PROCEEDINGS OF SCIENCE

Progress towards completion of the MICE demonstration of ionisation cooling of muons

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The Muon Ionisation Cooling Experiment (MICE) based at the Rutherford Appleton Laboratory aims to demonstrate $10-20\%$ ionisation cooling of a beam of muons by its interaction with low Z absorber materials followed by restoration of longitudinal momentum in RF linacs. The apparatus required to achieve STEP IV of the experiment, includes the first absorber cell, of either liquid hydrogen or lithium hydride, sandwiched between two particle tracking spectrometers. Two very large superconducting spectrometer solenoids and one focus coil solenoid will provide a magnetic field of $\sim$ 4T in the volume of the two trackers and the absorber cell. The development, testing and integration of these challenging components will be reported.

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1. MICE

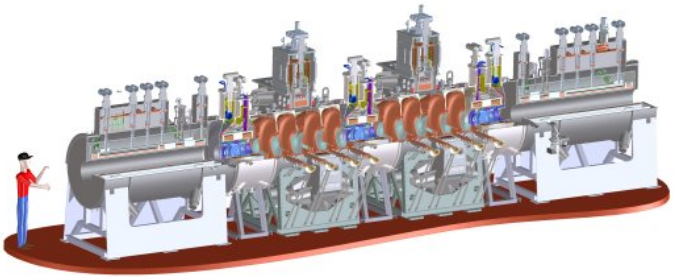

Figure 1: Layout of MICE (Step VI).

The Muon Ionization Cooling Experiment (MICE) [1] (Fig. 1) is under development at the Rutherford Appleton Laboratory (UK). The goal of the experiment is to build a section of a cooling channel that can demonstrate the principle of ionization cooling.

MICE expects to achieve [2] emittance cooling of at least 10% and to verify the cooling performance for various configurations and beam conditions. The experiment will be assembled, tested and operated in steps (Fig. 2), starting with the beam line and the detectors for particle identification and then progressively introducing the spectrometers, the absorbers and the RF reaccelerating cavities.

The beamline is now constructed and operational [3]. Its properties have been measured. The PID detectors (TOF0, TOF1, Ckov, TOF2, KL, EMR) are installed. They have been commissioned with 13×10^6 triggers collected in Step I. MICE Muon Beam meets all the requirements.

2. Progress towards completion of MICE Step IV

The physics Plan for Step IV includes measurements of the equilibrium emittance of a given absorber and for a given beta function and measurement of 6D emittance change, as well as preci-

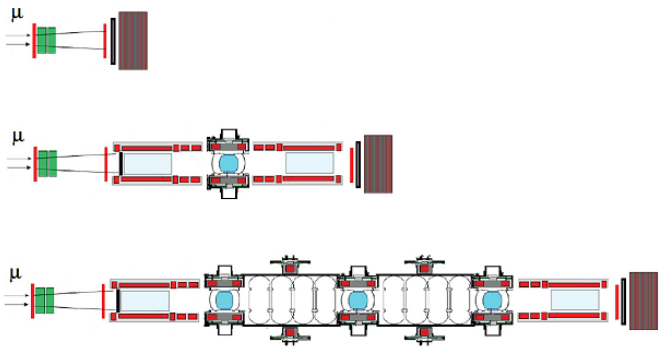

Figure 2: MICE schedule. Top: Step I; Middle: Stev IV; Bottom: Step VI.

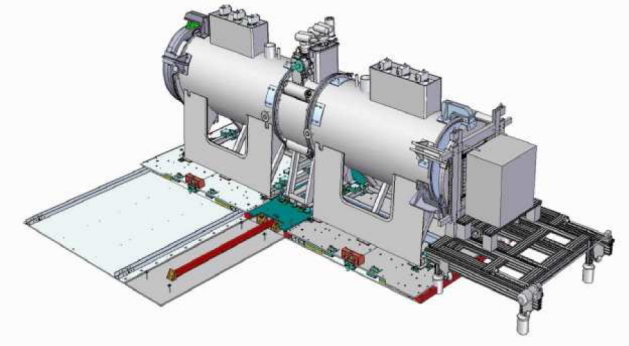

Figure 3: MICE Step IV (engineering drawing showing the two SS and the FC module).

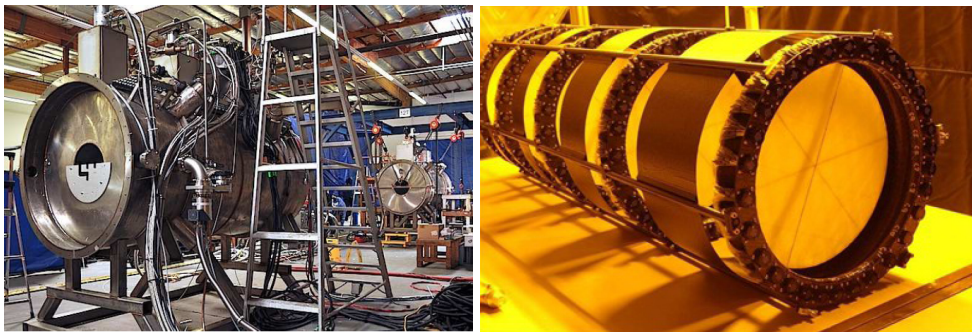

Figure 4: Left: Spectrometer solenoids; Right: Tracker detector

sion measurements of multiple scattering. Installation of the support infrastructure in the hall (Fig. 3) is well under way.

Both Spectrometer Solenoids (SS) are assembled (Fig. 4, left) and tested. Field mapping of SS2 has been completed and it is now at RAL. Both trackers (Fig. 4, right) have been extensively tested with cosmic rays [4]. A spare single station of the tracker has been tested at MICE beamline. The construction of the last element of the PID system - the Electron-Muon Ranger (EMR) is completed and first cosmic tracks have been seen. The detector in now under commissioning with beam at RAL. The liquid H_2 and LiH absorbers have been manufactured. Liquid H_2 system has been tested. The first AFC (absorber focusing coil) module being trained at RAL. 2MW RF power of the amplifier system has been achieved. Step IV is expected to be ready to take data in 2015.

References

[1] MICE web site *http://mice.iit.edu* contains detailed information about the experiment.

[2] MICE proposal, MICE note 21, (2003)

[3] MICE collab. , The MICE Muon Beam on ISIS and the beam-line instrumentation of the Muon Ionization Cooling Experiment, JINST 7 (2012) P05009, arXiv:1203.4089v2

[4] M. Ellis et. al., The design, construction and performance of the MICE scintillating fibre trackers, NIM A 659 (2011)136-153; arXiv:1005.3491v2