

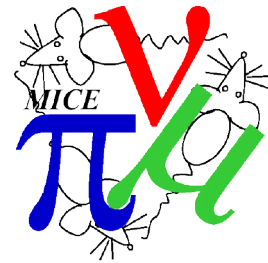


Introduction



C. Rogers, ISIS Intense Beams Group
Rutherford Appleton Laboratory

Reminder – Publication plan

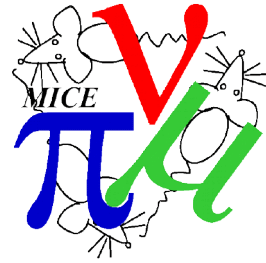


Title	Contact	Target date		Comments Jan-19
		Preliminary	Final	
Phase-space density/emittance evolution; rapid communication	C. Rogers	Apr18 w/s	Apr19	4th referees meeting before around CM53 (21, 22Feb19, RAL)
Measurement of multiple Coulomb scattering of muons in lithium hydride	J. Nugent	Jun18; CM51	Apr19	Unfolding issues; perhaps resolved; CM53, 21,22Feb19, RAL
Performance of the MICE diagnostic systems	P. Franchini	Feb19; CM53		Almost complete draft
Phase-space density/emittance evolution review paper	C. Hunt	TBD		Analysis now advancing
Phase-space density/KDE/6D-emittance evolution	C. Brown	TBD		Thesis published on initial analysis; taken over by C.Brown
Measurement of multiple Coulomb scattering of muons in LH2	J. Nugent	TBD		Awaits completion of LiH paper
Field-on measurement of multiple Coulomb scattering	A. Young	TBD		Analysis underway
First particle-by-particle measurement of emittance in the Muon Ionization Cooling Experiment	V. Blackmore		Jun18, CM51	Accepted by EU Phys. J C; awaiting referees
The MICE Analysis and User Software framework	D. Rajaram	May18 w/s	Jun18, CM51	RAL-P-2018-007; 1812.02674; submitted to JINST; referees comments received

Emittance Evolution



First observation paper



February 20, 2019

Muon Ionization Cooling Experiment

Version 0.0

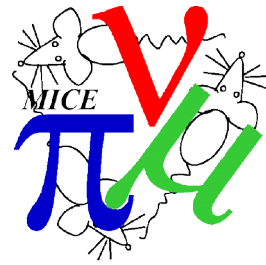
First demonstration of ionization cooling using the Muon Ionization Cooling Experiment

MICE collaboration

Muon beams of high brightness have the potential to carry the search for new phenomena in lepton-antilepton collisions to extremely high energy. Such beams can be exploited to provide uniquely well-characterised neutrino beams. The muon beam can be produced through the decay of pions produced in the interaction of a proton beam with a target. A high-brightness beam then requires that the phase-space volume occupied by the beam is reduced (cooled). Ionization cooling is the novel technique by which it is proposed to achieve this. The Muon Ionization Cooling Experiment (MICE) collaboration constructed a muon ionization cooling cell and used it to provide the first observation of ionization cooling. These results have significant implications for the future development of high-brightness muon beams for particle physics.

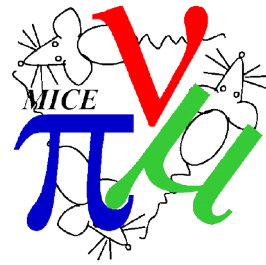
- Paper drafting now in progress
- Discuss
 - Structure of paper
 - Phase space density and fractional emittance
 - Sources and magnitude of uncertainties

Detailed emittance evolution



- Chris Hunt just getting to grips with this
- Scope of the paper is huge
- This is a massive undertaking!
 - Just in terms of data processing
- E.g. PID will need some attention at higher momenta
- E.g. MC will need retuning for higher momenta and other beam settings
- etc

Wedge analysis



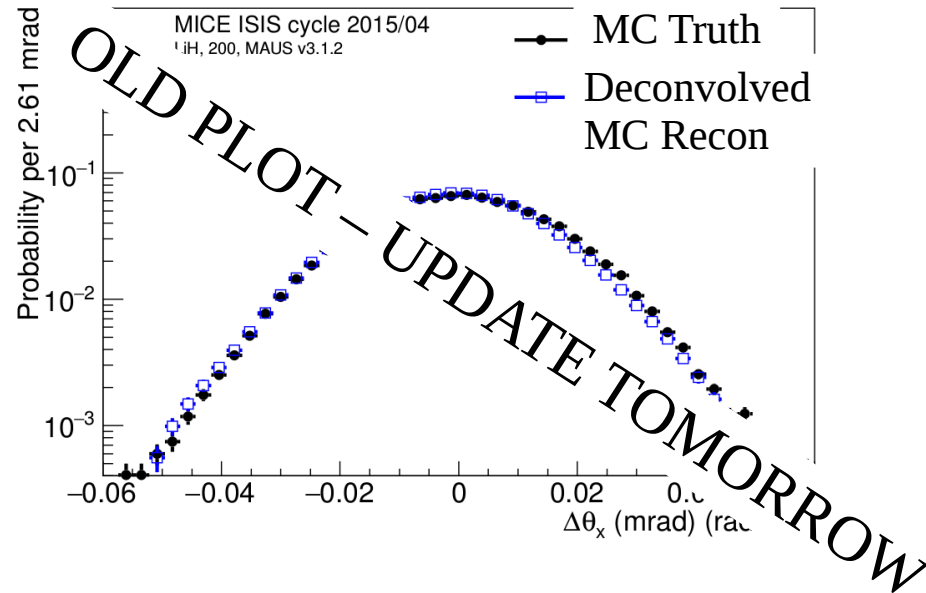
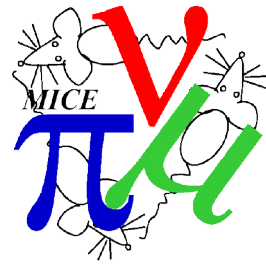
- Getting to grips with the analysis
 - Beam weighting/sampling
 - Phase space density or equivalent analysis
- Can we crystallise this into a full analysis loop
 - Sample selection
 - Detector resolution and efficiency
 - Systematic and Statistical uncertainties
 - Result



Scattering Analysis

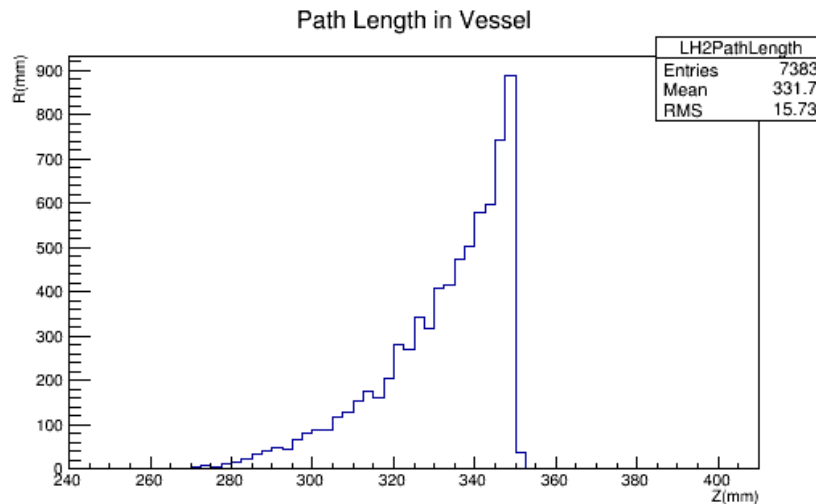
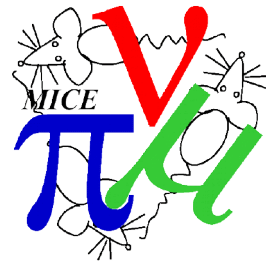


LiH scattering (Nugent)



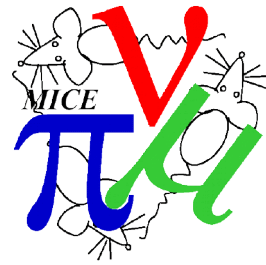
- Issues in projected angle deconvolution seem to be resolved
- Space angle deconvolution is not working and likely to be rather involved
 - Discuss whether to publish projected angle only

IH2 scattering (Gavriil)



- Detailed analysis on path length estimation looks nice
 - Need to understand how this can be treated in the analysis
- Need to tackle Particle Identification
 - This will be “new physics” at high momentum – cannot use tracker vs TOF

Field-on scattering



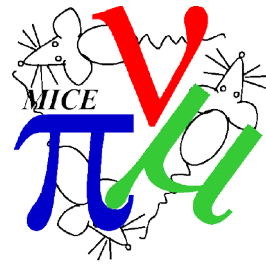
- Should allow larger angles to be measured
- Can we move to a convolution or deconvolution analysis?
 - Sample selection
 - Detector resolution and efficiency
 - Systematic and Statistical uncertainties
 - Results



System Performance Paper

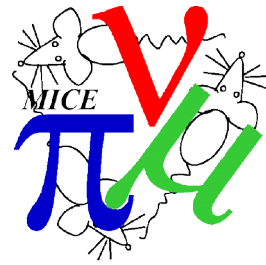


System performance paper



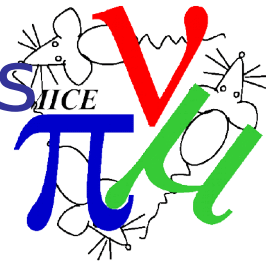
- Too many plots to summarise!
- Need to work on making sub-analyses consistent
 - E.g. same runs, same sample criteria

Energy loss analysis



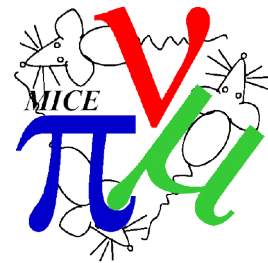
- Most complicated “system performance” analysis
- May come in too late for system performance paper
 - Does it have another home?

Optical alignment and aberrations



- Understanding the alignment of the optical system is important
 - Demonstrate understanding of the system
 - Untangle issues e.g. momentum inconsistencies
 - Prerequisite to understanding the aberrations
- Alignment algorithm c/o Chris Hunt
 - Other concepts by Chris Rogers, YingPeng
- Understanding of the aberrations valuable theory
 - First particle-by-particle measurement of transfer map/higher order terms?
 - Beamlet analyses do exist...

Other Papers - Measurements



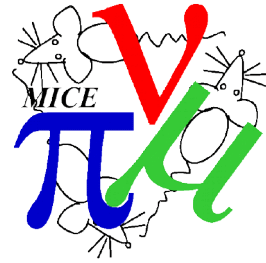
Scattering
In LH2

Field on
Scattering

6D
Emittance
Evolution

Detailed
Emittance
Evolution

Other Papers and Techniques



Tracker
Performance

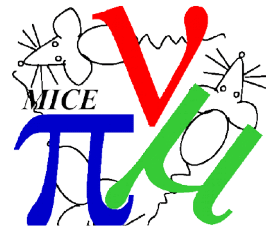
PID
Performance

System Performance Paper

Transfer Map
And Optical
Heating

Optical
Alignment

Comments



- Well done to Victoria and Durga for getting papers to journal
- We have a **great data set**
- We have a **great analysis team**
- There are **great opportunities**

Now is the time to
make it happen!

