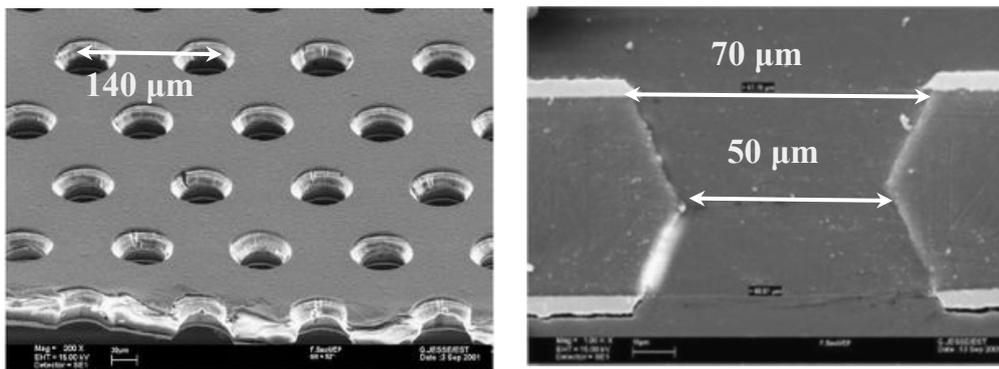


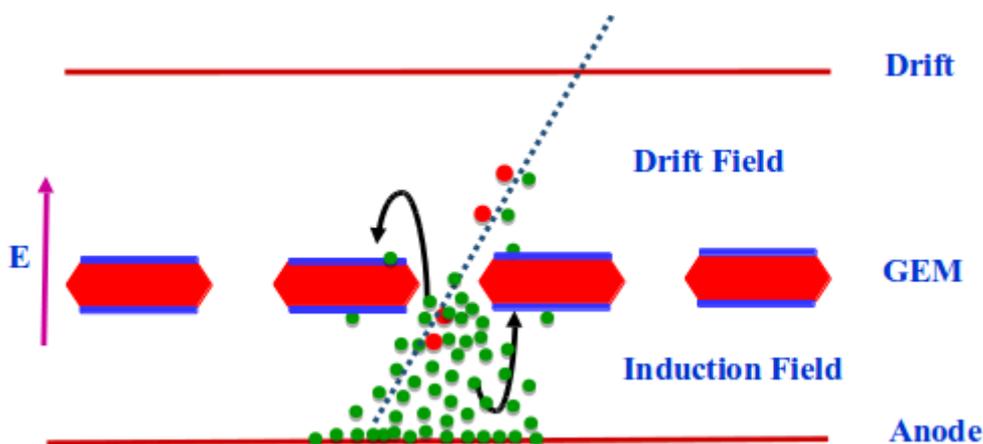
## Gas Electron Multiplier (GEM)

Gas Electron Multiplier (GEM) was first introduced by F. Sauli in 1997 at CERN. It consists of a gas filled chamber with inside a single or multiple GEM foils. A continuous flow of gas mixture passes into the detector which allows the avalanche of electrons to occur. The GEM foil consists of two thin layer of copper separated by an insulating dielectric medium Kapton. The thickness of copper layer is around  $5\mu\text{m}$  and for the Kapton it is around  $50\mu\text{m}$ . A standard GEM foil has a matrix of high density holes etched into it by the process of photo lithography. These holes have typical diameters of about  $70\mu\text{m}$  at the surface,  $50\mu\text{m}$  at the center and pitch (hole to hole distance) of usually  $140\mu\text{m}$  as given in the figure.



**GEM foil and hole dimensions**

In general, all GEM detectors work with the same principle. The system consists of a drift field where all the initial gas ionization takes place. Voltage applied across the gem electrodes to produce high electric field inside the holes. Electrons are ionized through primary and secondary ionization above the foil and then drift into the hole where multiplications occur due to avalanche mechanism. Then all the electrons are transferred into the induction region and get collected over the anode. The ratio between the number of electrons produced after the multiplication and the number of electrons above the GEM foil is referred as the Gain of the detector. In order to achieve higher gain, multiple GEM structure are generally employed.



**Single GEM with avalanche mechanism**

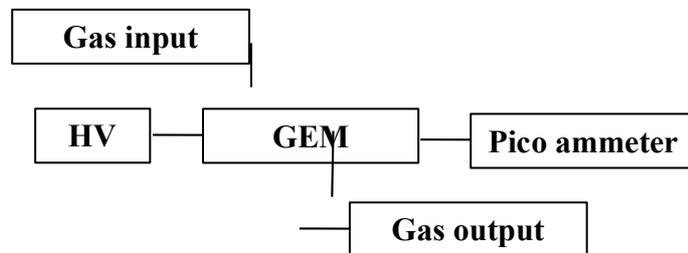
Objective :

To study the Gain variation of GEM with Voltage.

Apparatus Required:

1. GEM detector
2. Pre mixed Gas system with a Bubbler
3. Radioactive source
4. High Voltage power supply
5. Pico ammeter for current measurement

Procedure:



The experimental setup for measuring Gain and Energy resolution is given in the above block diagram.

- A premixed gas mixture is continuously flushed through the entire detector volume.
- The corresponding pressure, temperature and relative humidity is maintain through out the experiment.
- A high voltage power supply with a voltage divider circuit is connected to each electrode of the GEM chamber.
- A radioactive source ( Fe <sup>55</sup> ) is placed on the top of the window.
- The output current is measured using a Pico-ammeter. The anode current both with source (anode current source ) and without source (anode current background ) are recorded. Anode current only due to source = | anode current souce – anode current background | .

Gain of the GEM detector can be calculated by the following formula.

$$\text{Gain} = I_{\text{anode}} / \text{No. of primary electrons} \times \text{elctron charge} \times \text{Count rate}$$

Where,  $I_{\text{anode}}$  = anode current only due to the source measured from a pico ammeter.

Number of primary electons and Count rate for Ar/CO<sub>2</sub> 70/30 gas mixture, with Fe <sup>55</sup> source are taken as 212 and 140 kHz respectively.