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Beam monitoring detectors for High Intensity Muon Beams

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Currently PSI delivers the most intense continuous muon beam in the world with up to few $10^8 \mu\text{/s}$ and aims at keeping its leadership upgrading its beamlines within the HIMB project to reach intensities up to $10^{10} \mu\text{/s}$, with a huge impact for low-energy, high-precision muon based searches.

Here we present two novel beam monitors designed for the current PSI beams and that will be upgraded for the HIMB operations: the scintillating fiber (SciFi) detector, a grid of scintillating fibers coupled to SiPMs, and the MatriX detector, a matrix of plastic scintillators coupled to SiPMs.

The advantage of these highly segmented detectors is to be able to withstand high magnetic fields (up to 1.25 T) and to measure the full beam rate at once.

The final version of the SciFi detector is going to be assembled in 2022 to be included permanently along the MEG II beamline and it will include an insertion system to perform measurements at demand. As a grid of fibers it is quasi non-invasive and 80 % of the beam passes through without being affected by the detector: it could be used for real time monitoring of the muon beam during data taking. It is able to perform particle ID through energy deposition and TOF measurement.

The final version of the MatriX detector is going to be assembled in 2022. It is thought to be used for beam tuning in high magnetic field environment and can easily be redesigned to fit space requirements. A major upgrade from the prototype will be the use of thinner scintillators, from 2 mm to 250 μm in thickness, and the introduction of a plexiglas light guide between the scintillator and the sensor to stop low energy particles and increase separation with MIPs.

The performances of these detector as measured along the beamline, their detailed MC simulations and the beam characteristics will be presented.

Collaboration

MEG II

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