Progress on Beam Selection Routines and Analysis

C Hunt

September 7, 2017

Contents

Introduction

- Things have not been as smooth as I would have liked...
- A lot of time has been spent assisting Jaroslaw and Chris to analyse discrepancies between different approaches to design magnetic settings.
  The sensitivity of the settings to LH2 geometry is seemingly quite significant.
- I've been investigating differences between different MC studies and between MC and Data.
- Nailing down the field uniformity systematic effect is also not seeing agreement between MC and Data.
- At the moment nothing quite agrees as well as I was hoping.

Aims for NUFACT

- To demonstrate the recent results that have been made public,
- To outline the current developments in the analyses that will hopefully bare fruit soon,
- To be able to demonstrate some of these developments with MC data.
  e.g. An emittance scan using beam selection - demonstrating heating and cooling.

That last one has caused me the most trouble.

Recent Efforts

- I have been working on a beam selection analysis for some months now (when I have time)
- It has previously only been applied to data - MC is only required to verify the emittance residuals.
- Data was looking promising: we were approaching a region of phase space with good transmission and a distinct cooling signal - but this is far from finished.
- So run some MC studies using settings that should be identicle to the 4 primary configurations we have data for.

Recent Efforts

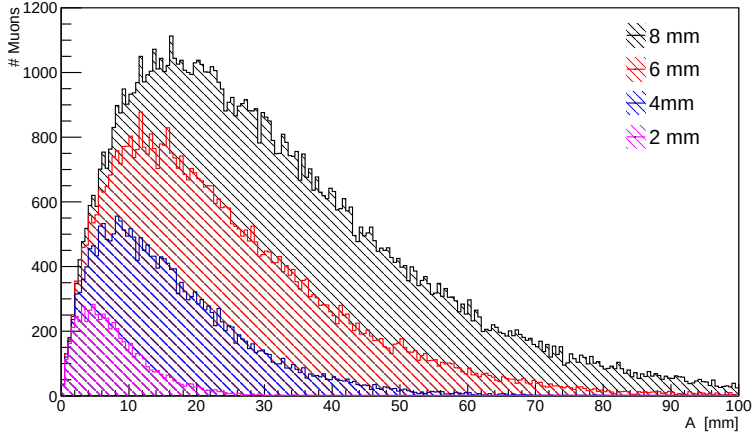
The proceedure:

1. Create MC geometries for each of the settings required,
2. Simulate a huge beam (12mm) with a lot of muons for each setting,
3. Perform beam selection at the upstream reference plane for emittances between 1 mm and 10 mm,
4. Analyse reconstructed tracks upstream and downstream to calculate emittance change and transmission,
5. Compare the different settings to see which performs optimally,
6. Compare with the respective data sets to see how close we are!

Some Results

Selected Amplitude Distributions

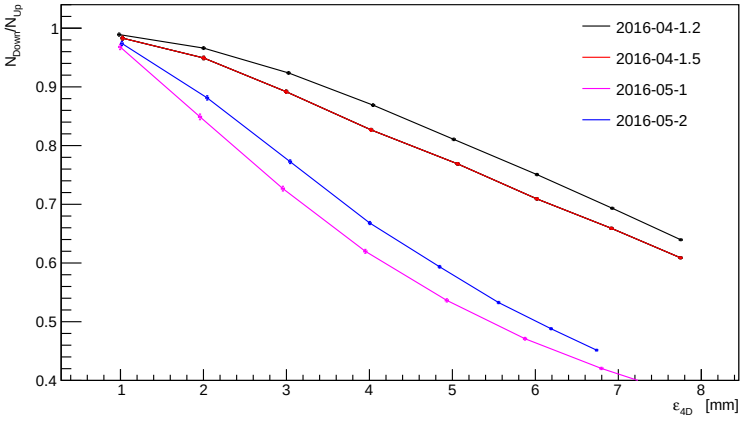
2016-04-1.2



Still working out the fine details (The parent distribution doesn't fit on the plot. . .)

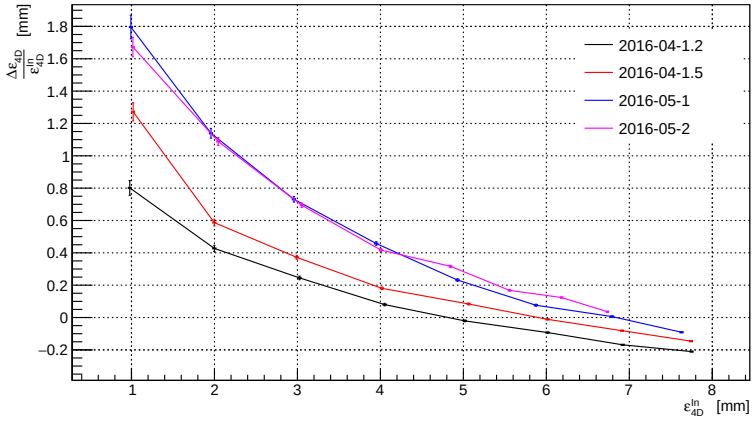
Some Results

Transmission For Different Settings



Some Results

Fractional Emittance Change For Different Settings



Analysis

We can note that:

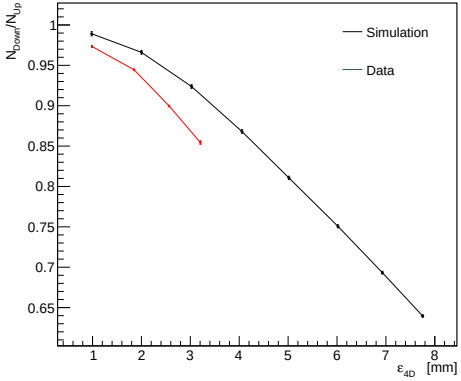
- The setting: 2016-04-1.2 appears to perform the best.
- Both optimal transmission and emittance reduction
- I believe this is the setting that was the favourite during their original creation.

So everything appears to be working well - and needs some more rigorous tests.

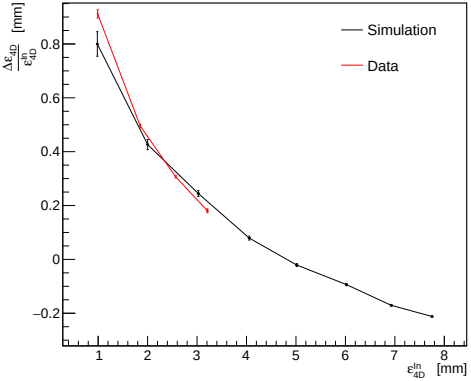
The following analysis is very preliminary, will not be presented at NUFACT.

Analysis

A (Brief) Comparison with Data



Transmission



Emittance Change

Analysis

- There is clearly a significant difference between Data and Simulation.
- Currently verifying against some batch MC to see which is closer.
- Analysis of MC Truth indicates the reconstruction is working very well.
- Current belief is that the initial beam conditions are causing the discrepancies.

Different diffuser settings change the (dis)agreement between Data and Simulation. The Simulation assumes a matched beam - however I have the framework to use MC to propagate a real beam. This will hopefully start to close the gap.

Conclusions

For NUFACT:

- I would like to present the MC Study.
- I think it highlights how much phase space we have to probe and our ability to demonstrate more than just a single measurement - in addition to a clear cooling signal.
- The apparent difference between the study and reality is still a worry however.

For the Analysis Group

- After NUFACT, hopefully have more realistic beam conditions,
- Use Data to seed the Simulation.