

UPCOMING CONFERENCE PRESENTATIONS

Ulisse Bravar

University of New Hampshire

8 July 2011

Upcoming Conferences

- Poster at PANIC 2011
MIT, Cambridge MA, 26 July
- Talk, parallel session, at APS-DPF
Brown University, Providence RI, 11 August
- Title
MICE step I: first measurement of
emittance with particle physics detector

Status

- Poster for PANIC 11 ready
minor changes still possible
- Talk for APD-DPF: work in progress
haven't even started yet
- Same results & same figures presented
at both conferences

Poster

- Five sections



The Muon Ionization Cooling Experiment Step I: First Measurement of Emittance with Particle Physics Detectors

Ulisse BRAVAR
University of New Hampshire
on behalf of the MICE Collaboration

Motivation:
Muon cooling channel is needed to achieve required luminosity in future Neutrino Factory and Muon Collider.

$$\mu^+ \rightarrow e^+ \nu_e \bar{\nu}_\mu$$

Ionization cooling principles:

- Liquid Hydrogen absorber reduces both p_{\parallel} and p_{\perp} of the muon beam
- Acceleration in RF cavities restores p_{\parallel} to initial value, does not affect p_{\perp}
- $(p_{\perp} / p_{\parallel})_{\text{final}} < (p_{\perp} / p_{\parallel})_{\text{initial}}$ results in reduced transverse emittance ϵ_{\perp} of muon beam

$$\frac{d\epsilon_{\perp}}{dX} = -\frac{\epsilon_{\perp}}{L} \frac{dE}{E} + \frac{1}{2} \frac{(0.014 \text{ GeV})^2}{E m_{\mu} X_0}$$

MICE goals:

- Demonstrate the feasibility of a muon ionization cooling channel for the first time
- Measure a 10% reduction in the transverse emittance of the muon beam to 1% of itself, i.e. achieve a 10^{-3} absolute accuracy

MICE experiment layout:

MICE schedule:

STEP I	2015
STEP II	2016
STEP III	2017
STEP IV	2018
STEP V	2019
STEP VI	2020

MICE components:

- two spectrometers
- upstr. & downstr. PID cooling channel
- three Liquid Hydrogen absorber modules
- two RF modules, eight 201 MHz RF cavities
- solenoidal field
- 18 superconducting coils
- B-field = 0 to ± 4 T

MICE progress:

Beamline & target:

- beamline fully commissioned
- target is being upgraded

AFC module:

- LIH absorbers under construction
- solid absorbers investigated
- focus coils under construction
- full AFC module near completion

Spectrometers & diffuser:

- SciFi trackers completed
- spectrometers = work in progress

RFCC module:

- RF cavities under construction
- RF power sources ready
- arrangements for coupling coils

Particle identification detectors:

- ToF 1 & ToF 2 completed
- Cherenkov & KL calorimeter ready
- EMR prototyped

MICE Step I: Layout:

Particle ID / beam characterization:

- μ^+ losses
- Time of Flight
- Cherenkov detector

Emittance measurement:

ToF setup:

Muon beam transverse emittance:

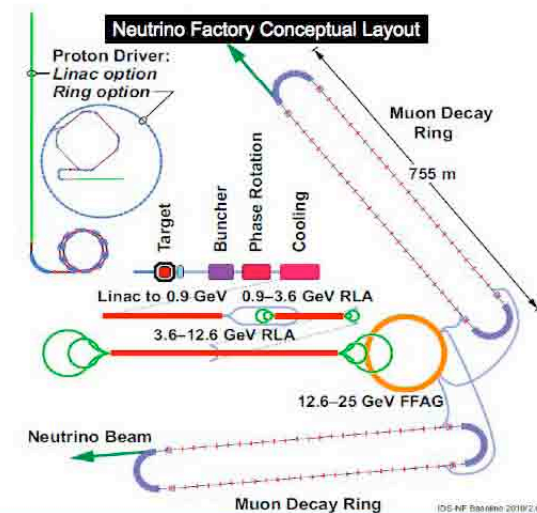
- horizontal transverse trace space
- baseline muon beam (5.6 mm mrad, 200 MeV/c)

Poster 1

- Usual 'old' remarks

Motivation:

Muon cooling channel is needed to achieve required luminosity in future Neutrino Factory and Muon Collider.



Muon Collider Conceptual Layout

Project X
Accelerate hydrogen ions to 8 GeV using SRF technology.

Compressor Ring
Reduce size of beam.

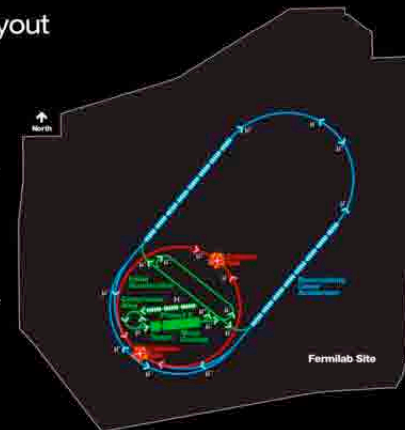
Target
Colliders lead to muons with energy of about 200 MeV.

Muon Capture and Cooling
Capture, bunch and cool muons to create a tight beam.

Initial Acceleration
In a dozen turns, accelerate muons to 20 GeV.

Recirculating Linear Accelerator
In a number of turns, accelerate muons up to 5 TeV using SRF technology.

Collider Ring
Bring positive and negative muons into collision at two locations 100 meters underground.



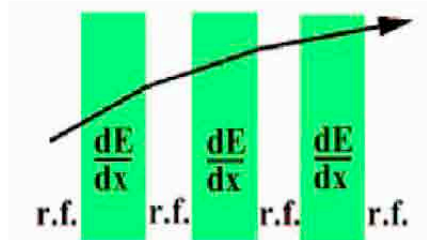
Poster 2

- Again, usual remarks

need to fix symbols
in cooling formula

Ionization cooling principles:

- Liquid Hydrogen absorber reduces both p_{\parallel} and p_{\perp} of the muon beam
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- $(p_{\perp}/p_{\parallel})_{\text{final}} < (p_{\perp}/p_{\parallel})_{\text{initial}}$ results in reduced transverse emittance ϵ_n of muon beam



$$\frac{d\epsilon_n}{dX} = \frac{\#_n}{E^2} \left\langle \frac{dE}{dX} \right\rangle + \frac{(0.014 \text{ GeV})^2}{2 \epsilon_n^3 E m_{\mu} X_0}$$

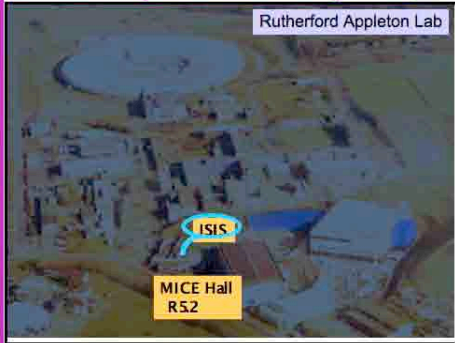
MICE goals:

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Poster 3

- MICE experiment

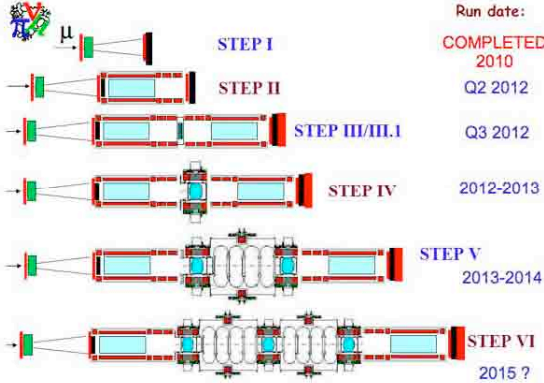
MICE experiment layout:



Rutherford Appleton Lab



MICE schedule:



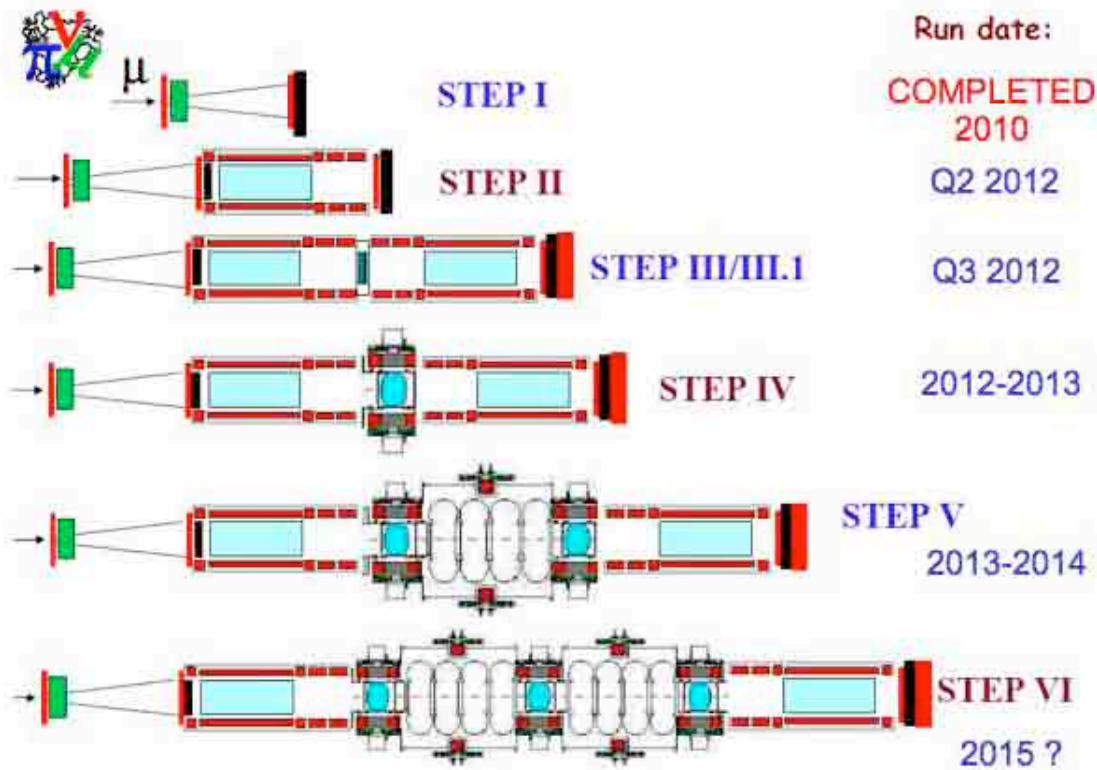
Step	Run date
STEP I	COMPLETED 2010
STEP II	Q2 2012
STEP III/III.1	Q3 2012
STEP IV	2012-2013
STEP V	2013-2014
STEP VI	2015 ?

MICE components:

- two spectrometers
- upstr. & downstr. PID
- cooling channel:**
 - three Liquid Hydrogen absorber modules
 - two RF modules, eight 201 MHz RF cavities
- solenoidal field:**
 - 18 superconducting coils
 - B-field = 0 to ± 4 T

MICE Schedule

- From A. Blondel's talk
MICE VC 141, 16 June 2011
- Check dates !!!




Poster 4

- Status of MICE

MICE progress:



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- beamline fully commissioned
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AFC module:

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Spectrometers & diffuser:

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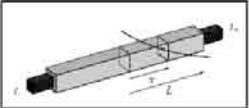




RFCC module:

- RF cavities under construction
- RF power sources ready
- arrangements for coupling coils



Particle identification detectors:

- ToF 1 & ToF 2 completed
- Cherenkov & KL calorimeter ready
- EMR prototyped



MICE Progress

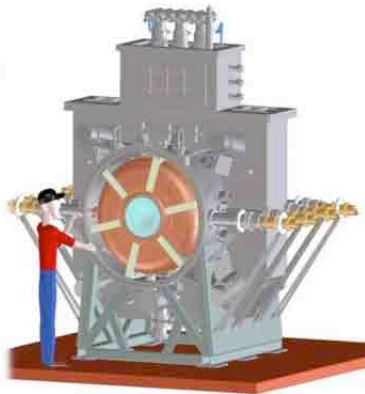
- From A. Blondel's talk
MICE Schedule Review, 23 May 2011

- About the RFCC module:

RFCC module:

- RF cavities under construction
- RF power sources ready
- arrangements for coupling coils

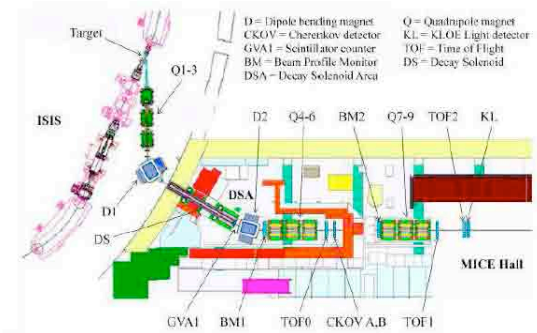
y



Poster 5

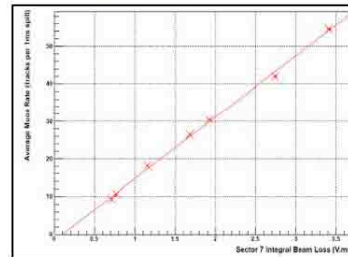
- MICE Step I

MICE Step I: Layout:

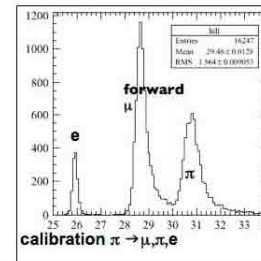


Particle ID / beam characterization:

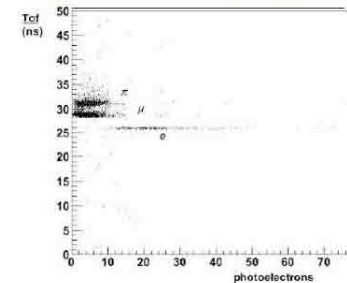
μ^+ losses



Time of Flight

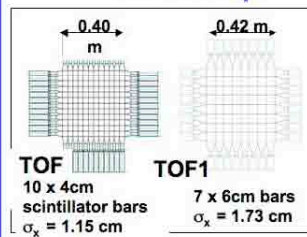


Cherenkov detector



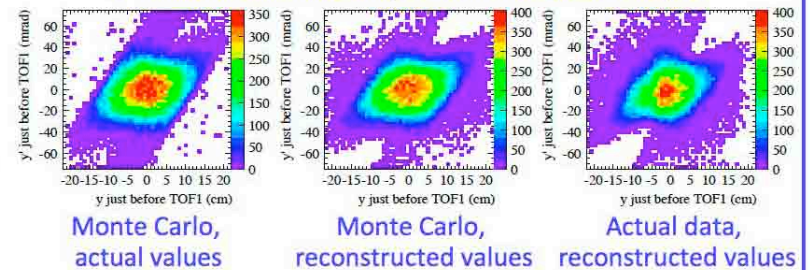
Emittance measurement:

ToF setup



Muon beam transverse emittance

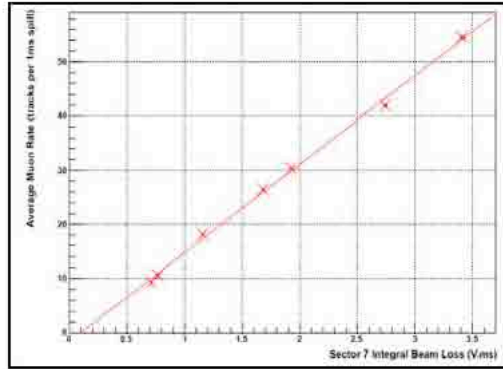
- horizontal transverse trace space
- baseline muon beam (6π mm mrad, 200 MeV/c)



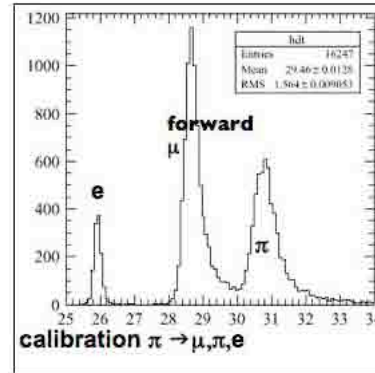
Results being presented

beamline paper

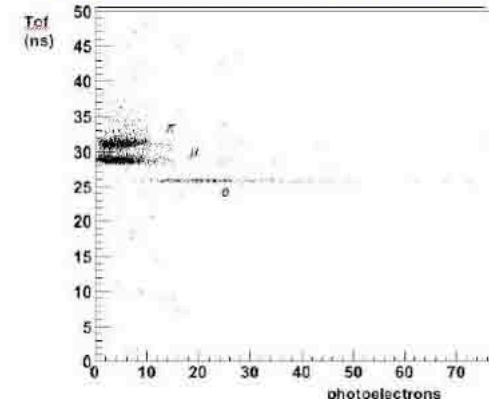
μ^+ losses



Time of Flight



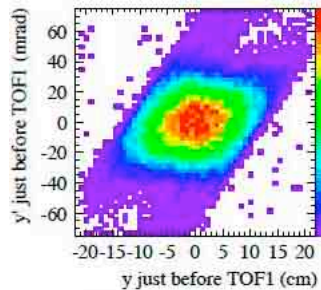
Cherenkov detector



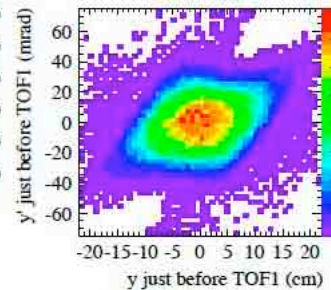
emittance paper

Muon beam transverse emittance

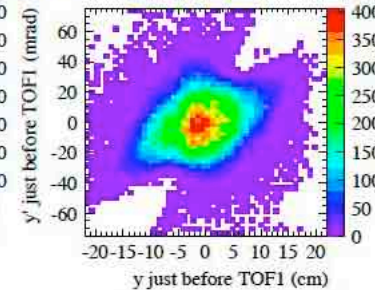
- horizontal transverse trace space
- baseline muon beam (6 π mm mrad, 200 MeV/c)



Monte Carlo,
actual values



Monte Carlo,
reconstructed values



Actual data,
reconstructed values

Conclusion

- Send comments to:
ulisse.bravar@unh.edu
- About two weeks remaining before
I need to finalize poster for PANIC 2011