ID contributo: **13** Tipo: **Oral Contribution**

A neural network based algorithm for MRPC position reconstruction

giovedì 13 febbraio 2020 09:30 (20 minuti)

Multi-gap Resistive Plate Chamber (MRPC) is a well-preformed gasous detector with good efficiency, high position and time resolution and low cost. In the recent years, muon tomography has attracted much attention due to its possible application to detect high Z materials. Precise measurements of the incident and outgoing angles of the cosmic muons are mandatory in this application. Large size MRPC with sub-millimetre position resolution should be an ideal candidate for the detector system. Prior work on improving the position resolution of MRPC mainly focuses on adjusting read-out panel and the detector geometry, while little work has been done on improving the position reconstruction algorithm.
The traditional method of the center of gravity (COG) for position (and other) measurements is extremely widespread in scientific and practical applications, which are far too numerous to list here. However, the use of the COG introduces a systematic error (discretization error) in measurement due to its origin in the discretization of the signal collection. This paper proposes a new position reconstruction algorithm based on the deep neural networks(NN) which gives a better result than COG method. This work is based on a standalone simulation of a 5-gap MRPC detector with 2.54 mm strip pitch.
A detailed simulation based on Maxswell and Geant4 is carried out and the noise and crosstalk compared to the experiment are introduced. Thus, we can easily get the signal charge and the discrete points of each strip, which will be feed into the network as input (features). Labels in the NN are the truth position where particles impinge into the detector. Finally it is trained to find the best prediction. X-ray test based on this 5-gap MRPC detector is carried out in our lab. The position resolution of this prototype with the deep learning based algorithm and the COG method will be given.

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