Status of MICE, the international Muon Ionization Cooling Experiment.

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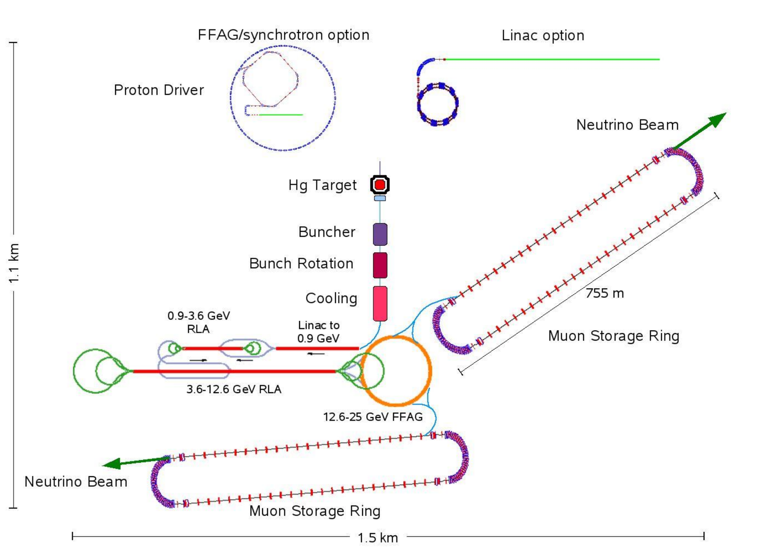
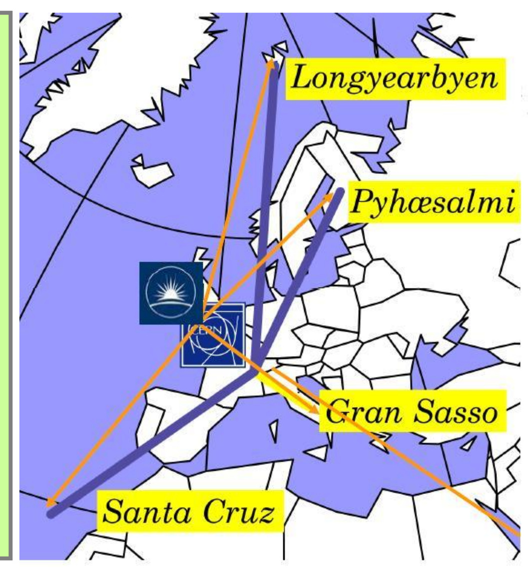
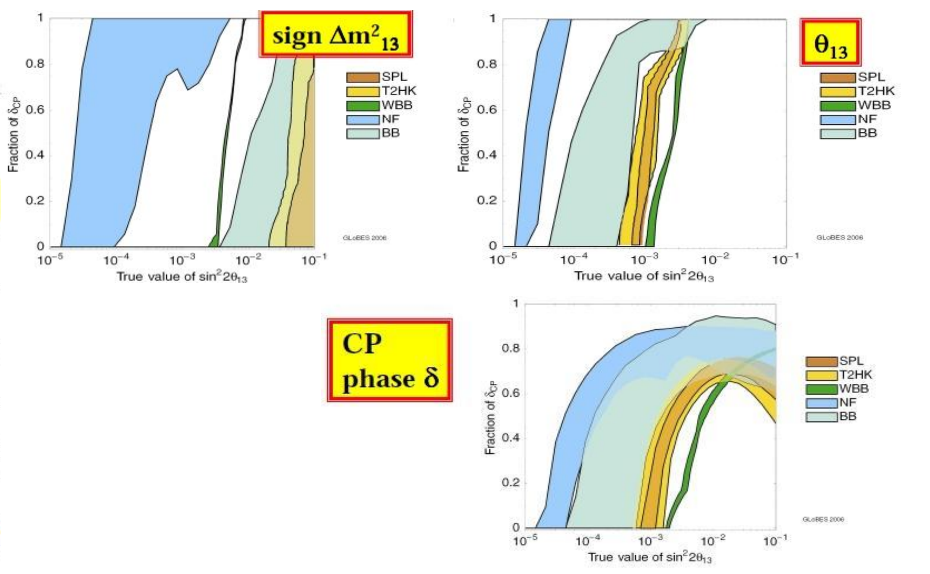
for the MICE Collaboration.

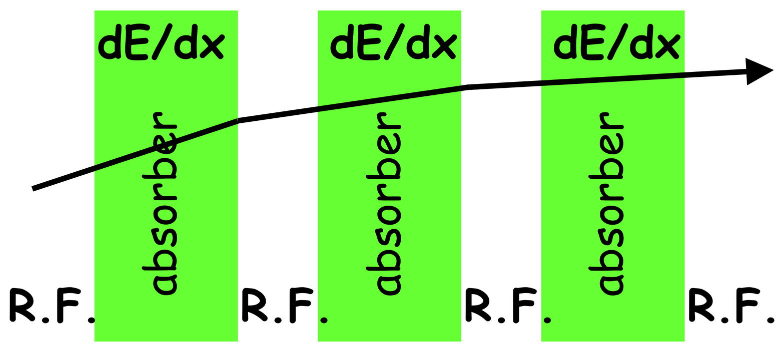


The Neutrino Factory based on a high-energy muon storage-ring is the ultimate tool to study the neutrino mixing matrix and is established as the best facility to discover, and study the possible leptonic CP violation. It will produce the most intense, pure and focused neutrino beam ($\nu_\mu + \bar{\nu}_e$ or $\bar{\nu}_\mu + \nu_e$) ever achieved and is also the first step towards a μ⁺ μ⁻ collider.



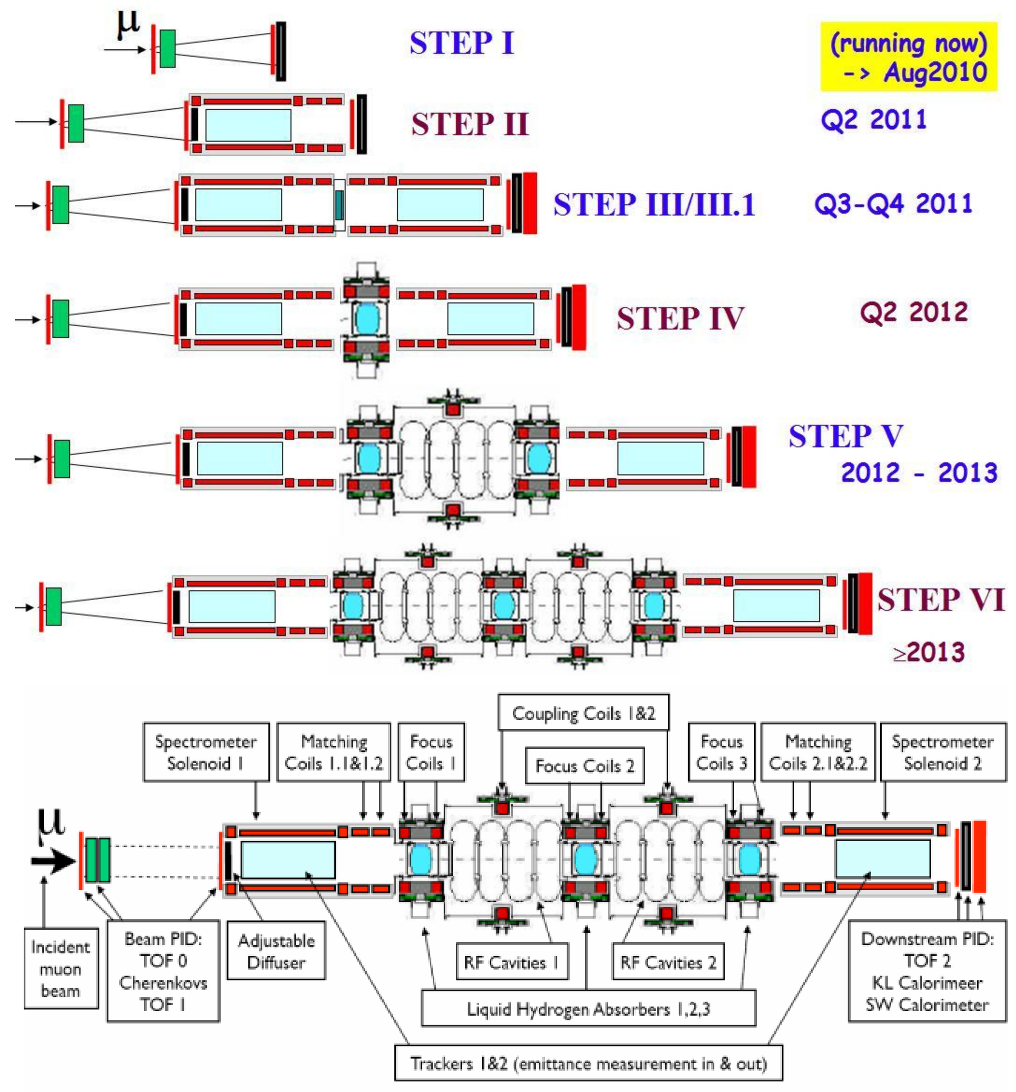


Muon ionization cooling technique provides the only practical solution to prepare high brilliance beams necessary for a neutrino factory or muon colliders because it is fast enough to cool the beam within the muon lifetime.



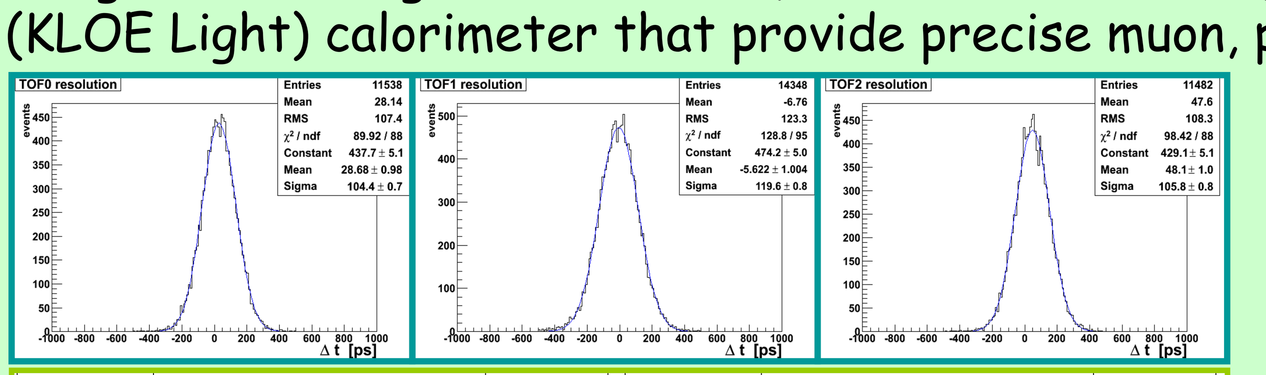
$$\frac{d\varepsilon_n}{ds} = -\frac{1}{\beta^2}\left\langle \frac{dE_\mu}{ds} \right\rangle \frac{\varepsilon_n}{E_\mu} + \frac{1}{\beta^3}\frac{\beta_\perp (0.014)^2}{2E_\mu m_\mu X_0}$$

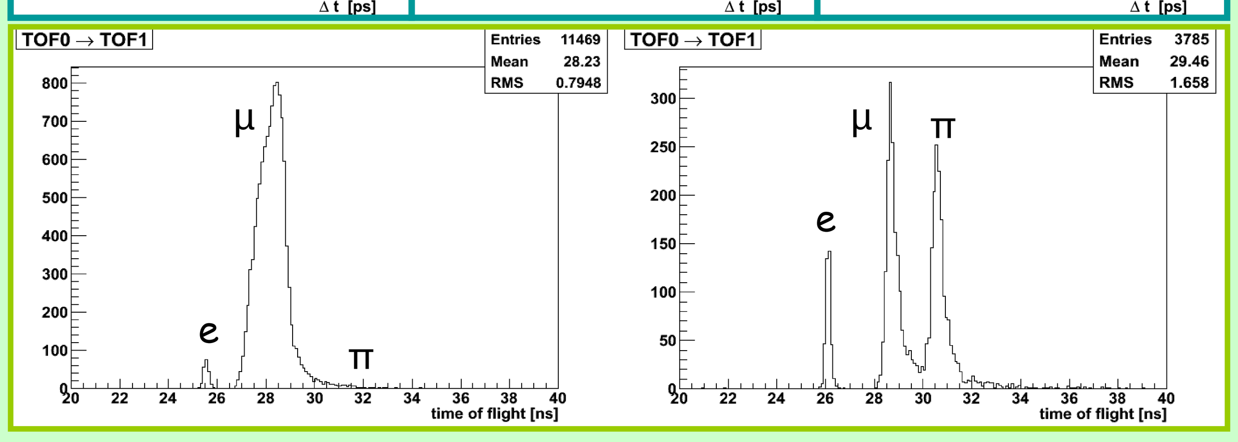
cooling **heating**



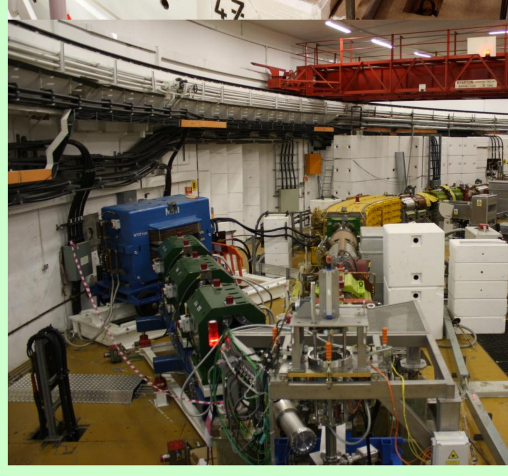
The Muon Ionization Cooling Experiment (MICE) is under development at the Rutherford Appleton Laboratory (UK). The goal of the experiment is to build a section of a cooling channel that can demonstrate the principle of cooling and to prove this by measuring its performance in a muon beam. The experiment will be assembled, tested and operated in six stages (steps). Each step will validate one part of the setup, starting with the beam line and the detectors for particle identification and then progressively introducing the spectrometers, the absorbers and the R.F. units. The final setup will be able to measure a 10% reduction in emittance (size) of the beam with a precision of 1%.

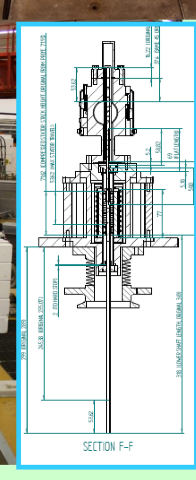
Step I (RUNNING NOW): measures the particle content of the muon beam, using time-of-flight detectors (TOF0, TOF1, TOF2), Cherenkov detectors and KL (KLOE Light) calorimeter that provide precise muon, pion and electron identification.





Measured resolutions of the time-of-flight detectors:
TOF0 – 52ps, TOF1 – 60ps, TOF2 – 53ps.
Time-of-flight distributions.
Left: high emitance muon beam with small contamination of electrons and pions will be used to demonstrate the ionization cooling.
Right: low emitance beam for calibration of the detectors. Electrons, muons and pions fall into three well defined peaks.

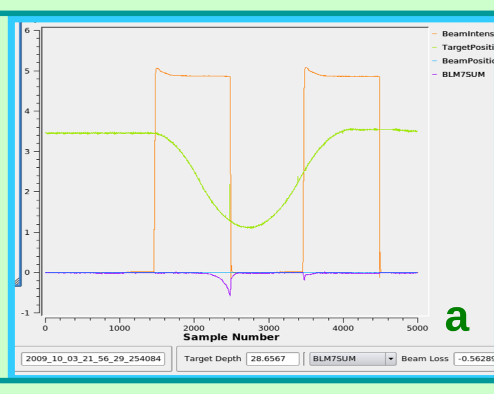


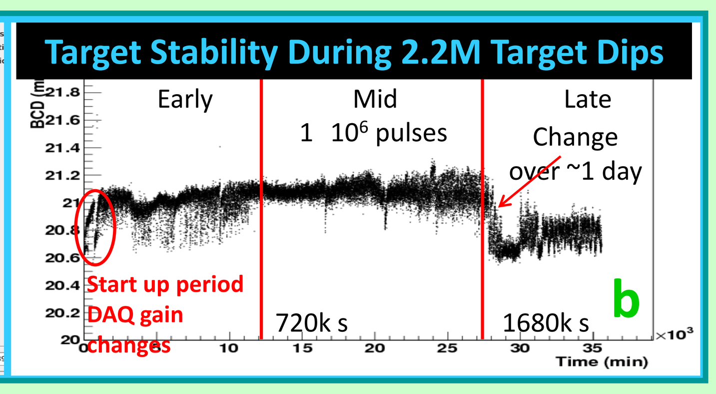


Top: panoramic view of the MICE experiment hall.
Bottom left: The MICE target area and the extraction of the secondary beam from the ISIS ring, plus technical plot of the target mechanism.

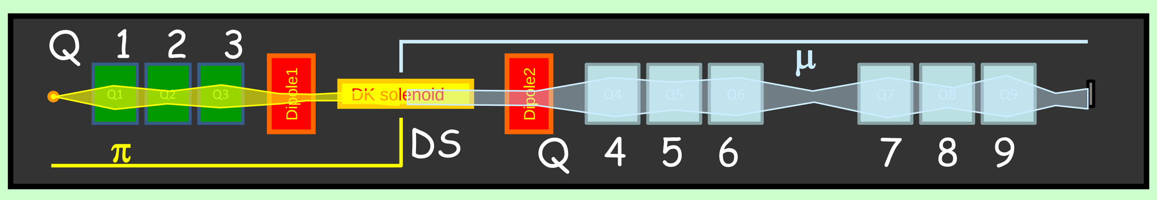
The current **MICE target** was installed in ISIS in September 2009. Since then, it has performed exceptionally well. Methods have been developed to regularly monitor target stability, including maximum target depth. Target operation studies have also been done to improve beam line performance.

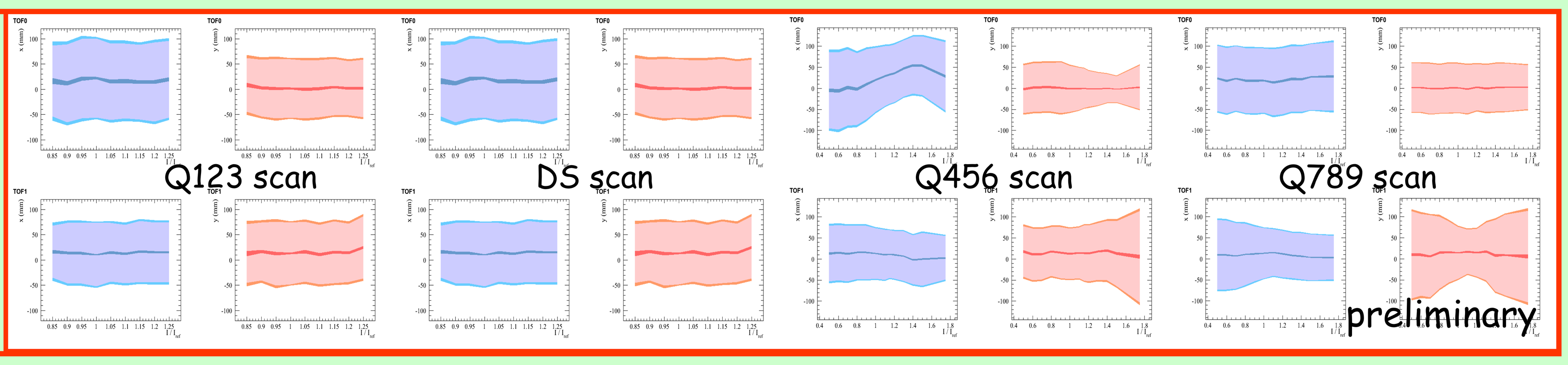
Left (a): target DAQ display showing ISIS beam intensity (orange), MICE target position (green), and beam loss (purple). **Right (b):** target (dip depth) for a run with 2.2M successive target dips.





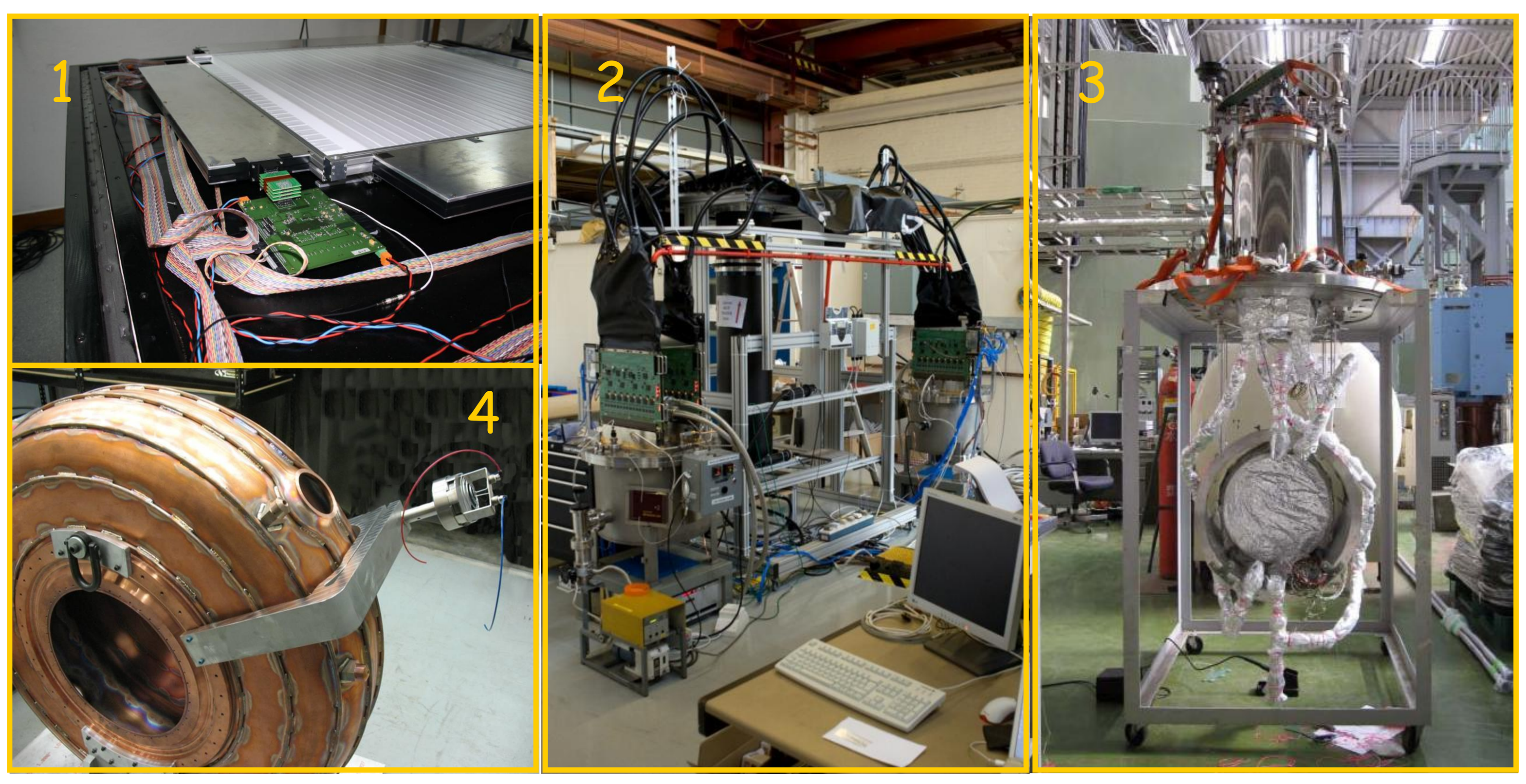
The effect on beam size and position of varying magnet currents around their reference values has been studied. The plots show 1σ measurement errors on the mean position and the RMS beam size.





Preparation for the next steps is in progress.

1. The **Electron Muon Ranger (EMR)** is in construction now. Tests of a single module have shown a high efficiency and spatial resolution. The full detector, with 40 modules and magnetic shielding, will be ready for installation in MICE by February 2011.
2. Both **trackers** are presently being commissioned in a cosmic-ray test stand and are ready to be installed each in its spectrometer magnet. Delivery of the first magnet will open Step 2.
3. Cooling test of the first **liquid H_2 absorber** was finished in December 2009. Assembly of the second absorber is in progress now.
4. The fabrication of the first five **R.F. cavities** and beryllium windows was completed. Measurements of the electromagnetic properties of the cavities are going now.



The MICE Collaboration - http://mice.iit.edu