Update on the Long Emittance Paper

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Introduction

- The focus is now shifting from Chris' paper over to mine,
- Until now I had developing the routines required for beam selection, which are quite stable now,
- Started to focus on producing high quality plots for the note and paper, following the last analysis workshop,
- This is an overview of what I've managed to acheive during the last two weeks.

Some Caveats

- There was an error in my personal lookup table for analysis runs - I don't have all the data included yet. That will change next week!
- I vastly underestimated the effort required to analysis and plot the results for so many cooling channel, beamline, diffuer and momentum settings. Bureaucracy is quite complicated.
- Although the software exists to do so, the end analysis has not been finished yet. I've been working on the cuts, combination routines and MC generation.
- I've been struggling to produce all the Monte Carlo due to a surprise bad allocation error. There is not Monte Carlo in this presentation yet unfortunately.

The Data

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

And 7 to 8 beamline settings,

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

producing 4 different 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.

Hardest part is finding the best way to combine all the combinations to generate useful and concise plots.

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 - this saves some energy,
- Just need to compare the cuts-data from 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

The Analysis

I've selected plots from some of the settings to highlight the cuts and the and the resultant selected beam.
These should all be standard.

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

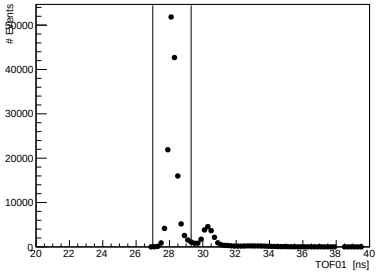
Diffuser Radius

UNDER CONSTRUCTION

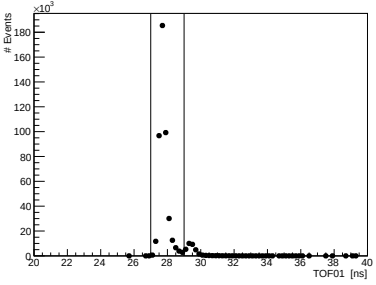
Having an issue. It does work, just didn't make it in time for this presentation.

TOF01 Time

2017-02-3, $p = 200\text{MeV/c}$, $\epsilon = 3\text{mm}$



2017-02-2, $p = 200\text{MeV/c}$, $\epsilon = 6\text{mm}$



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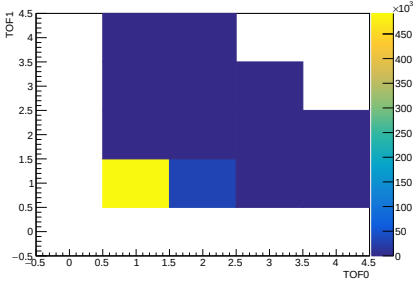
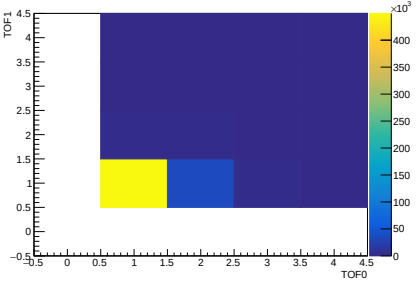
TOF01 Spacepoints

2017-02-6, $p = 140\text{MeV/c}$, $\epsilon = 6\text{mm}$



2017-02-2, $p = 200\text{MeV/c}$, $\epsilon = 6\text{mm}$



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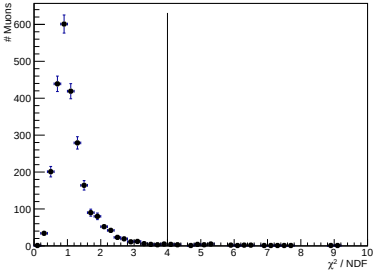
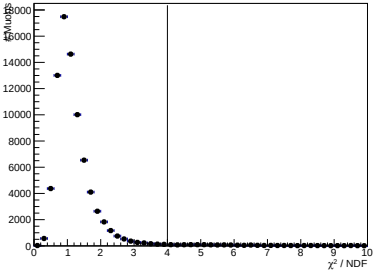
Upstream SciFi χ^2/NDF

2017-02-1, $p = 140\text{MeV/c}$, $\epsilon = 3\text{mm}$



2017-02-4, $p = 240\text{MeV/c}$, $\epsilon = 3\text{mm}$



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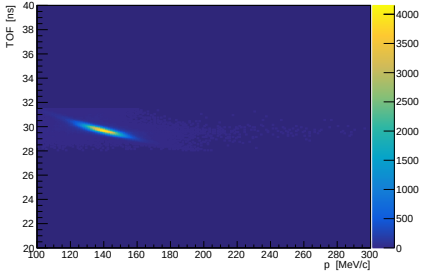
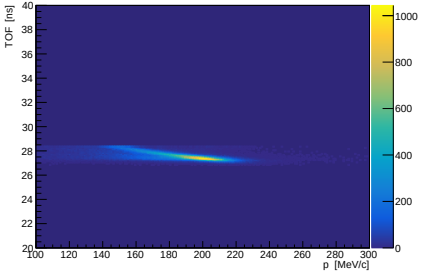
Banana Plots

2017-02-4, $p = 140\text{MeV/c}$, $\epsilon = 6\text{mm}$



2017-02-8, $p = 170\text{MeV/c}$, $\epsilon = 10\text{mm}$



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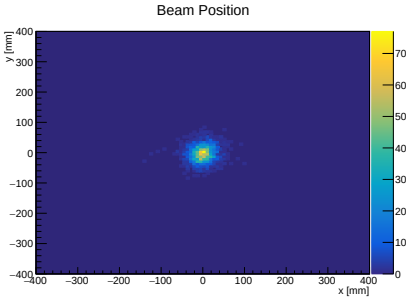
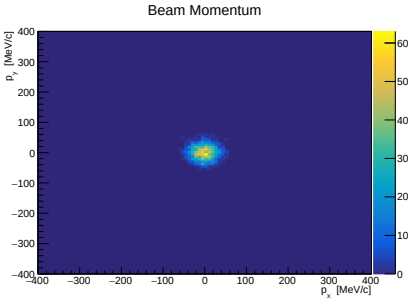
Beam in Upstream Tracker

2017-02-1, $p = 140\text{MeV/c}$, $\epsilon = 3\text{mm}$



2017-02-1, $p = 140\text{MeV/c}$, $\epsilon = 3\text{mm}$



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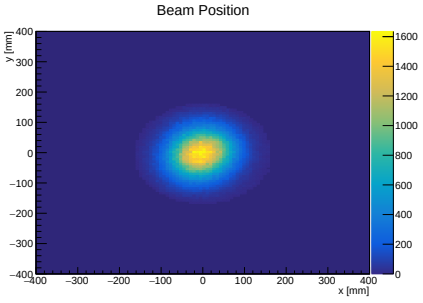
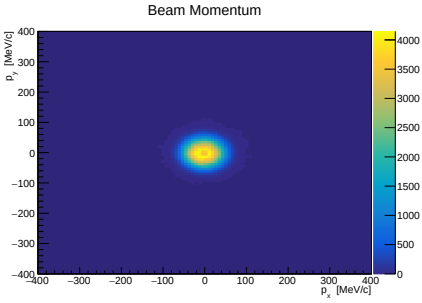
Beam in Upstream Tracker

2017-02-4, $p = 140\text{MeV/c}$, $\epsilon = 10\text{mm}$



2017-02-4, $p = 140\text{MeV/c}$, $\epsilon = 10\text{mm}$



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Current Status

- This is the first time I've attempted to analyse the entire dataset. The bugs are now being found!
- I don't have backup plots to swap in at this stage - it takes several hours to run through the all the analyses, hence we are still quite light on plots.
- Beam selection routines are in a run as standard - plots currently being produced.

After these stages, the different emittance settings are combined within each cooling channel setting - this provides the beam selection routines with the full statistics to sample with.

Next Steps

- Need to fix the database I have of the run numbers - include those missing runs!
- The plotting routines are nearly finished, just fixing the last few bugs with the matrix-plots,
- Going to include a fractional-emittance algorithm analysis,
- Need to start mapping out the paper as the plots come are produced to see what's missing.

Stayed tuned for the CM!