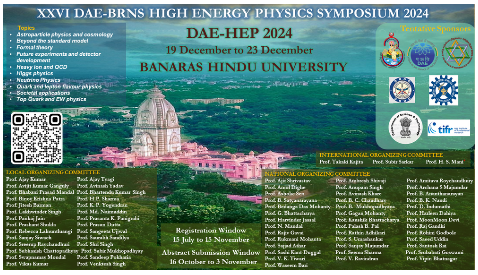

Contribution ID: **478**

Type: **Oral**

Material Identification and Binary Classification of High-Z Materials in Cosmic Muon Imaging using PRM and Deep CNN

Muon Scattering Tomography (MST) is an effective technique for identifying special nuclear materials (SNM) in cargo transporting across borders, posing a significant threat to homeland security. Images of SNM and other materials in cargo can be produced on the basis of scattering suffered by cosmic mons while passing through the objects. The magnitude of scattering is known to be dependent upon the atomic number and density of the object material for a given muon momentum. The production of such images can be accomplished by tracking incoming and outgoing muons with position sensitive detectors followed by reconstruction of the respective trajectories and calculation of the scattering angle using suitable algorithms. Further, the images are analyzed for discrimination of materials and their identification.

In the present work, an image processing protocol is proposed with the help of simulated images for a prototype MST setup which is currently under construction. The images were produced from analyzing scattering angles within the target material using the Point of Closest Approach (PoCA) algorithm and further processed with a Pattern Recognition Method (PRM). Kernel shapes used in the PRM were varied to improve the model's ability to define boundaries. Following this, Deep Convolutional Neural Network (DCNN) was employed to classify different materials. The model was trained using histogram images generated from the density of PoCA points and the scattering angles of muons in various materials, like Aluminium (Al), Iron (Fe), Lead (Pb), Uranium (U) etc. as simulated with GEANT4. Different filters including the same kernels used in PRM have been implemented to optimise the model. Several other parameters were also optimised, and the Receiver Operating Characteristic (ROC) curve was generated to compare performance across models. The highest Area Under the Curve (AUC) observed was 0.9921, with an overall model accuracy of 95% for classification between Uranium and Lead.

Field of contribution

Experiment

Author: Mr GHOSH, Saikat (Saha Institute of Nuclear Physics, A CI of Homi Bhabha National Institute, Kolkata 700064, India)

Co-authors: Ms SINGH, Sreeja (School of Engineering and Technology, Adamas University, Barasat, Kolkata 700126, India); Mr DUTTA, Shubhabrata (Saha Institute of Nuclear Physics, A CI of Homi Bhabha National Institute, Kolkata 700064, India); Mr DAS, Subhendu (Saha Institute of Nuclear Physics, A CI of Homi Bhabha National Institute, Kolkata 700064, India); Mrs MAJUMDAR, Nayana (Saha Institute of Nuclear Physics, A CI of Homi Bhabha National Institute, Kolkata 700064, India); Mr MUKHOPADHYAY, Supratik (Retired from Saha Institute of Nuclear Physics, A CI of Homi Bhabha National Institute, Kolkata 700064, India)

Presenter: Mr GHOSH, Saikat (Saha Institute of Nuclear Physics, A CI of Homi Bhabha National Institute, Kolkata 700064, India)

Track Classification: Societal applications