Progress with the MICE Scintillating fibre trackers

Edward Overton on behalf of the MICE tracker group

The MICE Experiment

The reduction of beam emittance is a requirement for a future Neutrino Factory or Muon Collider, a task which must be performed quickly due to the short muon lifetime. Ionisation cooling reduces the total momentum of the muons by passing the beam though an absorber material, followed by the restoration of only the longlitudinal momentum using RF cavities.

The goal of the Muon Ionisation Cooling Experiment (MICE) is to produce a cooling channel long enough to provide a 10% emittance reduction of a muon beam. The beam emittance will be measured before and after cooling with an absolute accuracy of 0.1% using a range of particle detectors.

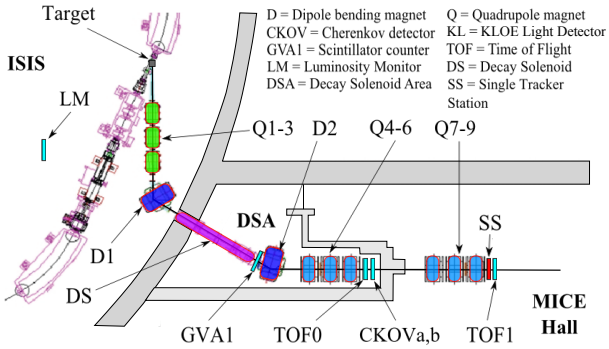

Figure 1: MICE beamline configuration used for the single tracker station test.

The Fiber Tracker

Two scintillating fibre trackers have been built, each one comprised of 5 individual tracking stations. At each station three planes of 350μm diameter scintillating fibre are orientated at 120° to each other, enabling a precise position measurement of a traversing particle. The tracker will then be fitted inside a 4T solenoidal field, allowing the longitudinal and transverse momentum of a particle to be found. Cosmic ray testing has verified the light yield and performance of the trackers, finding the mean light yield to be 11.23±0.01 PE.

Progress

The completion of the tracker cosmic ray tests and MICE Step I running have provided an opportunity to test a single spare station of the tracker inside the MICE beamline. The test was performed by installing the station between Q9 and TOF1 as seen in figure 1. The readout electronics which will form part of the complete system were included in the MICE DAQ and the integration gate for the front end boards was synchronised to particles in the MICE beam using an ISIS diagnostic signal. The successful completion of the test has enabled the light yield of the station for a range of low momentum muon beams to be found and the reconstruction efficiency to be studied.

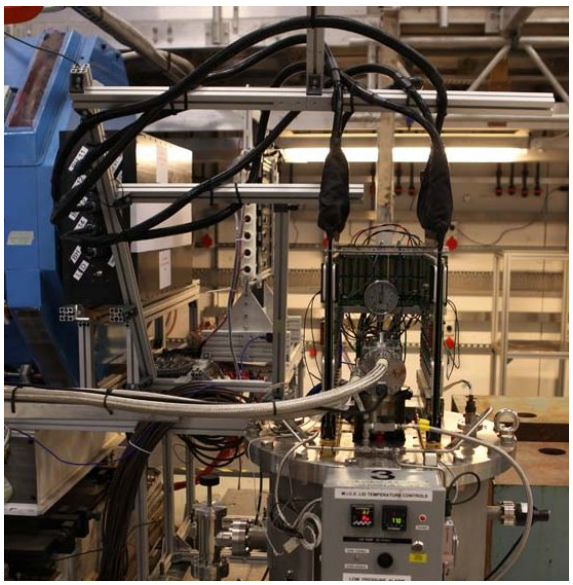

Figure 2: The single station mounted between Q9 and TOF1, with waveguides connecting the station to one of the four readout cryostats containing VLPCs and AFE-IIt readout boards.