Comprehensive Cooling Paper

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MICE CM51

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Imperial College
London

Contents

Conceptual Description

"A comprehensive analysis of ionization cooling within the MICE Cooling Channel."

- Show that MICE has succeeded and is good agreement with the simulation,
- Precise and well understood systematic corrections,
- Small systematic errors,
- Use all relevant data, minimize statistical errors,
- Demonstrate comparisons of emittance, beta, momentum, etc
- Provide the information required to build a cooling channel?

Current Status

- Recently started and depends on the outcomes of previous analyses,
- The required (un)lucky key people have been identified and introduced to what's coming,
- Had the first meeting two weeks ago and a session at the analysis work shop.
- Looking at defining the key plots and the data sets required,
- The required improvements in analysis have been mostly finalised,
- Just need to get the work done.

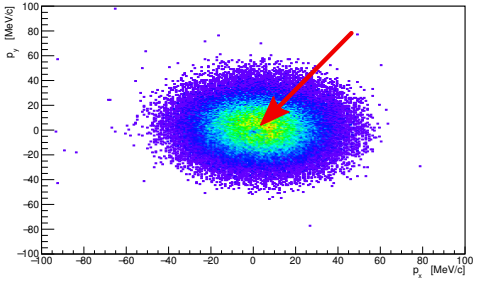
Ongoing Work

A brief look at the current activities that are of key interest.

Data Sets and Presentation

- Need a parameter to describe each unique run configuration - equilibrium emittance/delta emittance at 6mm/integrated amplitude change/etc?
- Want plots to show performance from different points of view with as many different settings as possible with comparisons to theory.
- Compare different values of:
  - Absorber beta-function
  - Initial emittance
  - Initial momentum
- Combine data sets with identical cooling channel settings - rely on sampling to provide the relevant beams,

Track Fitting



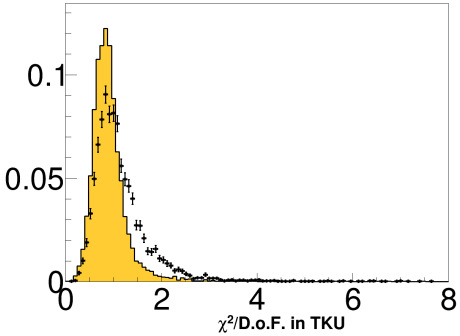
- The "low-$p_\perp$ hole" is a more interesting issue within the emittance reduction analyses,
- Will likely look at reseeding methods, similar to the Emittance Measurement paper, but more like global track-fitting,
- Possible upgrades to the track finding process is possible if required.

Now we have good field maps, uniformity systematics and field integrated Kalman filtering is possible.

Tracker Glue...

Found an interesting discrepancy in the χ^2 values between Recon MC and Data.

- Using an empirical fix at present,
- Conversations with Alan Bross, Chris Rogers and Geoff Barber,
- Geometry is not perfect, believe SiO_2 pearls used to improve flow of glue,
- Glue has higher density and higher-Z materials,
- Have a plan of action to close the loop, just need a worthy candidate...



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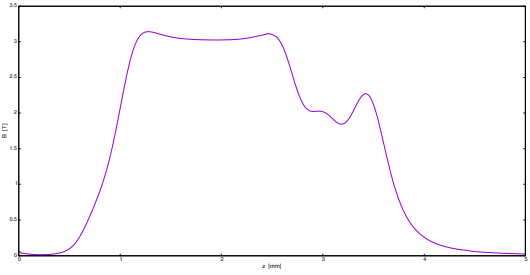
Field Maps

Jo will provide a more detailed update!

One of the key sources of systematic uncertainty is the knowledge of field maps.

- Starting to look at integrating them into MAUS for the Monte Carlo simulations,
- Jo has the ability to generate field maps for certain useful settings, they are being investigated at present,
- Required for the analysis of track fitting systematics - need to tune the alignment and uniformity based uncertainties.



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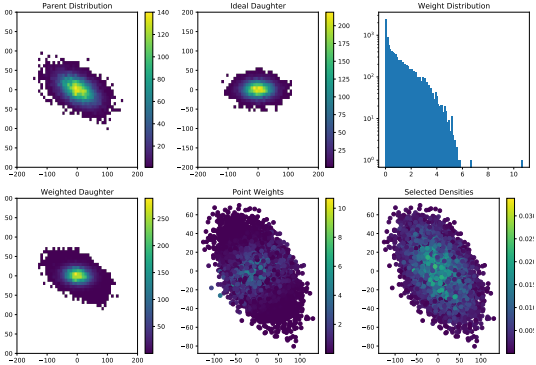
Beam Selection/Weighting

Recently been my main focus.



- Trying to select a 4D distribution that is "matched" in SSU to reduce optical heating,
- 1D and 2D selections turn out to be easy, 4D is a struggle.
- Trying various histogram, paramtetric, and voronoi tesselation methods, with some success.

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Other Activties

- Absorber model

  Provides a theory uncertainty for our comparison - needs understanding. Currently being investigated - can use our own data! See Craig and Ajit's Presentations.

- Optics models and Theory

  Paul is doing very well, model stability and development looking good.

- Amplitude Theory

  Attempt to describe amplitude migration mathematically being considered. Another theoretical validation we can do.

Other Activities

- Beamline Model

  A key component of our MC model. Need to see good agreement between upstream reconstruction and the MC data. See Tom and Paolo's presentations.

- Magnetic Alignment.

  Have an algorithm and a proceedure for the tracker-solenoid alignment. Use global tracking for tracker-TOF alignment, just need the SSU-AFC-SSD alignment.

Going Forwards

What to expect in the next few months.

Example Layout

1. Introduction
2. Measuring Emittance
   - Is this the most precise measurement of emittance ever?
3. MICE
4. Theory
   - MC model, Optics models, Absorber models
5. Uncertainties
   - Stats, alignment, fields, fitting...
6. Beam Selection
   - Routines and results, justification of method
7. Results
   - Need to decide on "*The Plot*", is it only one?
   - Compare theory, MC and data
8. Discussion
9. Conclusion

By The Next CM

- Have the MC Geometry complete, including tracker station construction and new field maps. Tuning that last fraction of a percent may take a little longer,
- Have a beam selection proceedure in place, with knowledge of its limitations,
- First pass analysis of *all* data files, need to identify exactly what we include,
- Have a decent piece of the theory section in hand, maybe the absorber descriptions and a basic optics model - maybe more.
- Implemented the reseeding algorithm for the track fit. Additional upgrades may still follow.
- Detailed plan for the magnet alignment, with results for TKU and TKD. AFC still tricky.

Lots to be getting on with, but we have a lot of analysis in hand and a clear direction.

Stay Tuned!