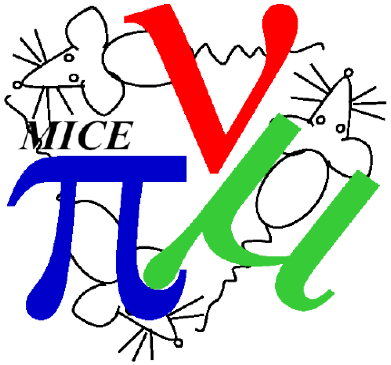
Preparing for Step IV Data Taking



Chris Rogers,
ASTeC,
Rutherford Appleton Laboratory

Plan for Analysis

- The construction project is extremely late
  - We have a very short period to take data in
  - We have lots of data to take
- Data taking will be busy and rushed
  - There will not be much staff for analysis
  - There will be a lot of data flying
- Our jobs depend on “smooth” data taking
  - Funding agencies have made this very clear
- **We must turn around analysis quickly and smoothly**
  - We must have analysis in place before data taking
  - We must have done the analysis in MC before data taking
  - Analysis team during data taking should be dealing with problems, not the basic analysis
- We are late!
  - And the heat is on

Step IV Papers

- For quick release (these are papers):
  - **Description of MICE Step IV**
  - **First observation transverse emittance reduction**
- Slower boil, worthy of a publication, maybe not one per bullet
  - **Diagnostics** MAUS
    - Global track fitting
  - **Magnetics** Beamline integration
    - Measurement of optical emittance growth and non-linearities
    - Direct measurement of the transfer map including higher order terms
  - **Absorber** Absorber
    - Energy loss
    - Multiple scattering in vacuo; dependence on Bz
    - Angular momentum
    - Beam (de)polarisation
    - Wedge
  - **“Cooling Channel”** Analysis
    - (Long, probably following end of Step IV with all results in) Observation of transverse emittance reduction
    - Emittance exchange with wedge

Description of MICE Step IV

- Section headings:
  - Introduction
  - Beamline (Beamline Integration)
  - Magnetic lattice (Magnets/Beamline Integration)
    - Field mapping
  - Description of absorbers (Absorber)
  - Diagnostics (Detectors)
    - Subsection for each detector
  - Readout and software (Computing)
  - Diagnostic performance (Analysis/MAUS)
    - Purity/efficiency of PID
    - Track fitting and resolutions
  - Measurement of magnet alignment (Analysis/Beamline Integration)
  - Quality of transported beam (Analysis)
- No emittance reduction plots
- Highly limited or no MCS and dE/dx plots
- Referencing previous papers on various topics

Plan

- We have section headings
- Will ask named groups to nominate section authors
- Everything up to “Readout and Software” can be written already, referencing existing papers
- Need to develop Monte Carlo/analysis for subsequent sections
  - Propose focus workshop/kickoff in mid-November
    - Late November is MPB
    - Highly desirable to be “in motion” well before christmas
    - Aim to deduce a list of plots, beam settings, MC settings by end of that meeting
  - Seek “champions” to lead on each topic
    - Group leaders to nominate by mid-November
  - Develop MC and analysis procedures
    - Feed back into run plan **before running!**
  - Understand how we measure/minimise errors

First observation of emittance reduction

- First observation of transverse emittance reduction
  - Show preliminary (but publishable) plots for the first “physics block”
  - Linear beam optics
  - dE/dx, MCS – just enough to support claim for “observation of emittance reduction”
  - Comparison with MC
  - Emittance reduction vs beta, momentum, etc
- Identify section leads by christmas
- Kick-off meeting in January

Global Track Fitting

- Probably
  - No one has ever done Kalman fit through quadrupoles
  - Worth pointing out that linear (and higher order) accelerator beam optics can be used as a linear system for Kalman filter
- Worth a paper I think
  - Need global track fitting routines to be done
- Owned by global reconstruction/MAUS

Magnetics

- As a collaboration, we do not understand the non-linear beam optics
  - This is not well understood by muon accelerator community in general
- There is scope for at least one theory paper and at least one experimental paper on this topic
- We should seek to develop non-linear beam optics capability to complement 3D tracking
  - Support overlapping solenoids
  - Support solenoids overlapping RF cavities (a paper in itself)
- I propose Beamline integration team should take lead
  - The group may need strengthening

Absorber

- We have promised “high resolution” measurement of materials physics processes
- Can we really deliver on this?
  - In absence of fields we lose the tails of the beam – where all the action is
  - Can we untangle the effects of field if we have fields switched on?
- Do we have the right data in our run plan?
  - Do we have enough statistics?
    - We seek to measure tail effects
  - Do we have the right data
    - Do we need more “field off” data
- **These questions must be answered before data taking**
  - **The time to act is now**
- Do we have sufficient people to address this?
  - I think Pavel Snopok “owns” the absorbers – but not sure

Absorber (cont)

- Two additional things that might make a paper
  - Is MC model correct in presence of fields
  - Can we see any beam depolarisation effect from e.g. high Z materials like in the diffuser?
- Speculative, needs more study

Cooling Channel

- Observation of emittance reduction
  - This paper will be informed by the “first observation” paper and studies surrounding it
  - Not much more to say now

Wedge

- MICE should do everything to say “it is successful”
- MICE should do everything necessary to support the accelerator physics community to develop realistic ionisation cooling lattices
- Is the core programme so sacred?
  - Do we learn much more by studying all the absorbers in 1000 different configurations at high resolution?
- Personal view: No!
  - We should certainly seek to run a wedge absorber and sacrifice core programme to do it
  - This may support core programme by enabling systematics measurement
    - Absorber group to demonstrate
- Need to more thoroughly develop the long observation of emittance reduction paper
  - Understand what the compromise is
- Absorber group should take the lead on this

Wedge

- MICE should do everything to say “it is successful”
- MICE should do everything necessary to support the accelerator physics community to develop realistic ionisation cooling lattices
- Is the core programme so sacred?
  - Do we learn much more by studying all the absorbers in 1000 different configurations at high resolution?
- Personal view: No!
  - We should certainly seek to run a wedge absorber and sacrifice core programme to do it
  - This may support core programme by enabling systematics measurement
    - Absorber group to demonstrate
- Need to more thoroughly develop the long observation of emittance reduction paper
  - Understand what the compromise is
- Absorber group should take the lead on this

Support Issues

- MICE would like an **offline analysis tool**
  - Calculation of emittances
  - Handling of errors
  - Shared placeholder for e.g. beam selection routines etc
- MICE would like a **control room analysis tool**
  - Check magnets are not very misaligned
  - Check beam optics looks reasonable
  - Check energy loss looks reasonable
- **Field mapping** is required by engineers by **early December**
  - Required to install magnets (for alignment)

Conclusions

- The construction team have left us with not much time
  - We cannot retake data
  - We have to turn around early analysis fast for funding agencies
- We **must** have a fleshed out analysis in place for the fast turnaround papers
  - My job depends on it!
- **We will take the wrong data** unless we prepare analysis for the papers in advance
- We need to develop a material physics group
- We need to strengthen our beam physics capability
- Final thought:
  - This is a top down overview
  - I have not thought of the most interesting, inventive papers
  - That is your job
  - I await suggestions!