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Investigation of THGEM technology for nuclear security applications

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Thick gaseous electron multiplier detectors are cheap, robust and scalable to large areas. Here we consider the application of THGEM technology to cosmic-ray muon scattering tomography in support of nuclear security. Muon tomography applications include the passive scanning of cargo containers for regions of abnormally high density, indicative of concealed special nuclear material. THGEMs are suited to this application as they are inexpensive and can be produced with large areas. THGEMs also have potential in response applications which require lightweight, high resolution, portable cosmic-ray tracking systems.

In support of these advantages, a preliminary experimental study was conducted. This work focussed on the design and characterisation of a 100×100 mm double THGEM detector with boards of 0.8 mm thickness, 1 mm hole diameter, 1.5 mm pitch and a rim width of 0.1 mm. The boards were operated in a Ar:CH4(95:5) gas mixture at a pressure of 1 atm. The detector readout was processed using a DRS4 evaluation board operated at a sampling rate between 0.7 GSPS to 5 GSPS. Each THGEM board was operated up to 2 kV, with transfer fields up to
1.1 kVcm-1.

A study of the pulse structure revealed a typical rise time of 3 to 4 ns, with a pulse height significantly above noise levels. The results also show good agreement between the operating point and breakdown voltage of the THGEM and Garfield ++ simulations. Through the comparison of THGEM detector to the coincidence of two scintillator detectors (using a DRS4 evaluation board), allows assessment of the THGEM efficiency.

Whilst this paper presents research focused on cosmic ray muon particle tracking, we discuss the applicability of THGEM detectors to other security
applications. These include, but are not limited to, the development of equipment for arms control and treaty verification, alongside the possibility for radiological detection using electron tracking within Compton Camera or Compton Tomography arrangements.

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