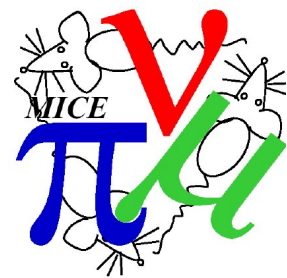


Tracker Alignment And Expectations from Analysis

Melissa Uchida

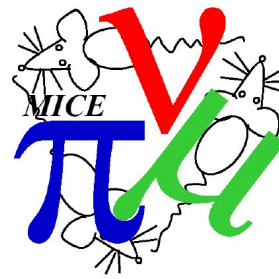
26/10/14



First let's clear something up...

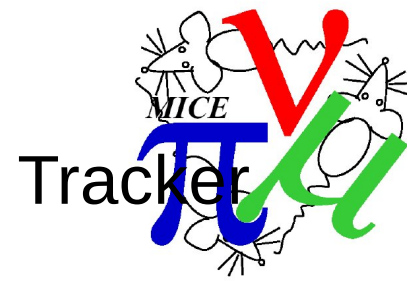
Tracker misalignment **cannot** affect emittance of
the beam
only the measurement of it...

Alignment



- Mechanical alignment
 - of tracker inside bore using Geoff's alignment gig possible to ~ 0.25 mm.
 - of SS in hall possible to ~ 1 mm (details tbc).
 - Plane to plane offset was measured with Computerised measuring machine at Imperial college.
- Internal alignment
 - a) Rotational offsets between tracker stations \leftarrow work in progress.
 - b) Non-parallel tracker stations (pitch) \leftarrow Has been considered but has been shown to have negligible impact.
 - c) X-Y offsets in trackers stations \leftarrow Accounted for in software by E. Santos.
- Mechanical alignment
 - a) Misalignment between the two Trackers \leftarrow work in progress.

SS Alignment



- Bore of SS aligned to cold mass (to 1mm) and aligned to bore (to 0.25mm).
- Beam diameter for max emittance 12.6 cm.
- Compare tracker, bore and cold mass alignment data.
 - We have the data from SSU and SSD is available
 - Alignment of tracker within bore known to 25 microns.
- Any offset in the cold mass to bore could cause the Trackers to be offset from one another..

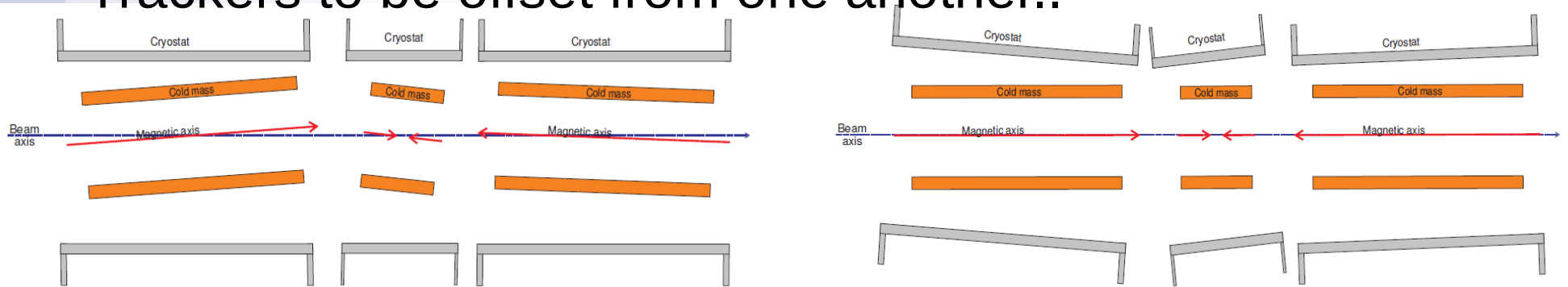


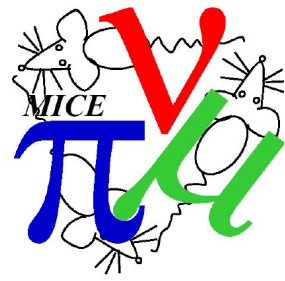
Figure 1: Misaligned modules in Step IV, much exaggerated.

Undesirable

Graphic stolen
from J. Cobb

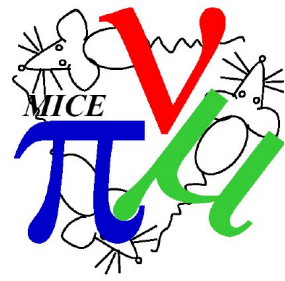
Desirable

How much of an offset in the Tracker can we handle?



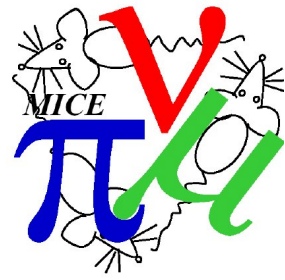
- Won't affect emittance, but can affect the measurement of it
- Tolerance of up to 1mm suggested from previous studies.
- Back of envelope calculation mm and mrad offset and rotation as a first step...
- Then full MC simulations.

MC simulation Using straight Tracks



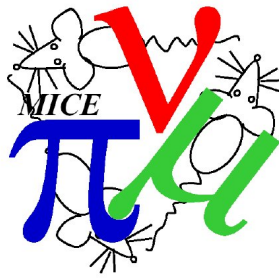
- Simulate the effect of 100,000 muons travelling through both Trackers
- Consider possible sources of scattering.
- Manually offset DS Tracker to US Tracker by $>3\text{mm}$ and $>3\text{mrad}$.
 - Using Tracker reconstruction without truth
 - Determine measurement capabilities
 - Maximum offset without loss of sensitivity
 - Software plan

Using straight Tracks



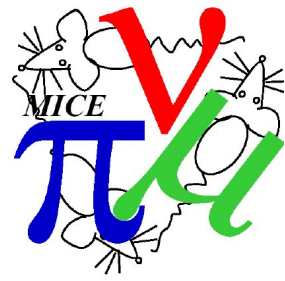
- ~ 5 days running for full calibration
- Compare position of tracks to expected position of tracks
- Accounting for any scattering (MC)
- Compare χ^2 of tracks fits in US and DS Trackers.
- Is any offset as expected?
- Note any misalignment in software so that reconstruction is aware.

How to take care of offsets in software



- Use kalman fitter in an iterative manner to calculate the x-y stations misalignments.
- Validation.
 - χ^2 minimisation - The overall χ^2 should decrease with alignment iteration, and the alignment corrections themselves should tend toward zero.
 - Check residuals.

Conclusions



- Early stages of planning at the moment.
- A three pronged (maths, MC and straight track beam) method will be used.
- Software can take care of misalignments up to ~1mm...
- Full determination of measurement sensitivity and software plan underway.