Designing and Making a Particle-track Imaging Demonstrator

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This detector exploits a new technique of electron multiplication to produce a visual image of the track of where a particle has been.

How it works

A negatively charged particle will leave a path of ionised* atoms as it passes through a box of gas, and the principle of this detector is to use the electrons given off during ionisation to trace where the negatively charged particle has been.

An electric field can then be used to direct these electrons towards the detector, passing first through an amplifier, in this case THGEMs.

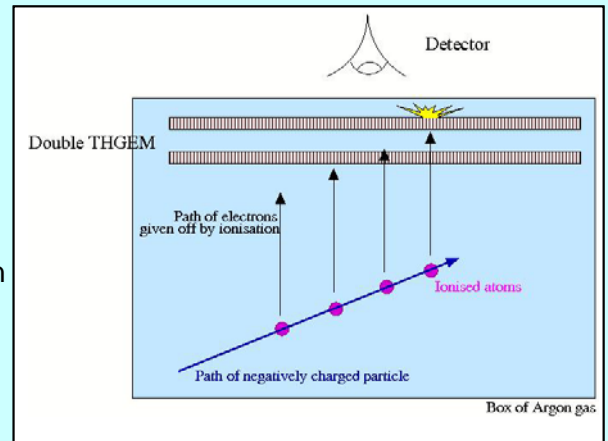*Ionisation: when an atom loses or gains an electron, and hence becomes charged*

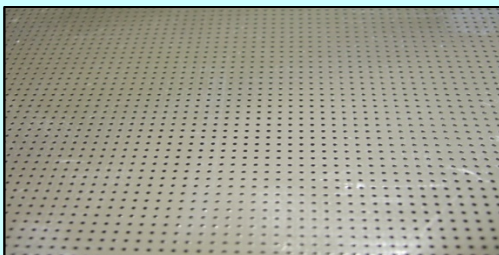*Fig1: Schematic Diagram of the detector setup*

Fig 2: Photograph of a THGEM – a printed circuitboard (PCB) with small holes in it

THGEM (Thick Gas Electron Multiplier)

In the detector set-up, the THGEM works as an amplifier, increasing the number of electrons by a factor of up to 10^6, hence making their position easier to detect.

When a large amount of charge is produced, the THGEM hole nearest to the surplus of charge will spark. This is detectable by the human eye.

Comsol

Comsol is a Finite Element Calculation programme which can be used to model physical situations. It was used to model changes in the electric field strength due to geometric differences in the THGEMs, such as distance between holes, PCB thickness, and diameter of holes, and hence some idea of the optimum was determined.
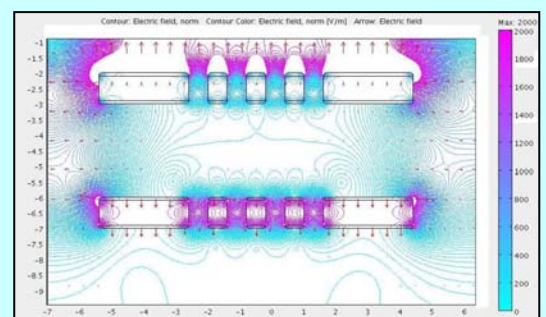

Fig 3: Electric field contour patterns for a cross-section of the detector, as generated by Comsol

The Final Product

After designing, developing and building the prototype detector, a larger scale demonstrator, working on the same principles can be built, and used to fully demonstrate the potential of this novel and particularly cost effective method of particle detection.

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