

The Muon Ionization Cooling Experiment

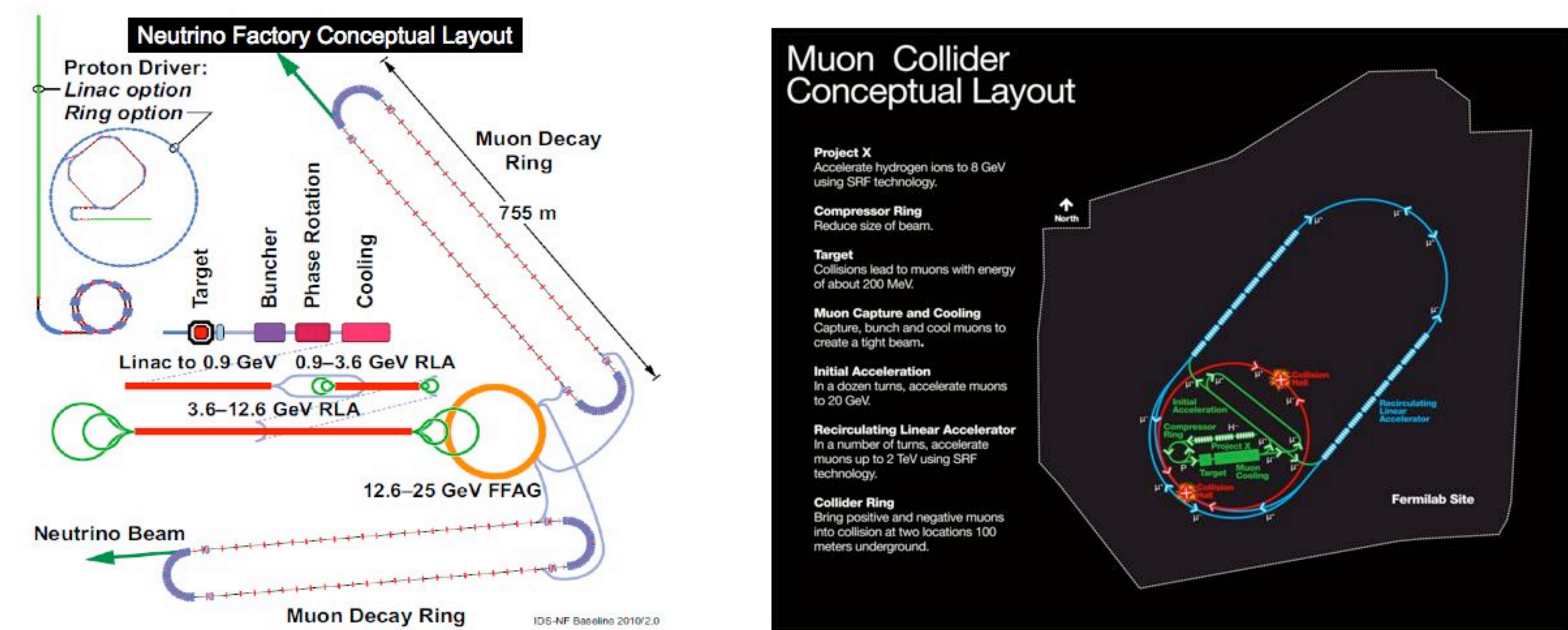
Step I: First Measurement of Emittance with Particle Physics Detectors

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on behalf of the MICE Collaboration

Motivation:

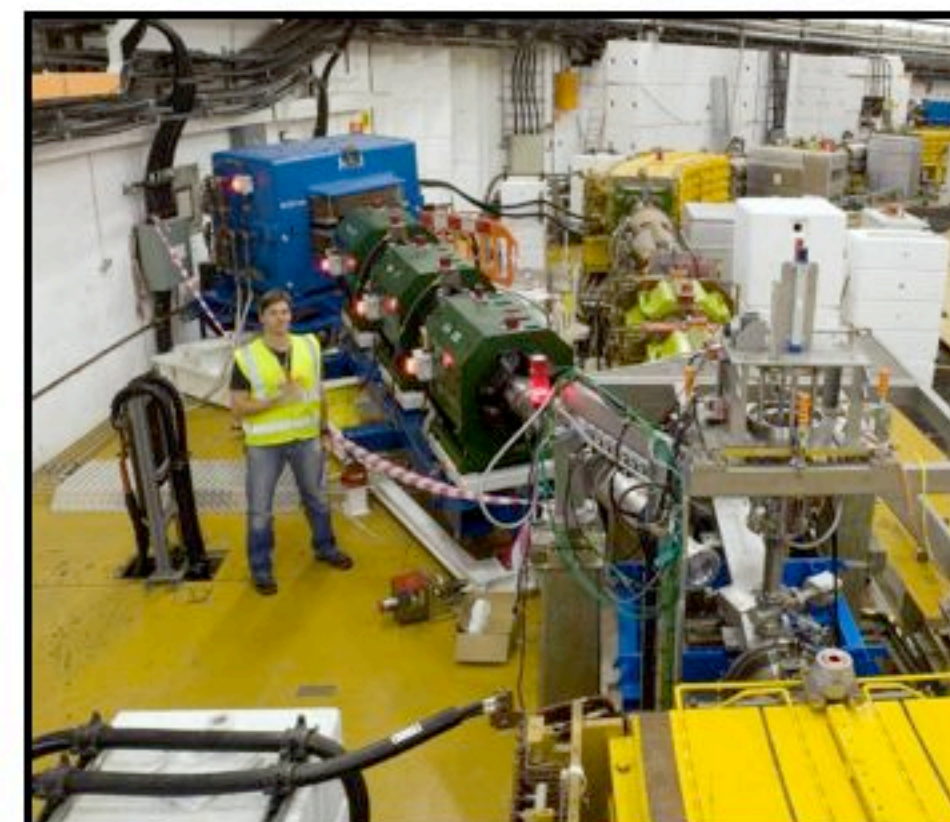
Muon cooling channel is needed to achieve required luminosity in future Neutrino Factory and Muon Collider.



MICE progress:

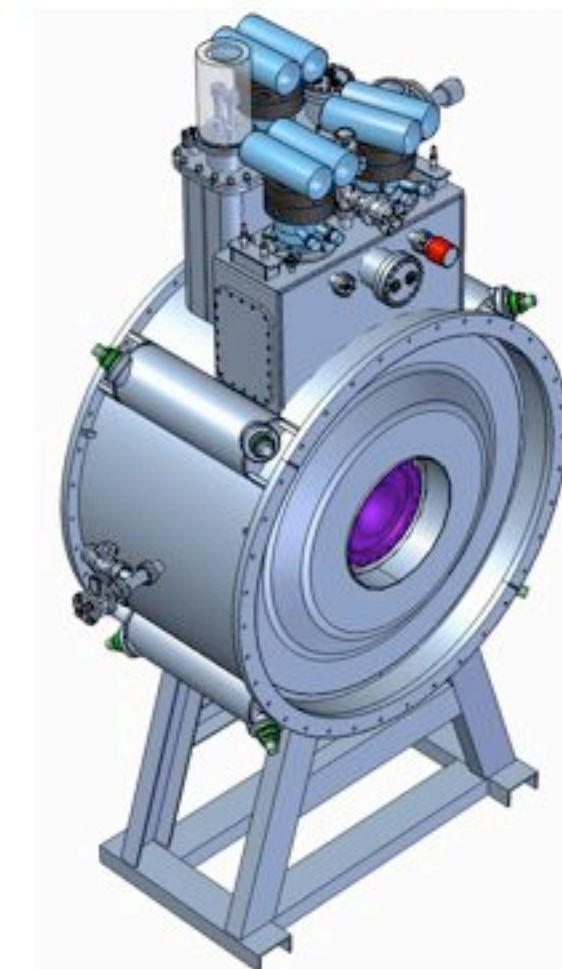
Beamline & target:

- beamline fully commissioned
- target is being upgraded



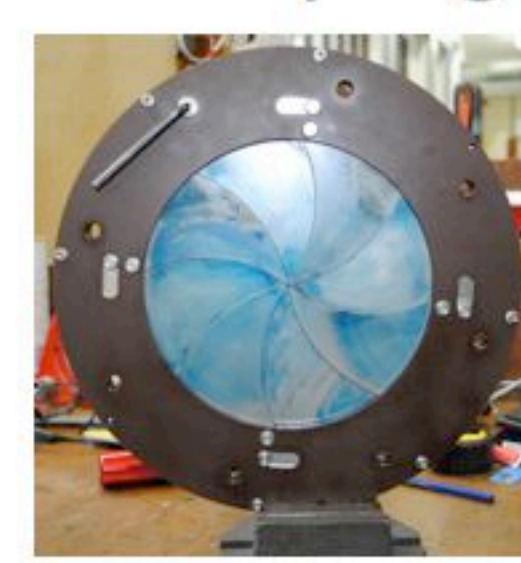
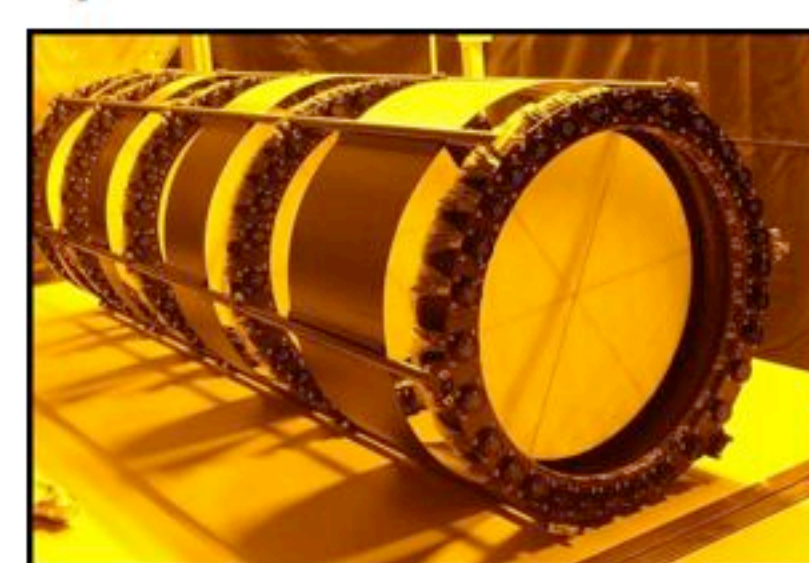
AFC module:

- 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

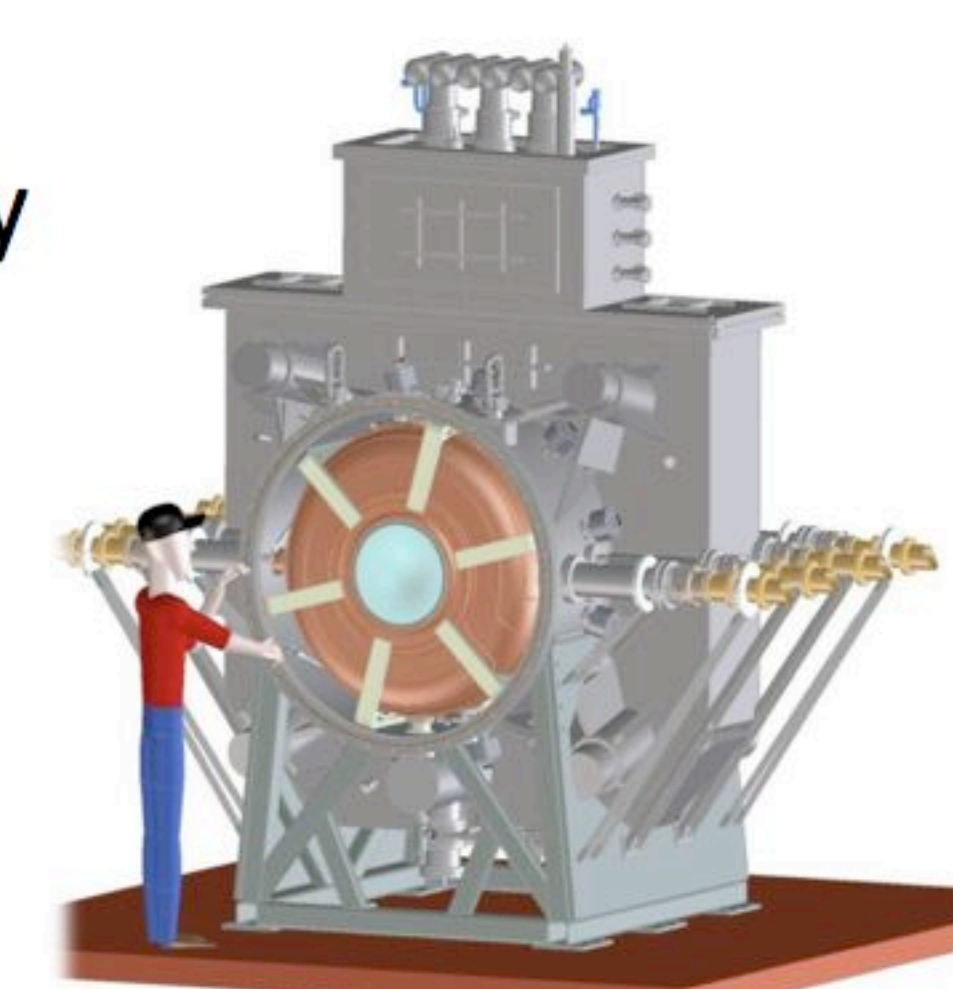
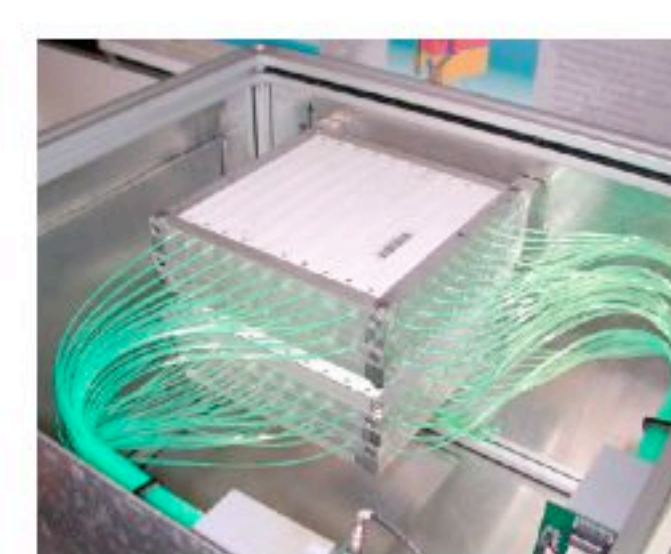
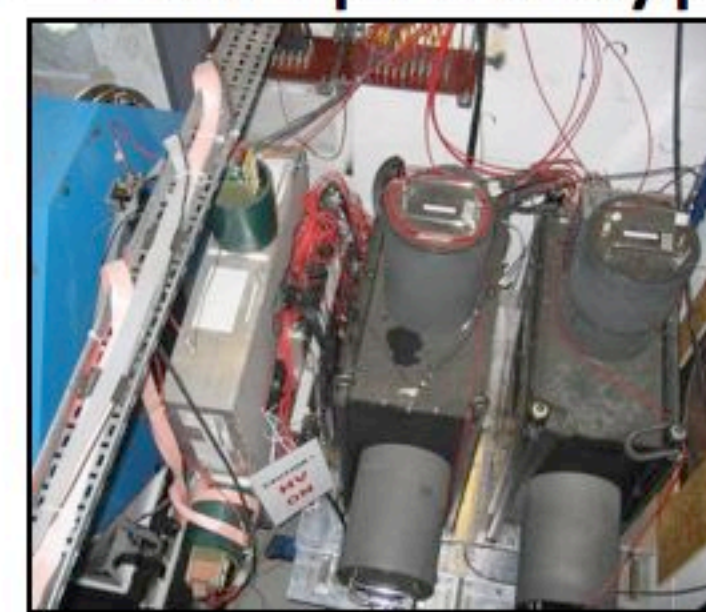


RFCC module:

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

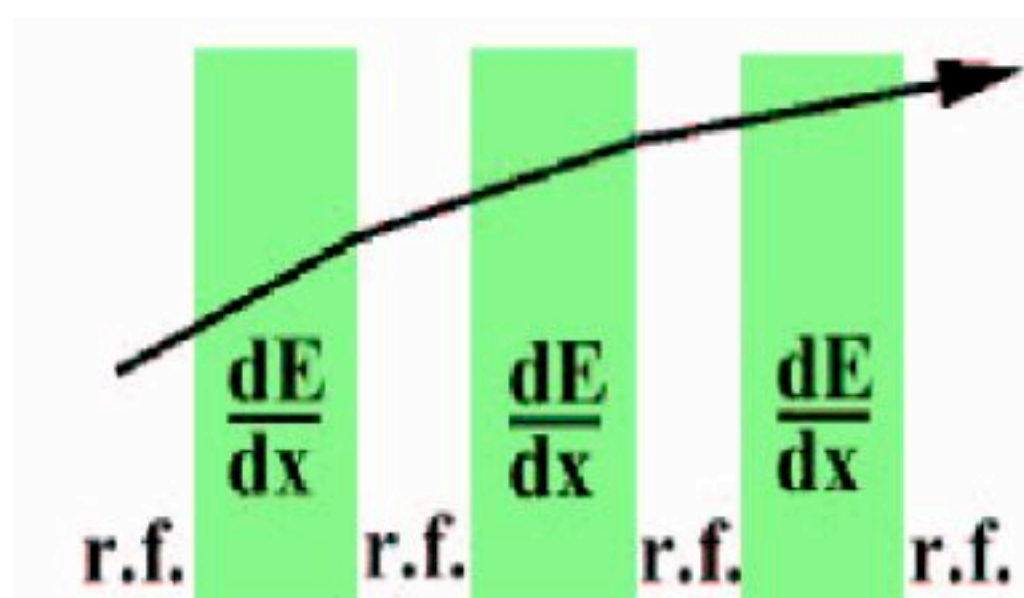
Particle identification detectors:

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



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_n of muon beam

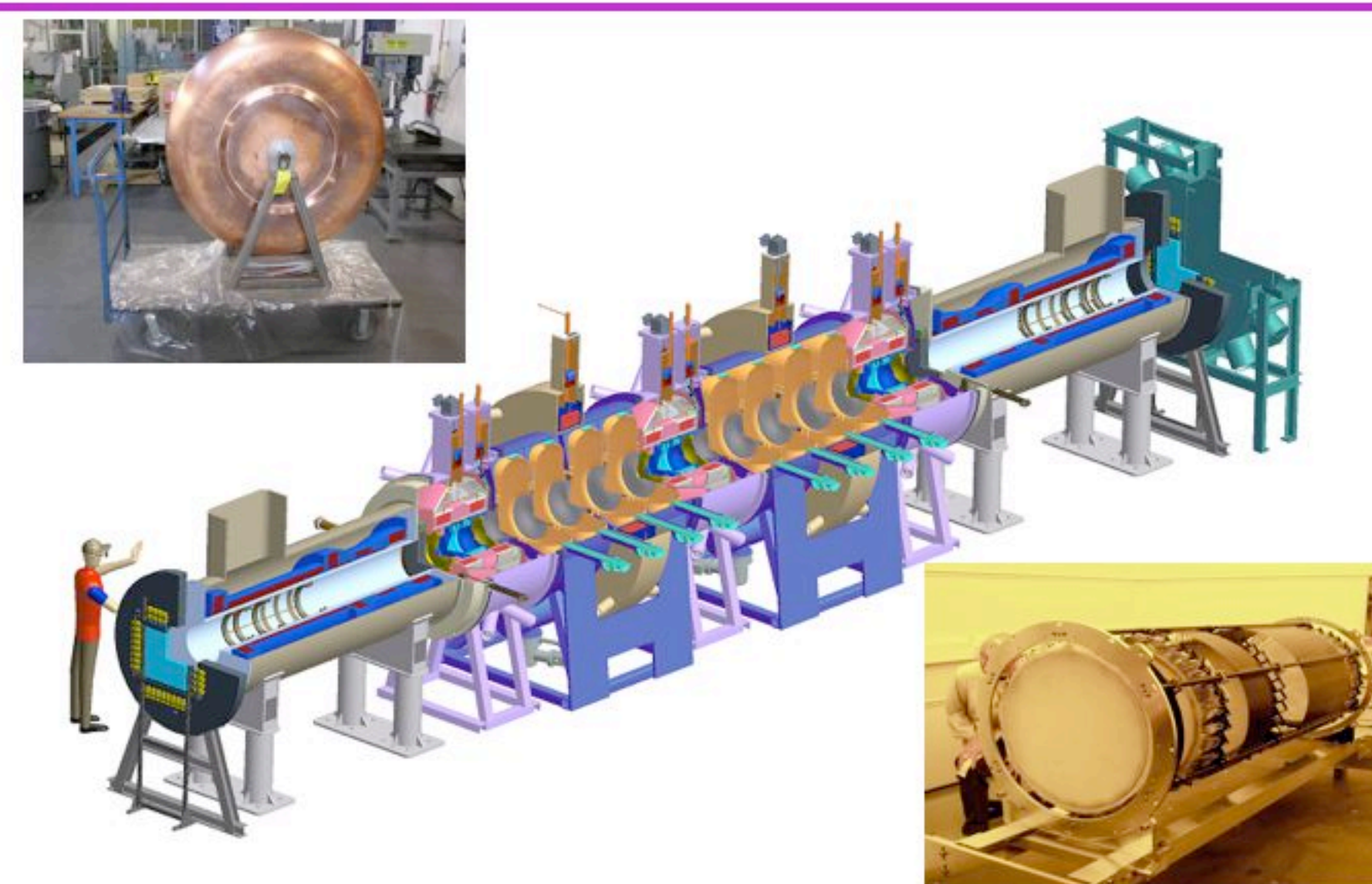
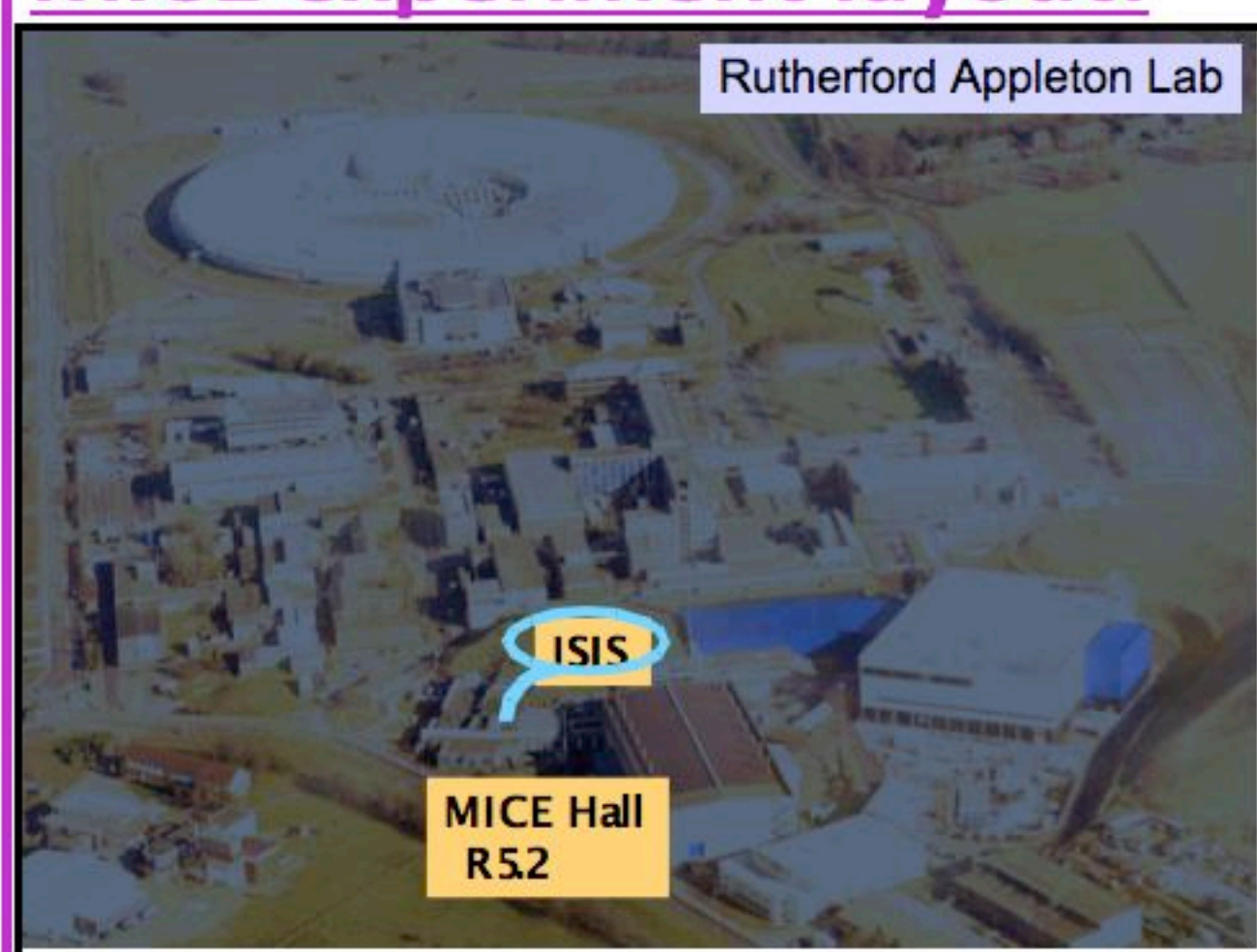


$$\frac{d\epsilon_n}{dx} = \frac{\#_n}{E} \left\langle \frac{dE}{dx} \right\rangle + \frac{!_t (0.014 \text{ GeV})^2}{2!^3 E m_\mu X_0}$$

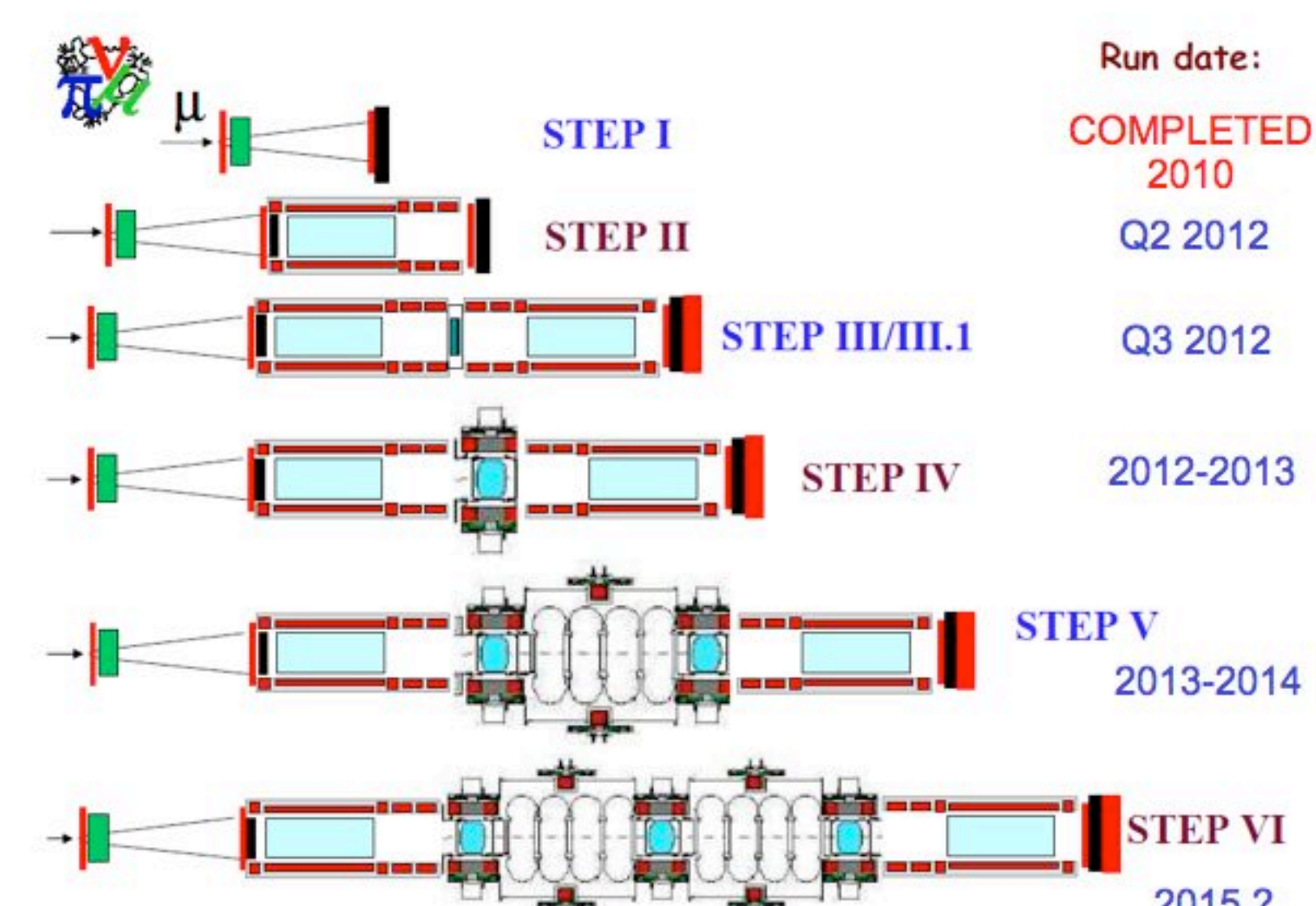
MICE goals:

- 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:

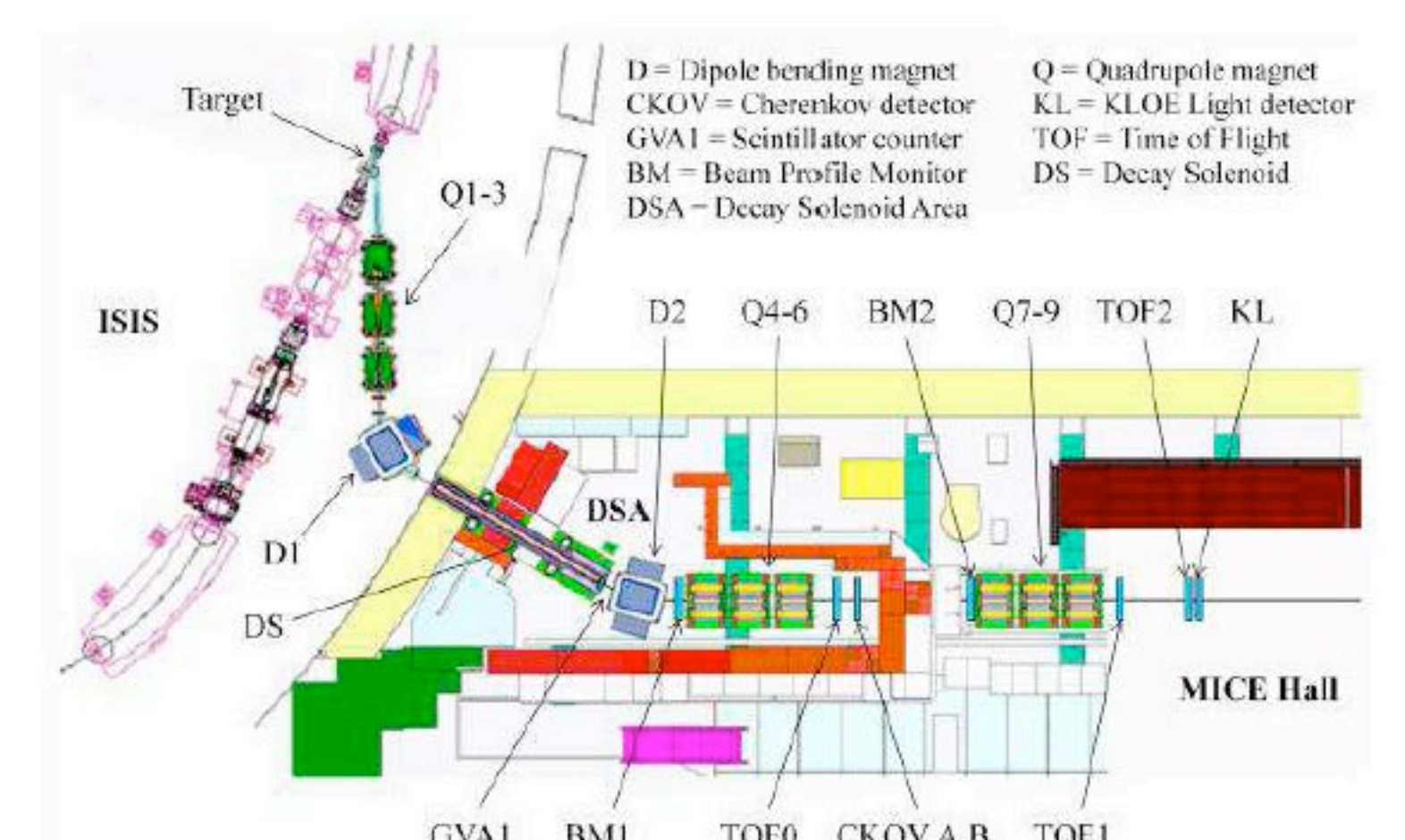
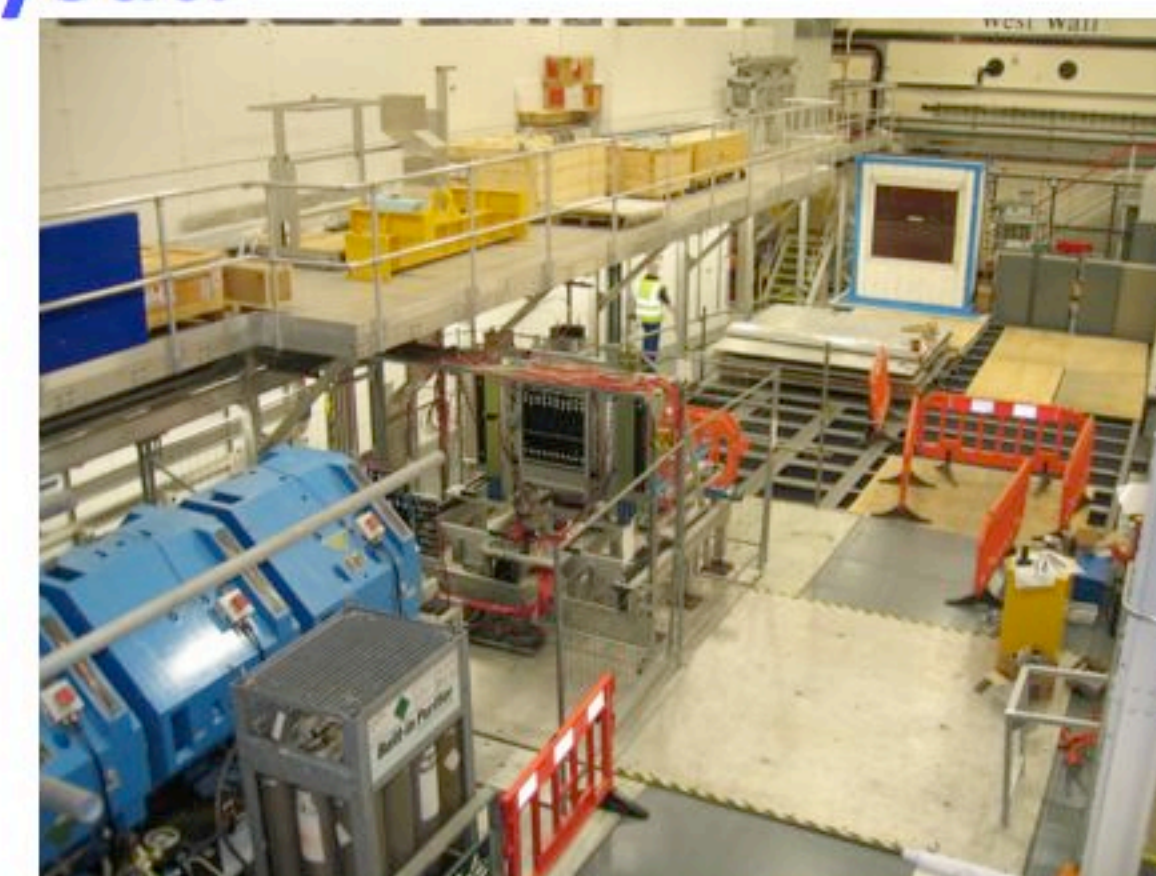


MICE components:

- 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

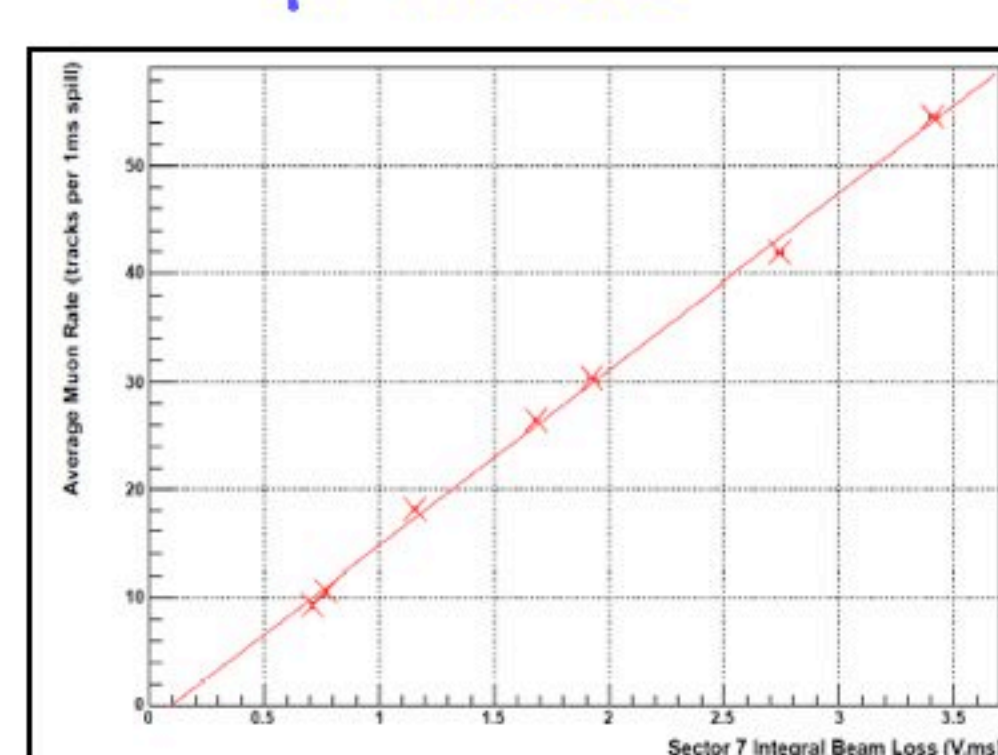
MICE Step I:

Layout:

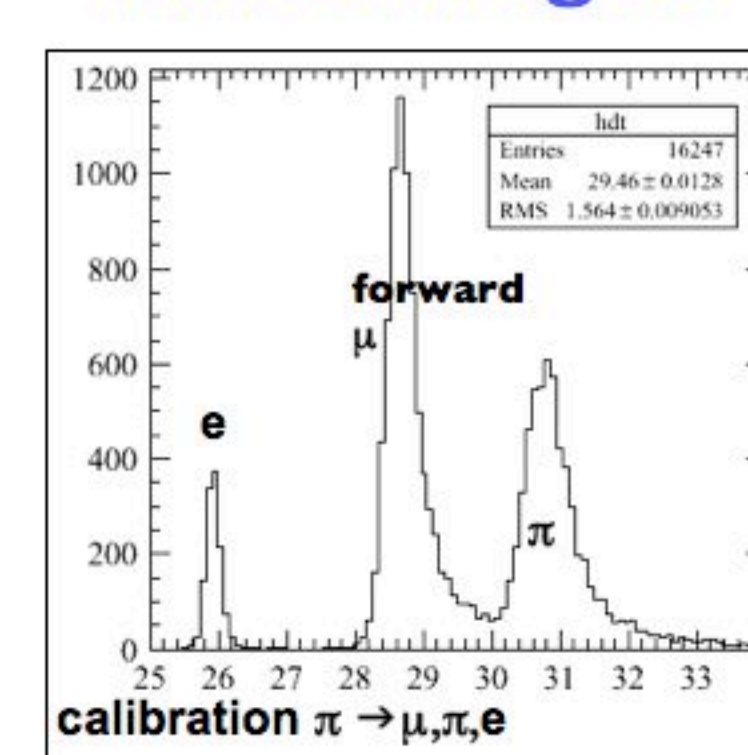


Particle ID / beam characterization:

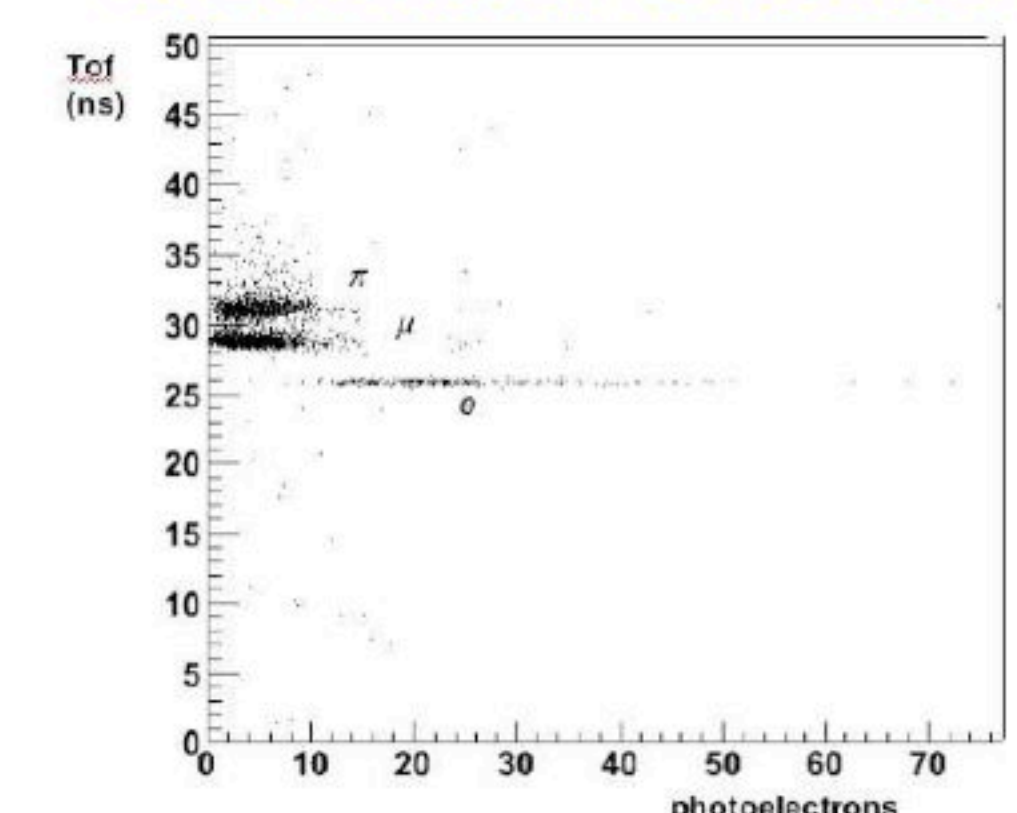
μ^+ losses



Time of Flight

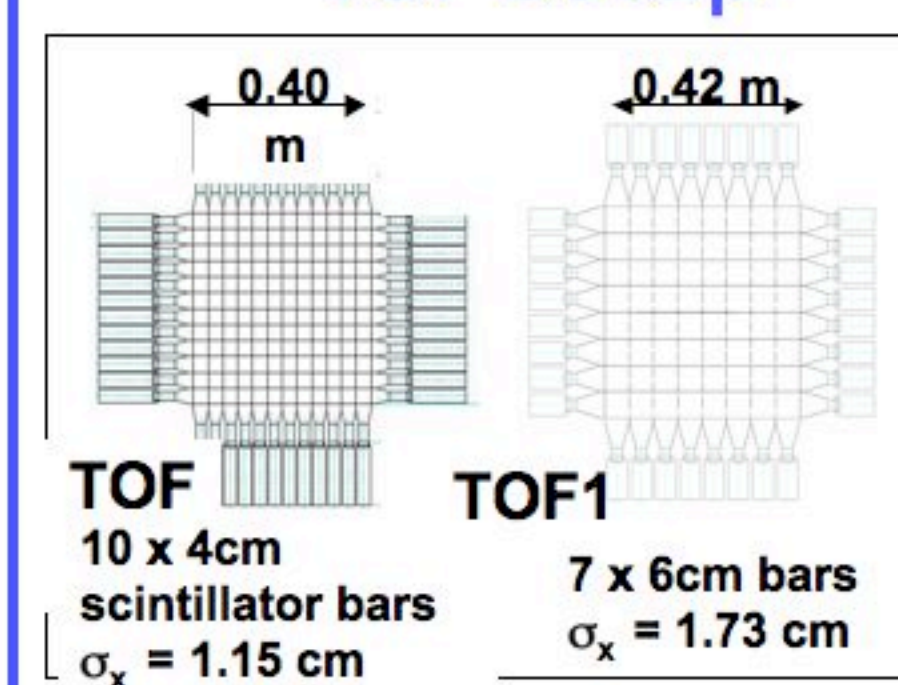


Cherenkov detector



Emittance measurement:

ToF setup



Muon beam transverse emittance

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

