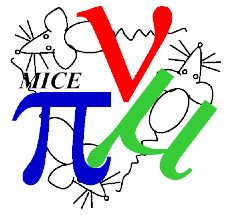


Progress in the construction of the MICE cooling channel and first measurements

Adam Dobbs, EPS-HEP, 23rd July 2011



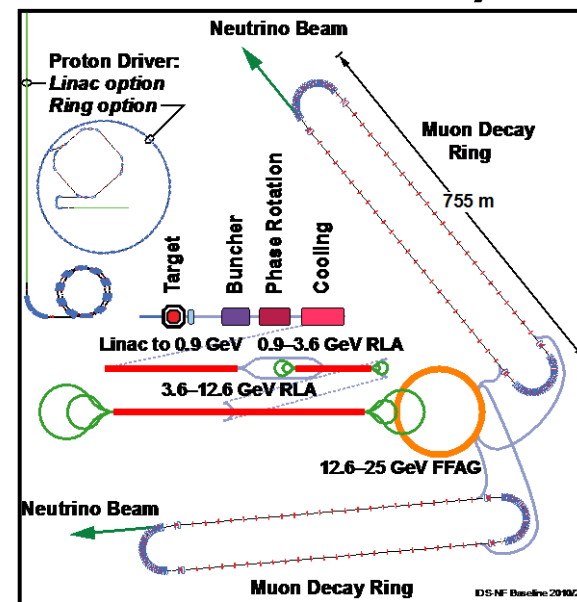
Outline

- I. Motivation: Neutrino Factory and Muon Collider
- II. Ionisation Cooling
- III. The MICE Experiment
- IV. The Beamline
- V. Emittance measurements
- VI. Particle Rates
- VII. Conclusion

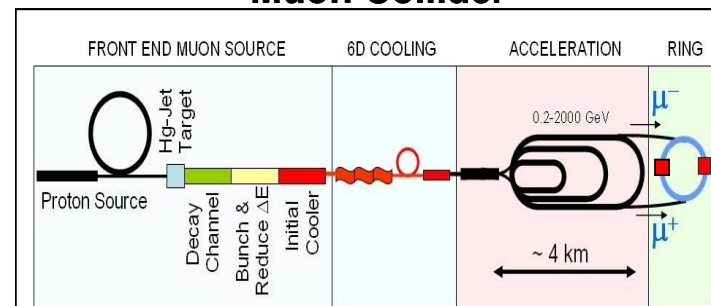
Motivation

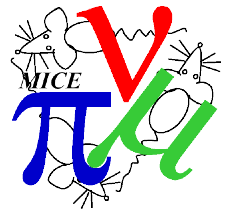
- ▶ **Neutrino Factory:** Best coverage of the oscillation parameter space of any proposed next generation oscillation experiment.
- ▶ **Muon Collider:** route to multi – TeV lepton – anti-lepton collisions. “Higgs factory”.
- ▶ Both types of muon accelerator with technology synergies:
 - ▶ Intense proton driver
 - ▶ Complex target
 - ▶ Muons from pion decay → Large initial emittance
 → **Muon cooling**

Neutrino Factory



Muon Collider





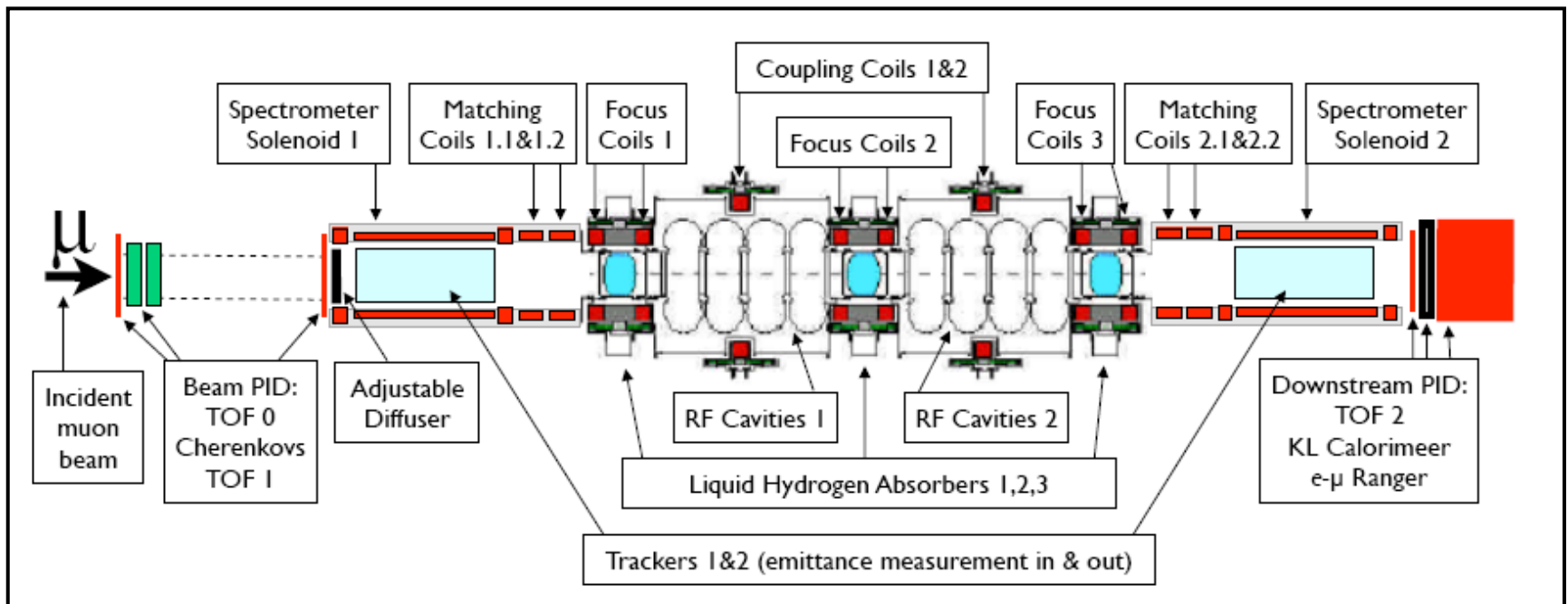
Muon Ionisation Cooling

- ▶ Traditional beam cooling techniques are too slow due to the short muon lifetime ($2.2 \mu\text{s}$ at rest)
 - ▶ Leads to concept of **ionisation cooling**
 - ▶ Beam momentum is reduced in all directions by passing beam through an absorber
 - ▶ Beam is re-accelerated in longitudinal direction
- Emittance reduction

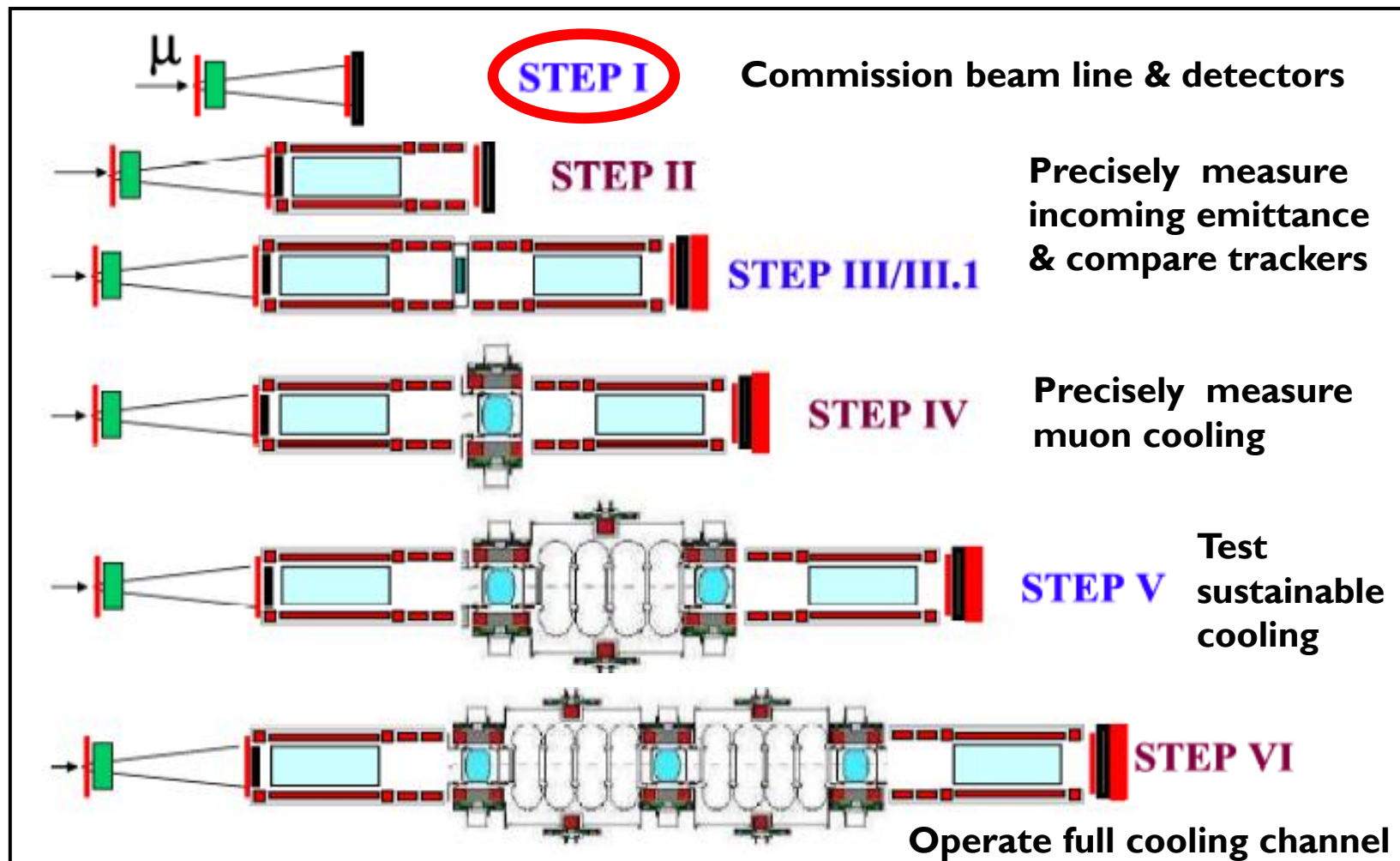


The MICE Experiment

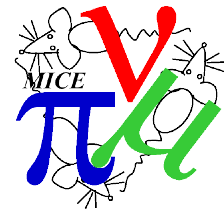
- ▶ Demonstrate muon ionisation cooling for application to a Neutrino Factory or Muon Collider
- ▶ Produce a 10% emittance reduction, with an absolute emittance measurement of 0.1%



MICE Steps

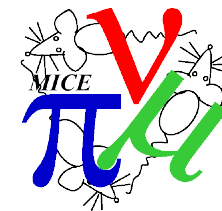


MICE Location

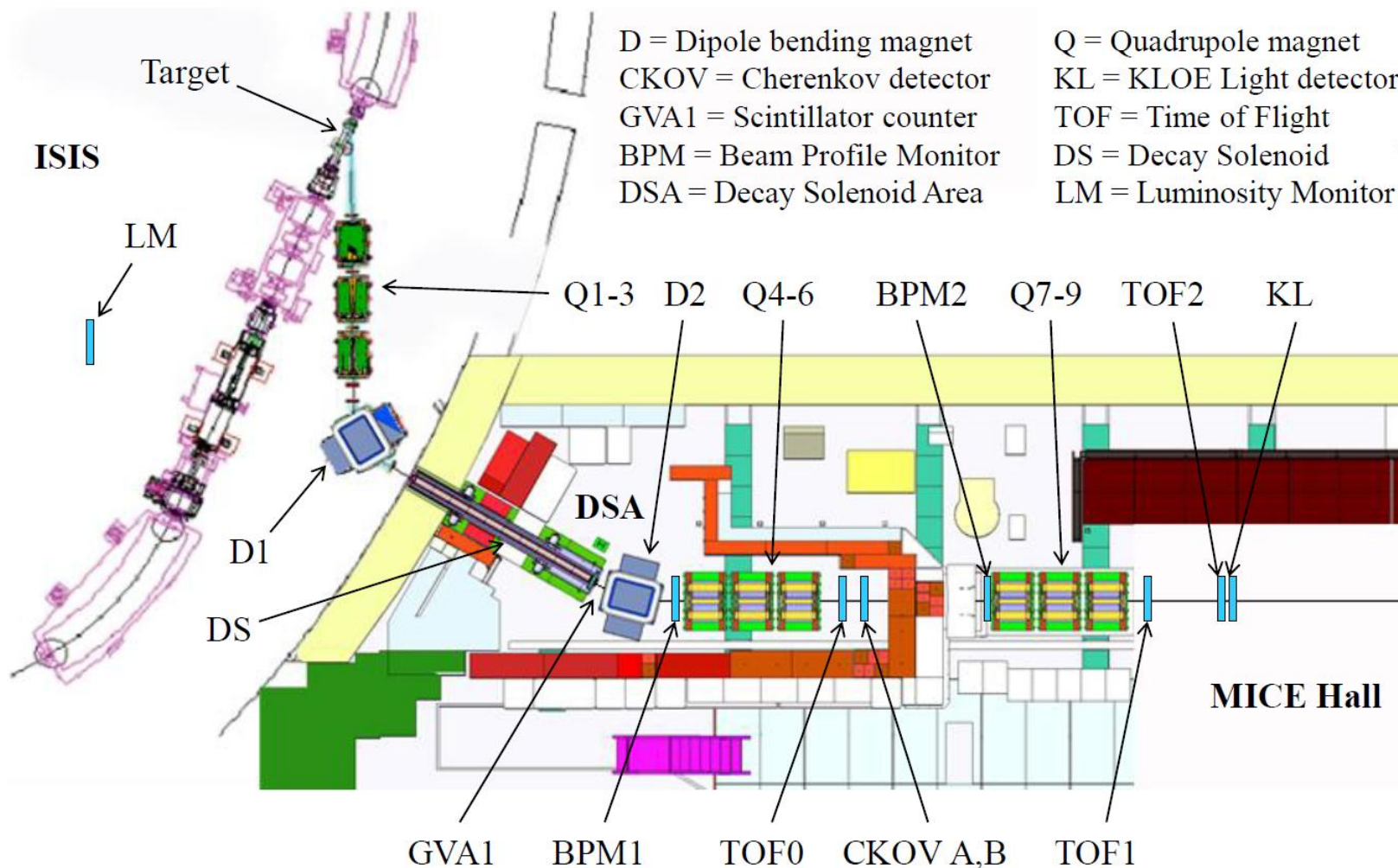


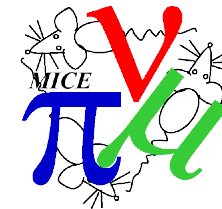
Hosted at the Rutherford Appleton Laboratory, U.K.

Proton driver provided by the ISIS 800MeV proton synchrotron



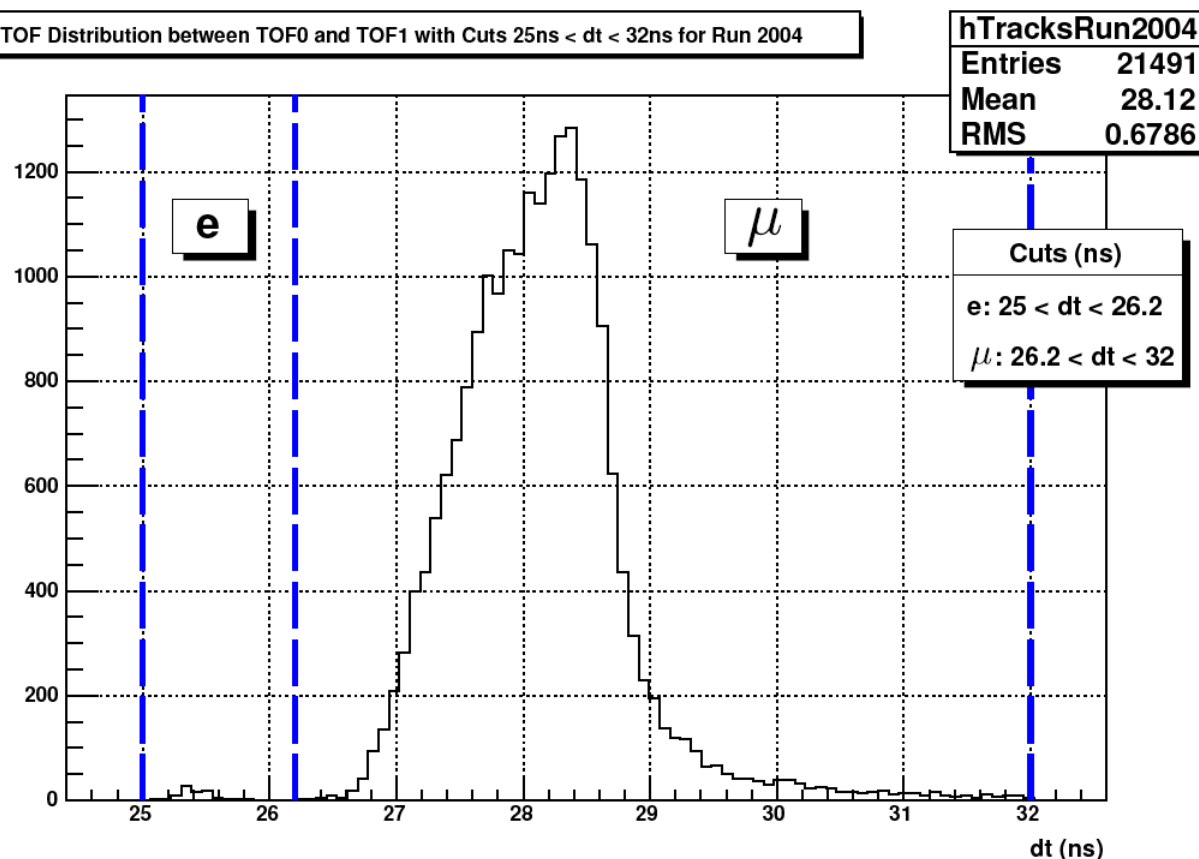
The MICE Beamline



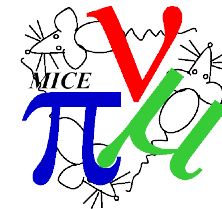


Particle Identification

TOF Distribution between TOF0 and TOF1 with Cuts $25\text{ns} < dt < 32\text{ns}$ for Run 2004



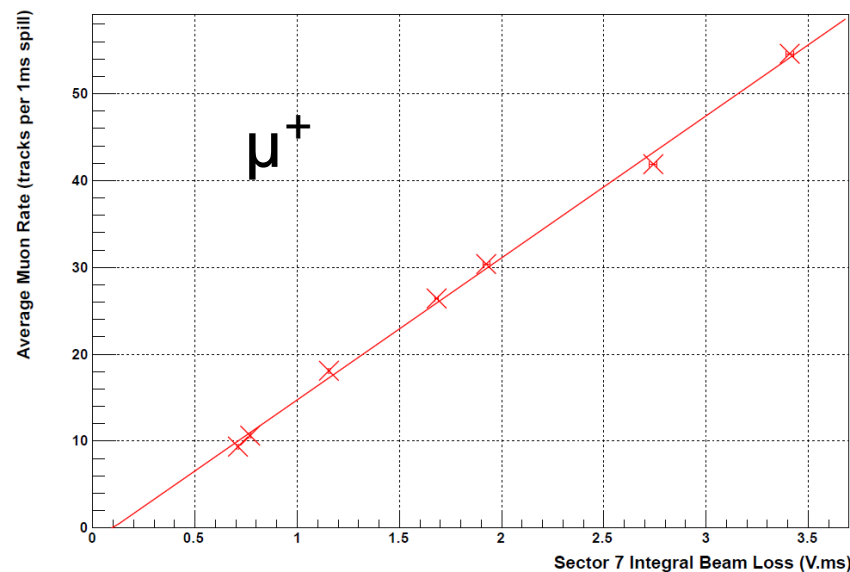
- ▶ PID from Time-of-Flight (TOF)
- ▶ Additional Pion – muon separation using CKOVs and Electron – Muon ranger (in commissioning)



Particle Rates

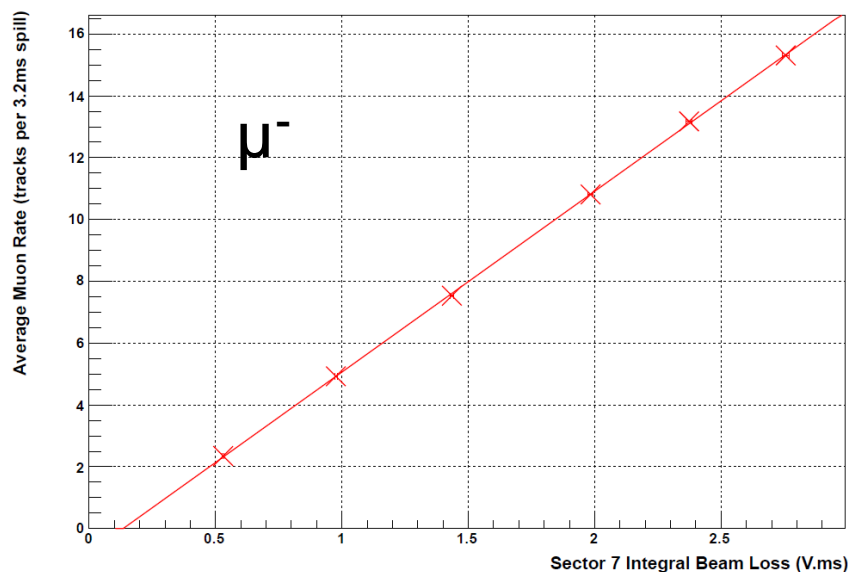
- ▶ Want 100s muons per spill
- ▶ Systematically study ISIS beam loss induce by MICE target and subsequent particle rate

Muon TOF Track Rate Vs Beam Loss with Cuts $26.2\text{ns} < dt < 32\text{ns}$ for 16th June 2010



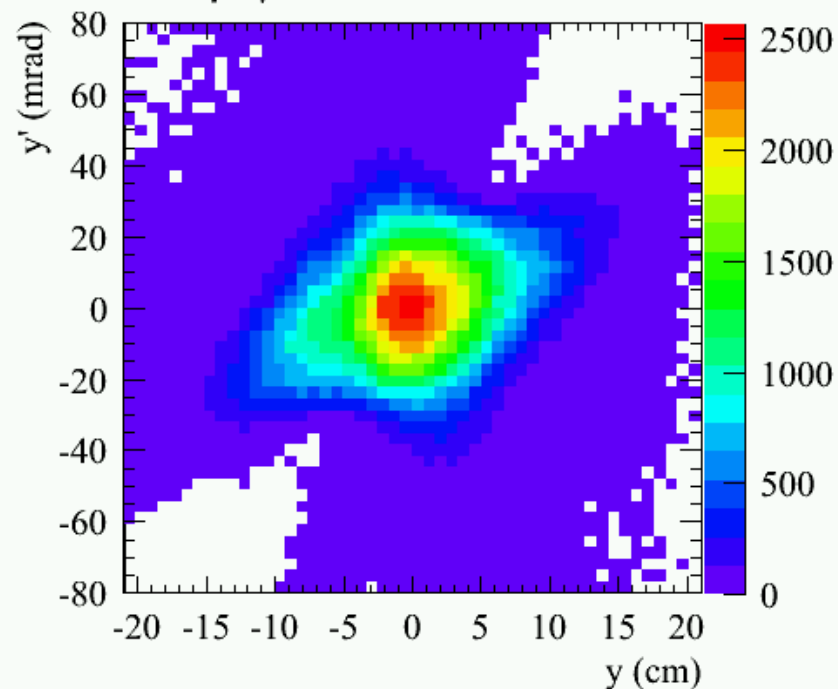
- ▶ Observe ~ 10 per 3.2ms spill at 2V.ms beam loss in μ^-
- ▶ ~ 30 per 1ms spill at 2V.ms beam loss in μ^+
- ▶ Dependant on beam optics

Muon TOF Track Rate Vs Beam Loss with Cuts $26.2\text{ns} < dt < 32\text{ns}$ for 15th June 2010



Beam Profile and Emittance

Base-line Step 1 μ^+ beam MICE data



Trace space plot showing beam emittance using TOF stations

Beam profile in real space using TOF stations

Base-line Step 1 μ^+ beam MICE data

