Contribution ID: **31** Type: **Plenary Talk**

# Material Identification with Cosmic Ray Muons using RPCs

*Thursday, 22 February 2018 16:40 (20 minutes)*

High energy cosmic ray muons are a suitable source for imaging larger and denser materials due to their high penetration power and considerably large life time (˜2.2 μs). We plan to build an imaging setup for material identification utilizing the Coulomb scattering of cosmic ray muons due to their interaction with the materials and tracking their trajectories with RPCs. To begin with, we consider a setup of six RPCs stacked in a parallel manner to read the position and timing information of the muons before and after their interaction with a phantom of a given material using a set of three RPCs for each phase. Here we present a simulation work carried out to study the image formation of a phantom of several materials produced in the present setup. A detailed modeling of the imaging system along with the RPCs is done using GEANT4 [1]. Several materials across a wide range of atomic numbers like Al, Fe, Pb, U, are considered as phantoms of a given dimension. Monte Carlo simulations are used to generate cosmic ray muons with the appropriate distribution of energies and momenta. The muon track reconstruction is done following two well established methods, Point of Closest Approach (PoCA) and Maximum Likelihood Scattering method (MLS) [2]. The performance of the image discrimination method based on the muon scattering is studied by receiver operating characteristics (ROC) analysis. The number of events and the time required to discriminate different materials and producing the image of the phantoms are estimated.
Currently, the imaging system along with six Bakelite RPCs with 2 mm gas gap and area 30x30 cmˆ2 are under construction. The readout plane for each RPC is equipped with parallel strips of width 1 cm and pitch 1 mm. The corresponding front-end electronics (FEE) and data acquisition system (DAQ) development is going on. A few preliminary test results on the developmental work are expected to be presented in the workshop.

References:
[1] S. Agostinelli, et al., "GEANT4 –a simulation tool kit,"Nuclear Instruments & Methods A506 (2003) 250303.
[2] M. Hohlmann, et al., "GEANT4 Simulation of a Cosmic Ray Muon Tomography System with Micro Pattern Gas Detectors for the Detection of High Z Materials", IEEE Transactions on Nuclear Science 56 (2009) 1356.

## Vidyo?

yes

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**Session Classification:** Simulation: Imaging and Muon Tomography