Totally Active Scintillator Calorimeter for the Muon Ionization Cooling Experiment

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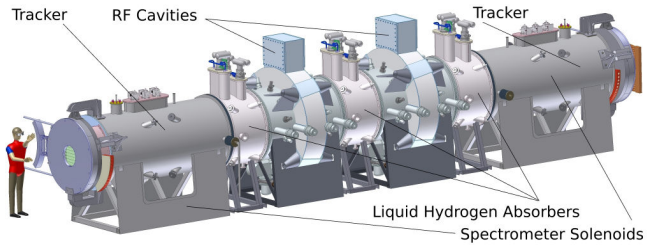
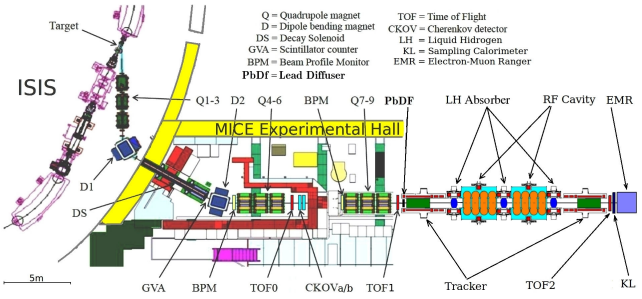
on behalf of the MICE Collaboration

1 Introduction

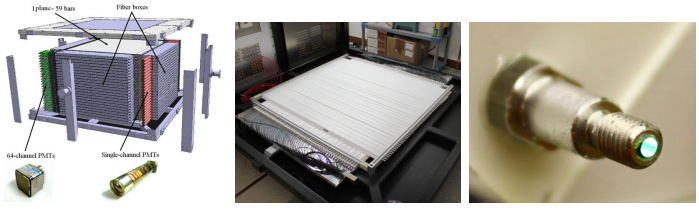
The Electron-Muon Ranger (EMR) is a totally active scintillator detector to be installed in the muon beam of the Muon Ionization Cooling Experiment (MICE)[1] - the R&D project for the future neutrino factory.



It is located at Ratherford Lab (RAL) in UK. The ISIS synchrotron at RAL accelerates high intensity protons up to 800 MeV that hit an internal target that provides a source of pions for a pion to muon decay channel, and thereby muons for MICE. The momentum of muons is around 200 MeV/c. The EMR will be installed at the very end of the MICE downstream detection system and will stop and measure properties of all outgoing particles and will help to reject decay electrons.

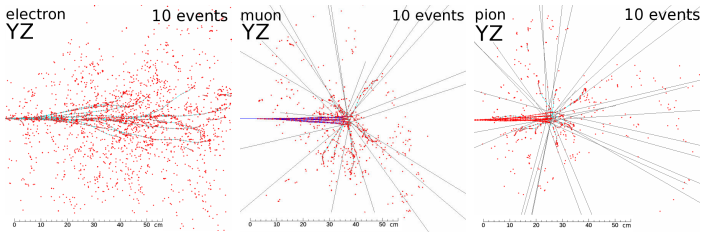


The detector is made of 48 planes of 59 scintillator bars each located in X-Y geometry. Each plane is read out on both sides by single anode PMT (total energy deposition per plane) and 64-channel PMT (individual bar readout)

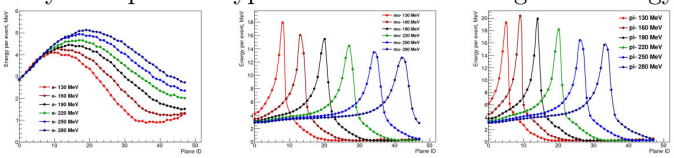


2 EMR Simulation and Physics

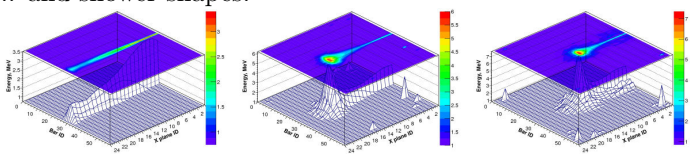
The EMR was simulated in Geant and particle identification and tracking capabilities were studied. Below are displays of 10 events from electrons, muons and pions.



Due to the high granularity of the detector it is possible to identify each particle type and measure its range and energy:

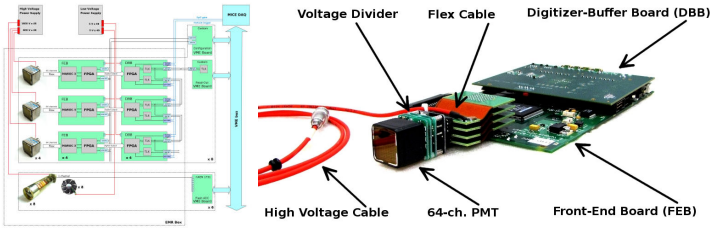


.. and shower shapes:



3 Electronics

The EMR has dual readout. Fibers from one side of a plane are bunched together and directed to a single-anode PMT which is readout by one flash ADC (CAEN V1731), there are 6 fADCs in total. Fibers from the other side of a plane are coupled to a 64-ch. PMT that is readout by custom-made FPGA based electronics:



4 Summary

The EMR is aimed at measuring properties of a low energy beam composed of muons, electrons and pions performing the identification particle by particle. It is shown that the granularity of the detector makes it possible to identify tracks and measure particle ranges and shower shapes. The read-out is based on FPGA custom made electronics and commercially available modules. Currently it is being built at the University of Geneva and it is planned to install it in MICE in the first quarter of 2013.

References

[1] http://mice.iit.edu/