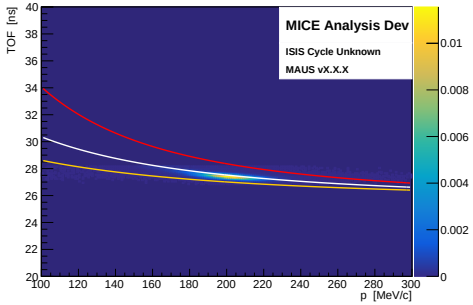
Banana plots

LH2 2017-02-1 10-140+M3-Test4



LH2 2017-02-2 10-200+M3-Test1



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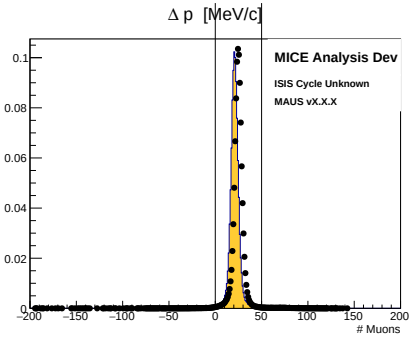
Banana Mass

LH2 2017-02-1 3-140+M3-Test3



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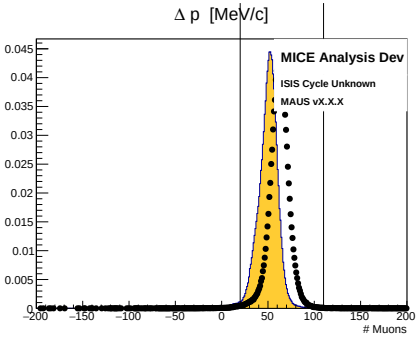

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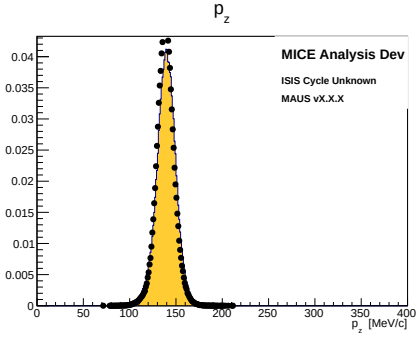
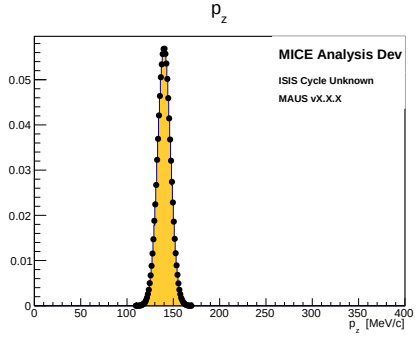
Momentum Selection

These beams have used a KDE sampling method to select the momentum
140 ± 3.5 MeV/c

LH2 2017-02-1 3-140+M3-Test3





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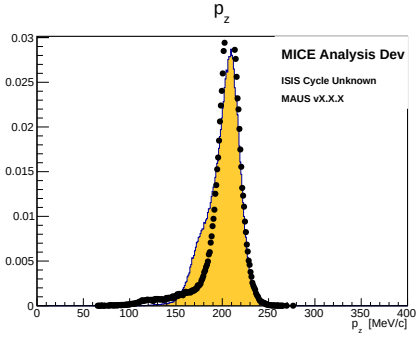
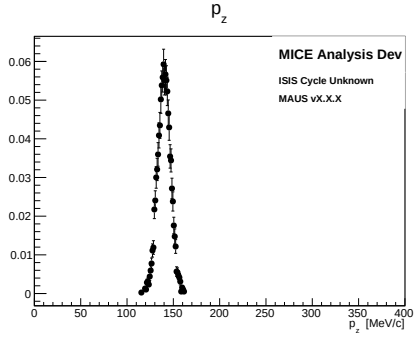
Momentum Selection

These beams have used a KDE sampling method to select the momentum
140 ± 3.5 MeV/c

LH2 2017-02-2 6-200+M3-Test1





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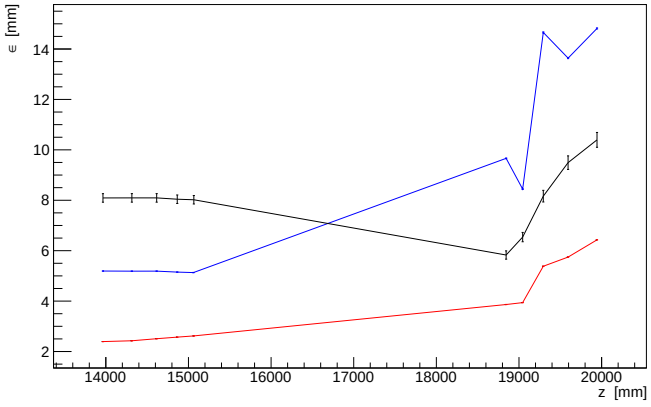
The “Dumb” Analysis

With everything we have we can do a very quick analysis of what the beams are doing.

Not for critical analysis. This is a sanity check!

Sanity Check 1

3mm 6mm and 10mm beams through the cooling channel.



We're seeing the beams as we expect.

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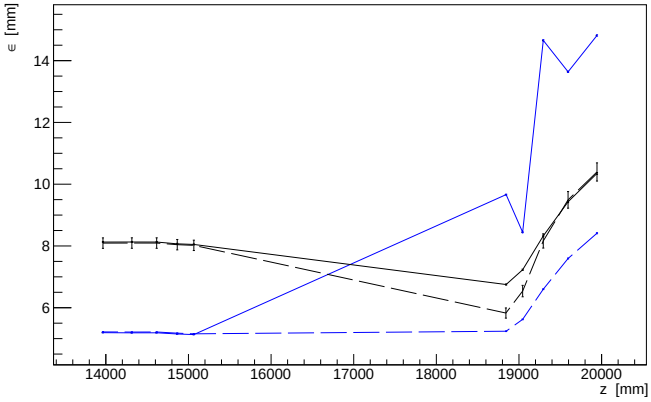
Sanity Check 2

6mm and 10mm beams WITH and WITHOUT LH2.



The absorber has an effect - but it is an unmatched beam!

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Next Steps

- Coming along quite quickly now,
- Plotting routines, MC generation and analysis are all ready to go,
- Adding on layers of analysis - next job is hybrid MC for all channels,
- Need to calculate processing time and look at using the Grid,
- Need to push the data through to the cooling analysis,
- Missing the fiducial radius cut.