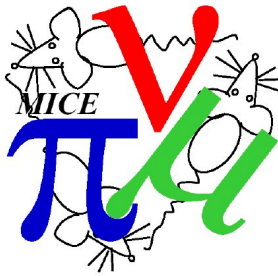

Step IV.0
Analysis Possibilities

Ed Santos
(Melissa Uchida)

25/11/13

Imperial College
London

The goal of this analysis is a Step IV emittance study with some intermediate measurements.

The intermediate measurements are made with different pre-Step IV configurations, where absorber and fields are gradually being put in place.

> *for the benefit of future analysis, these measurements improve the understanding of the experiment*

This analysis uses tracker reconstruction only.

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a review of possible sub-configurations and what we can measure in each of them...

Crawling towards Step IV

Geometry	Diffuser	Absorber	Sol. Fields	Analysis Goal
a	No	No	No	Measure transmission between trackers and mcs in the detectors.
b	Yes	No	No	Measure mcs in the diffuser.
c	No	Yes	No	Measure mcs in the absorber.
d	No	No	Yes	Measure transmission between trackers.
e	Yes	Yes	Yes	Measure transverse cooling.

Table 7.1: Geometry stages towards a complete Step IV and intermediate analysis goals.

Before the complete Step IV setup, there's room for measurements of multiple scattering and particle transmission - all useful for good understanding of the experiment.

complete Step IV

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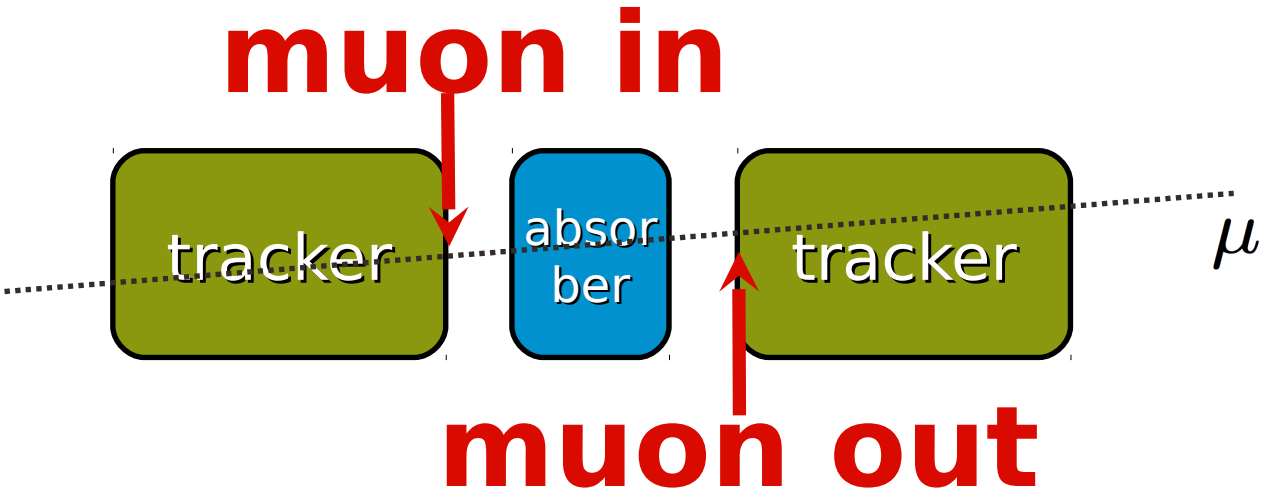
0-Field Measurements

- In a **0-Field Step IV** scenario the trackers can only measure the slopes of the straight tracks crossing them.
  - Full momentum recon requires Pz from the TOF's.
- Questions to address here:
  - do the trackers have enough resolution to make a MCS measurement as the particles cross the absorber?
  - how bad is the transmission?

The results from this analysis are not conclusive until the best geometry specification is used in the MC - geometry group is releasing it soon!

we need to be sure the absorber is correctly defined - things like the window material and its thickness are important

The setup



note that this should have mean value 0

Multiple Scattering

as a function of the incident angle

$$\Delta\theta_x = \theta_x^{out} - \theta_x^{in}$$

the MCS has an impact on the spread of the angles... not the mean. See Highland-Formula.

$$\theta_x^{MCS} = STD(\Delta\theta_x)$$

Transmission

as a function of the azimuthal angle

$$\phi = atan\left(\frac{P_y}{P_x}\right)$$

Slides by Ed Santos

Tracker Considerations for Step IV

- Measurement Capabilities.
- Backgrounds.
- Misalignments of optical elements is one of the largest sources of systematic errors. Minimise!
  - Tracker station offsets
  - Misalignment between the two Trackers.
- Magnetic field homogeneity.
- Differences in efficiency/errors etc. between the two trackers?
- Reconstruction efficiency.
- Online Plots.
- Step IV_0 Analysis possibilities.
- Attenuation length in fibres.

– Understood
– In progress
– Not yet considered

Misalignments

a) Rotational offsets between tracker stations ← work in progress.

b) Non-parallel tracker stations (pitch) ← Has been considered but has been shown to have negligible impact.

c) X-Y offsets in trackers stations ← Accounted for in software by E. Santos.

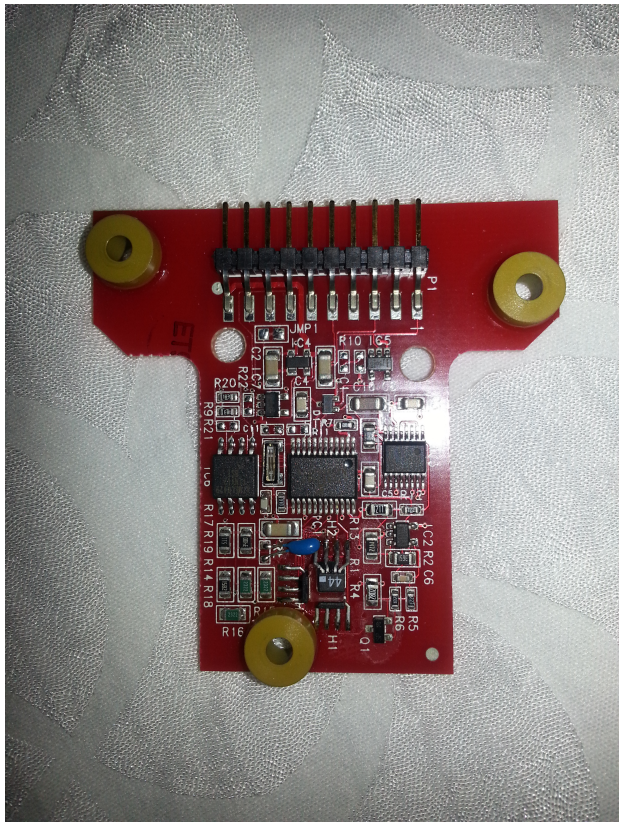
d) Misalignment between the two Trackers ← see later talk.

Magnetic Field Homogeneity

Inside solenoids

SS data analysis under way by

V. Blackmore.



Inside trackers

Hall probes inside trackers.

- We have 4 probes per tracker.
- Mounts and locations designed and manufactured.
- Proposal states:
  - 4T with max 10^{-5}T variation over 0.1m^3 along trackers.
  - Positions of sensors monitoring magnetic fields must be known to ~100 μm.

How close we can get to this (as only know magnet current to $1/10^3$ A) using probes ← TBC

Efficiencies

Reconstruction (SW)

Currently at 99.5% work is well under way to improve this see Adam Dobbs' talk in Software session

Hardware

Differences in efficiency/errors etc. between the two trackers

- Particle Response
  - Time integrated charge (RF) → when running.
- Light yield
  - Variation in light transmission between fibres <10%.
- How alike is their detection, interpretation, electronics readout, noise...

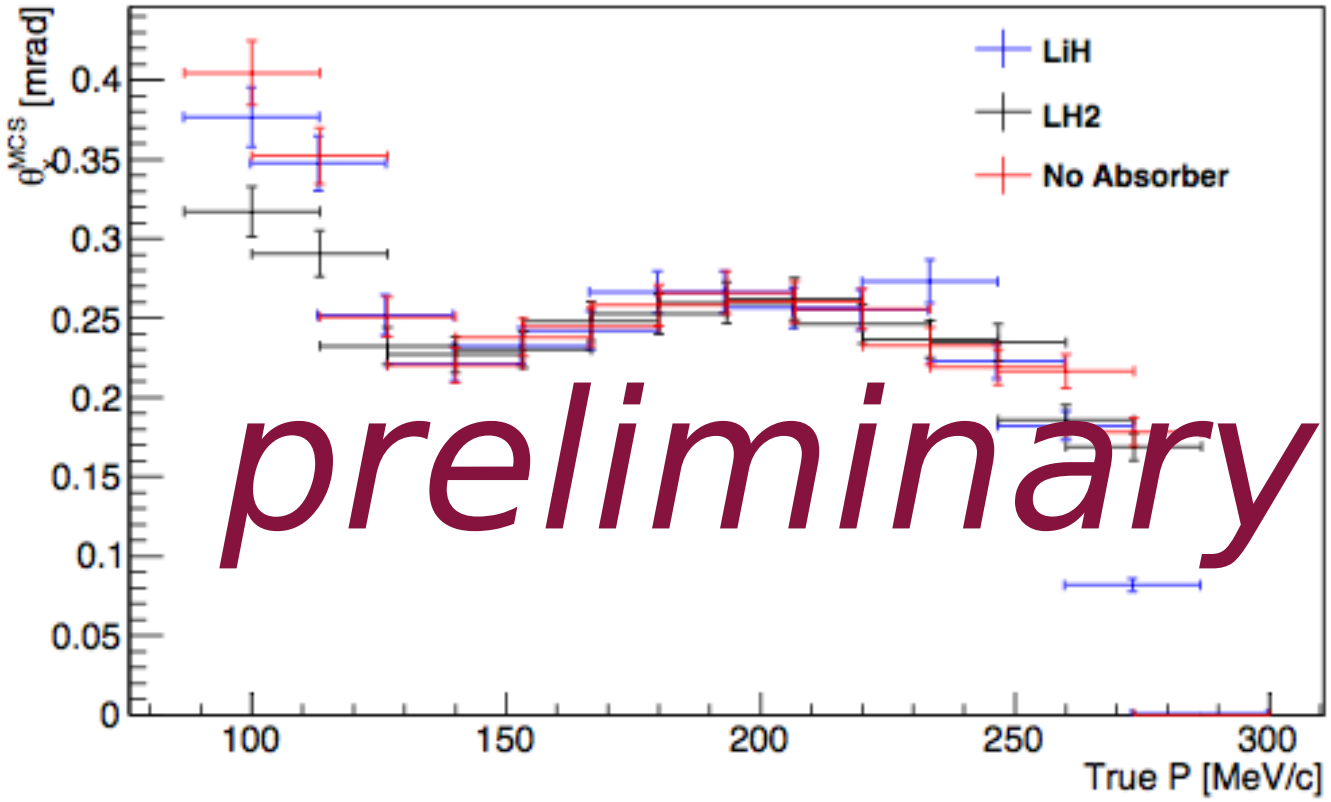
Conclusions

- Multiple scattering analysis using Tracker in progress.
- Need to look at θ_y
- Need to look at transmission
- Can then compare emittance between step IV.0 and step IV.
- Necessary measures to do analysis being considered.

For each choice of absorber: 100k muons with emittance uniformly picked from the interval [0.5, 9.5]

MCS

The rise at 150 MeV/c is not understood and probably an error... It shouldn't be here. It's work in progress and not really a matter for debate.



$$\theta^{MCS} \propto \frac{1}{\beta cp}$$

Slides by Ed Santos

8.Online Plots

a) Dead channels.
   a) Number of spacepoints/tracker station integrated over run & presented as bar chart
b) Channel-by-channel high gain RMS plot.
c) Saturated ADC channels flagged.
d) Number of digits per fibre plane (ribbon) and station.
e) Number of clusters per fibre plane (ribbon) and station.
f) Cluster maps with ADC threshold above a certain value.
g) Number of spacepoints, digits, clusters and tracks per spill per tracker.
h) High gain vs low gain plots.
i) High gain ADC counts vs channel ID.
j) Some sort of simple event display (already exists).

To Be Completed May 2014