Tracking with Multiplexed Resistive XY Micromegas for P348

Dipanwita Banerjee
ETH Zurich
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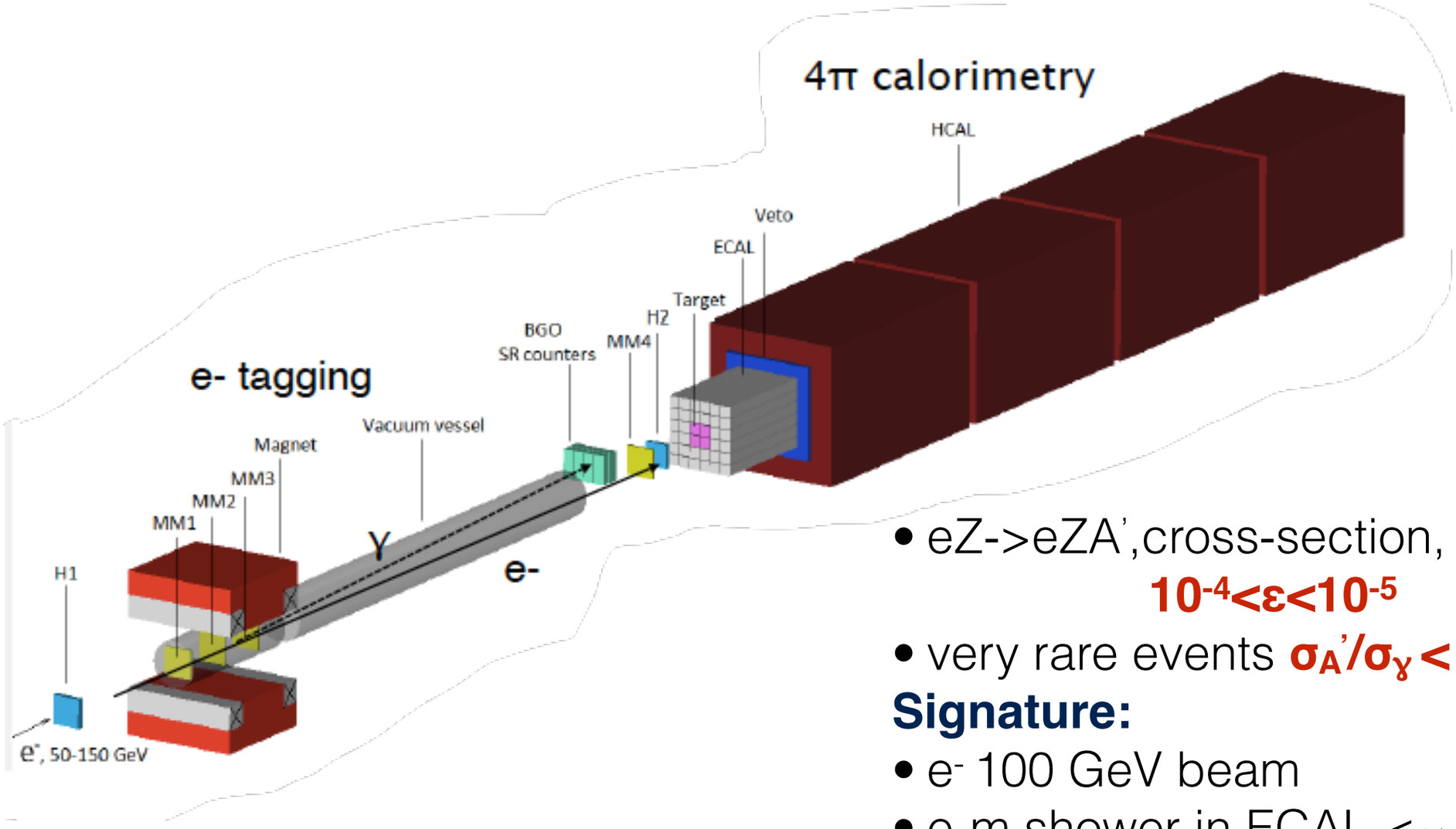
Direct Search for A'->invisible decay



- eZ->eZA',cross-section, Bjorken'09

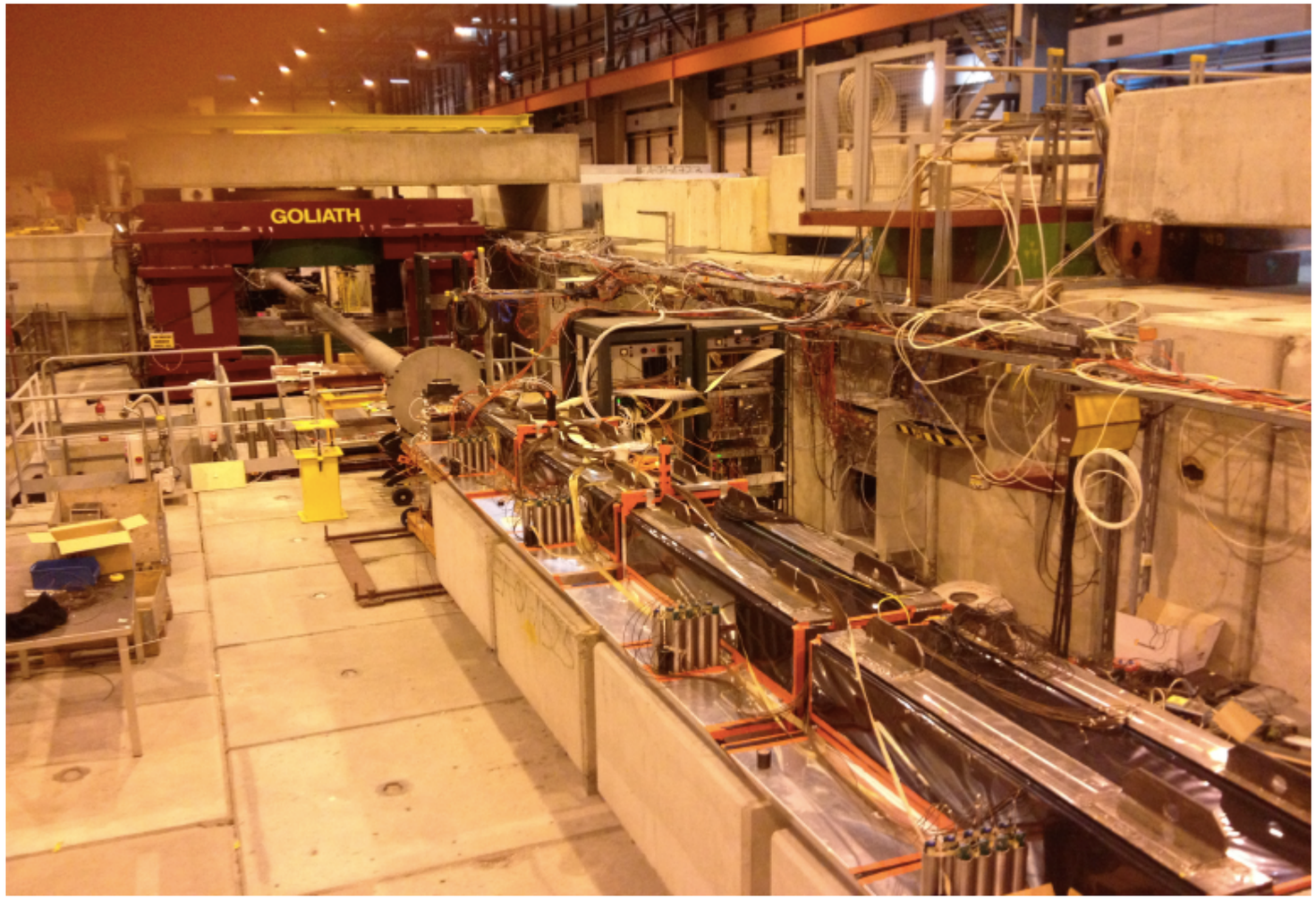
$10^{-4}<\varepsilon<10^{-5}$

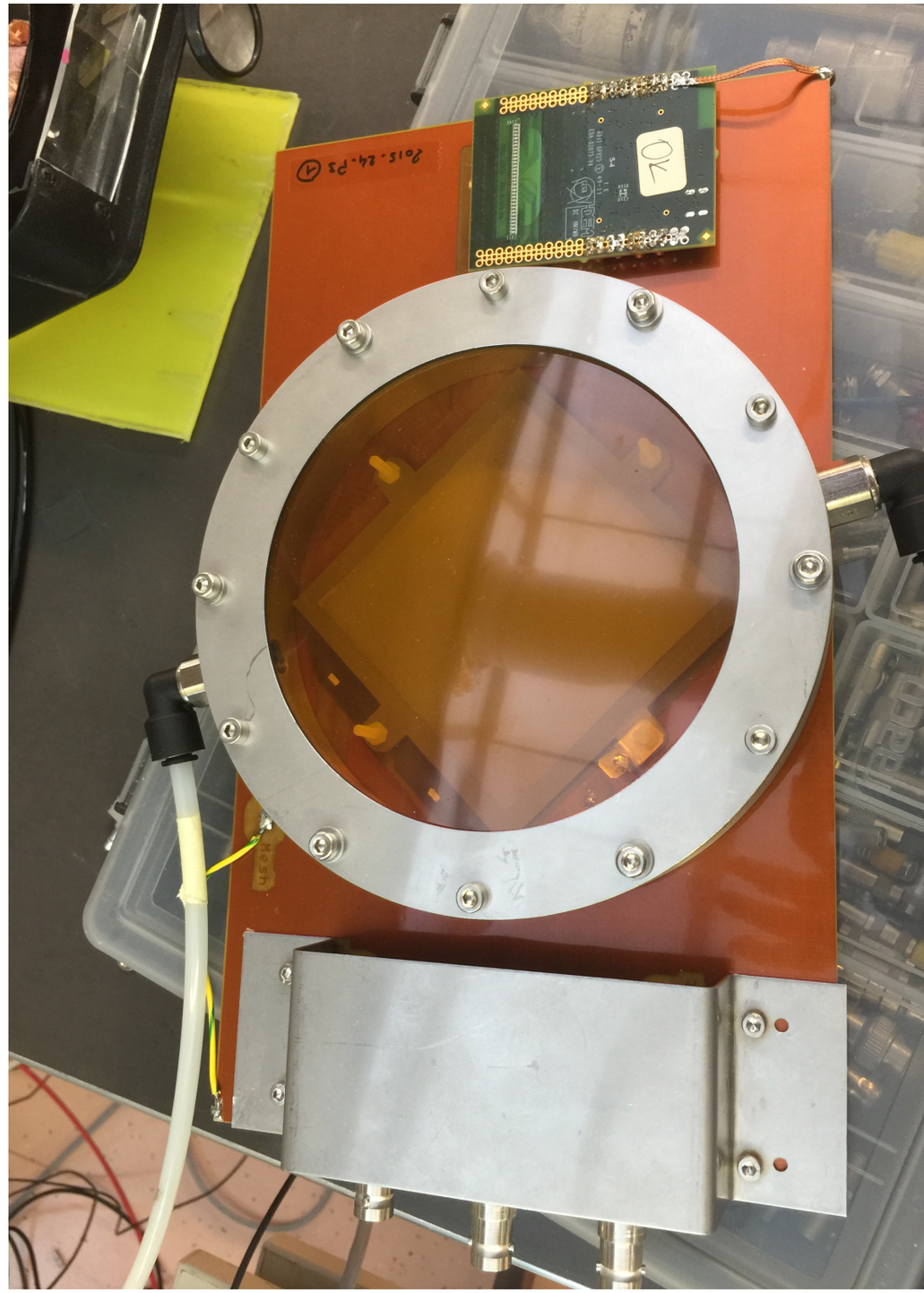
- very rare events $\sigma_{A'}/\sigma_{\gamma} < 10^{-12}$ -10^{-9}

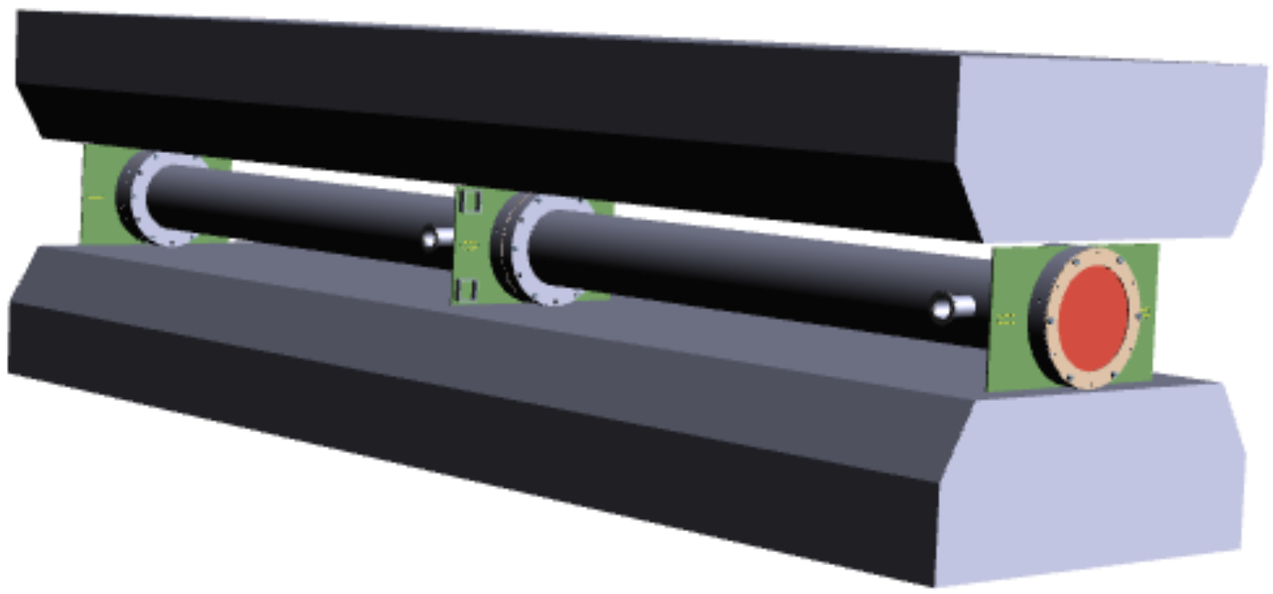
Signature:

- e^- 100 GeV beam
- e-m shower in ECAL <~ 50 GeV
- No signal in Veto+HCAL

P348 Detector Setup



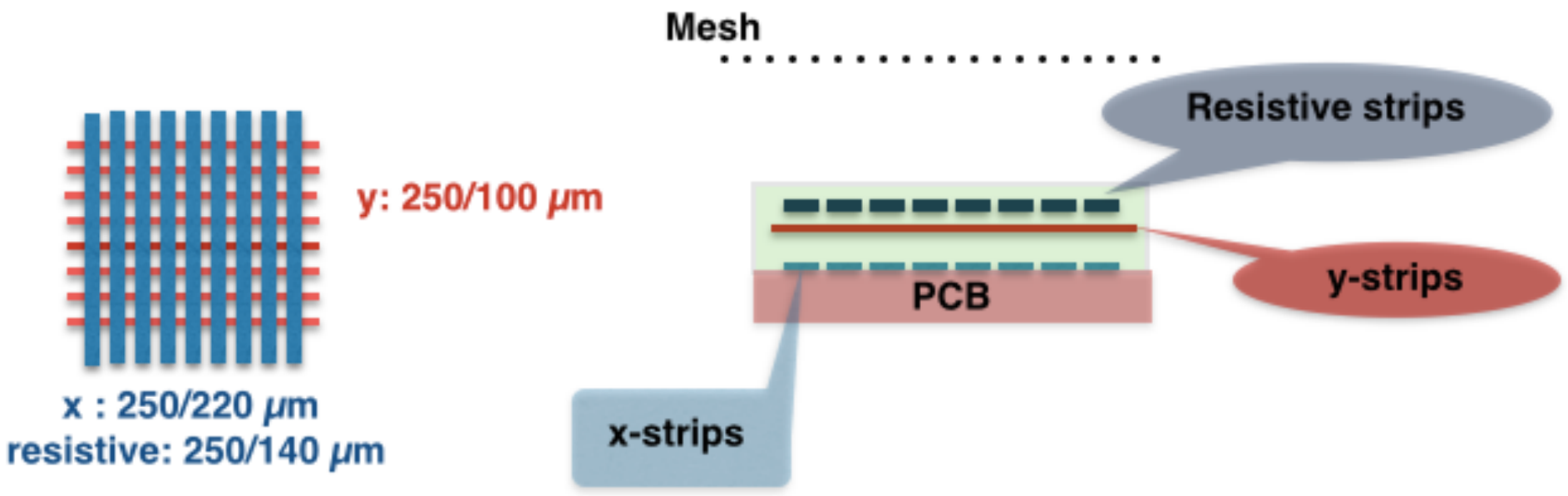




Micromegas description

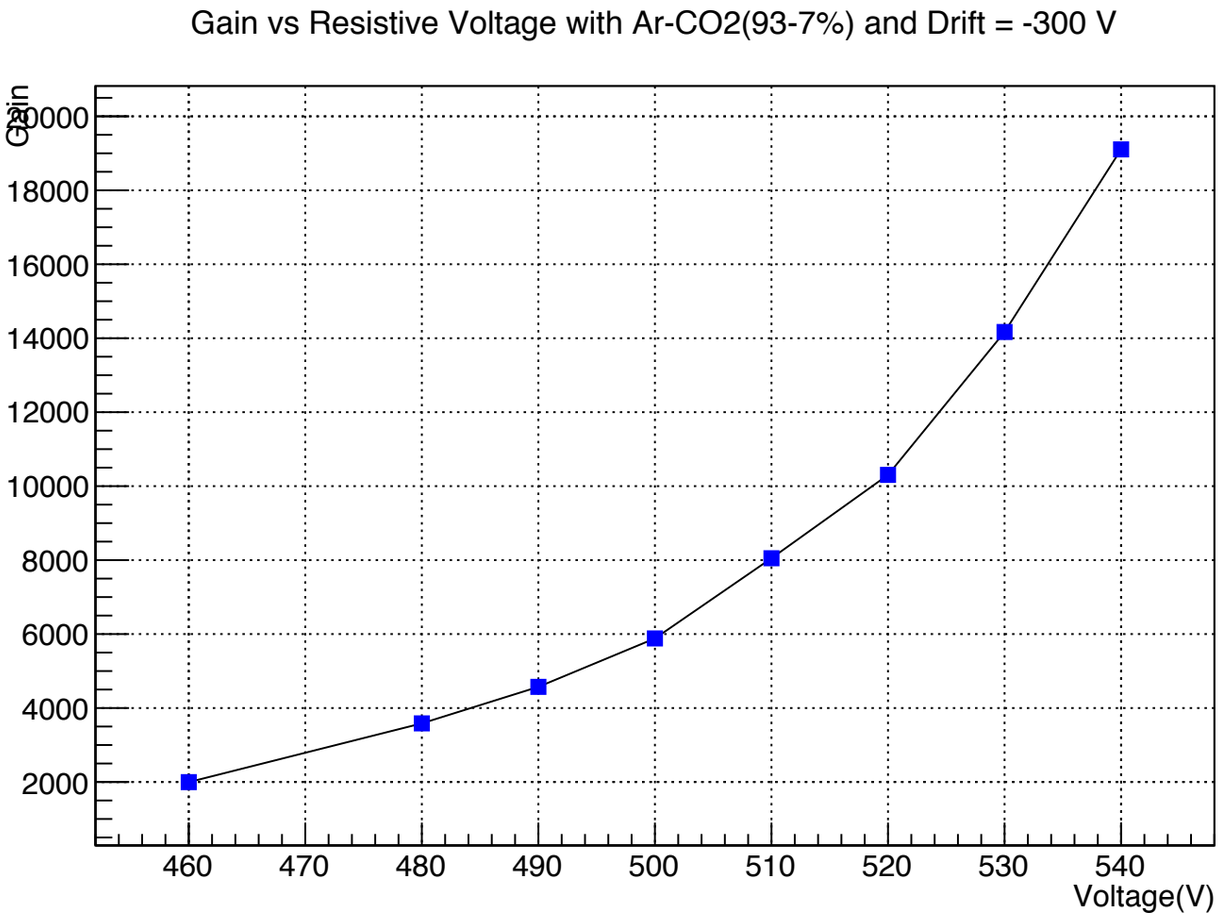
- **8cm x 8cm active area, resistive multiplexed XY Micromegas modules.**
- **HoneyComb PCB with ~ 200 μm FR4.**
- **320 strips of 250 μm pitch for X and Y co-ordinates. 640 strips in total.**
- **Multiplexed by a factor 5 using Genetic Multiplexing by S. Procureur … http://www.sciencedirect.com/science/article/pii/S0168900213012126**
- **128 electronic channels used to read the 640 strips.**
- **One APV chip/detector with SRS Frontend readout.**
- **Gas used Ar-CO2 (93-7%)**
- **Drift voltage = -300 V , Mesh Grounded, Resistive Strips = + 520 V - 540 V.**
- **MMDAQ for data taking and Recomm software (ATLAS Micromegas software) for hit positioning used with cuts on cluster charge and cluster width.**
- **Three detectors placed ~ 1 m apart in the H4 beam line.**
- **Beam used was electrons, 100 GeV, ~ 10^{4} -10^{5} e^{-}/spill. Each spill is ~ 5 sec.**
- **Rate of data acquisition ~ 800 Hz.**

Micromegas Schematic



- **Resistivity of the paste ~ 1 MΩ/square. Resistivity of each strip ~ 43 mm long = 200 MΩ**
- **X strips wider than Y strips to compensate the weaker capacitive coupling to the X strips.**

MM Characterisation



In order to characterise the detectors the voltage on the resistive layer was varied to measure the gain. Signal was read from the mesh. The Drift distance is 5 mm and the amplification gap is 128 μm. Drift voltage was set at -300 V and the mesh was grounded. The characterisation was done at the RD51 LAB with Ar-CO2 (93-7%) gas.

Gain at a resistive layer voltage of +520 V is ~ 1.03×10^4 as expected. It was compared with an already characterised detector of similar dimensions in the RD51 LAB.

Efficiency and Cluster widths of X and Y co-ordinates from data without field

- **Efficiency of detection for the X and Y co-ordinates (separately) for all three detectors were:**
  - ***MM1 —> X = 65.61 %***

    Y = 99.04 %
  - ***MM2 —> X = 46.78 %***

    Y = 97.81 %
  - ***MM3 —> X = 45.43 %***

    Y = 98.33 %

- **Efficiency of detection of both X and Y hits for each module :**
  - ***MM1 —> 65.59 %***
  - ***MM2 —> 46.73 %***
  - ***MM3 —> 45.38 %***

- **Cluster width for X and Y co-ordinates:**
  - ***MM1 —> X ~ 5 strips***

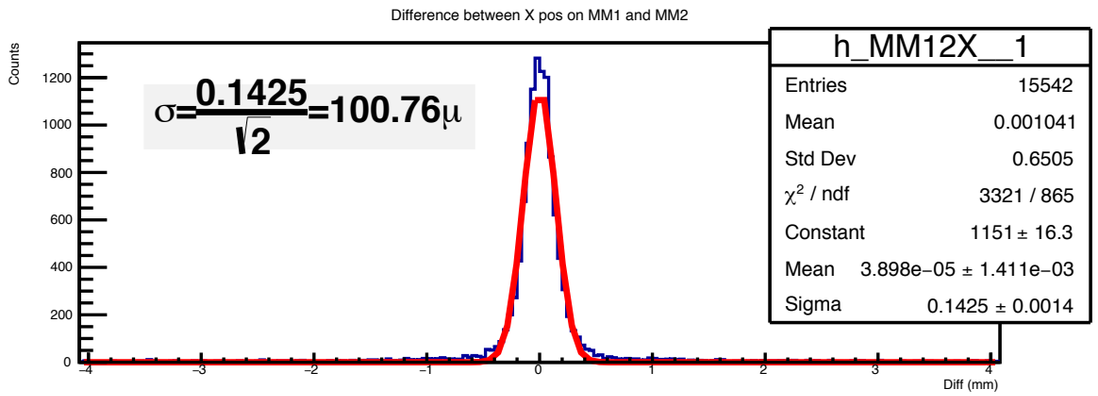
    Y ~ 14 strips
  - ***MM2 —> X ~ 8 strips***

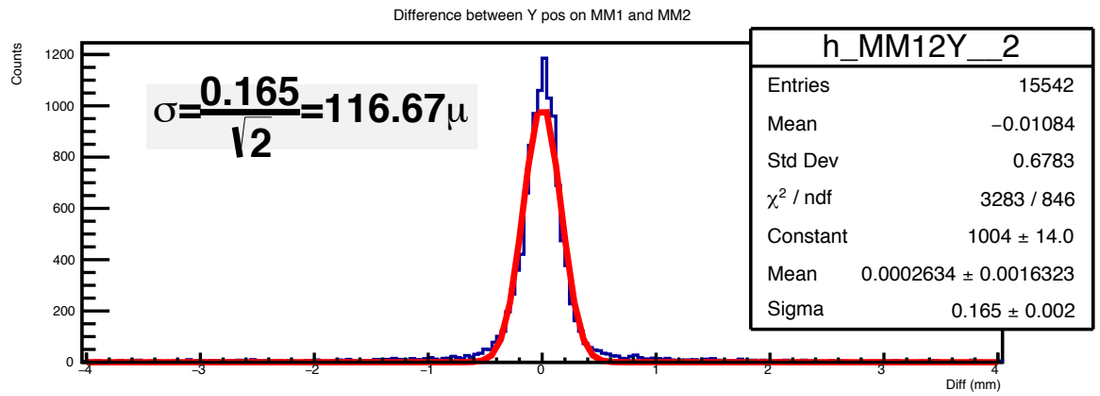
    Y ~ 14 strips
  - ***MM3 —> X ~ 5 strips***

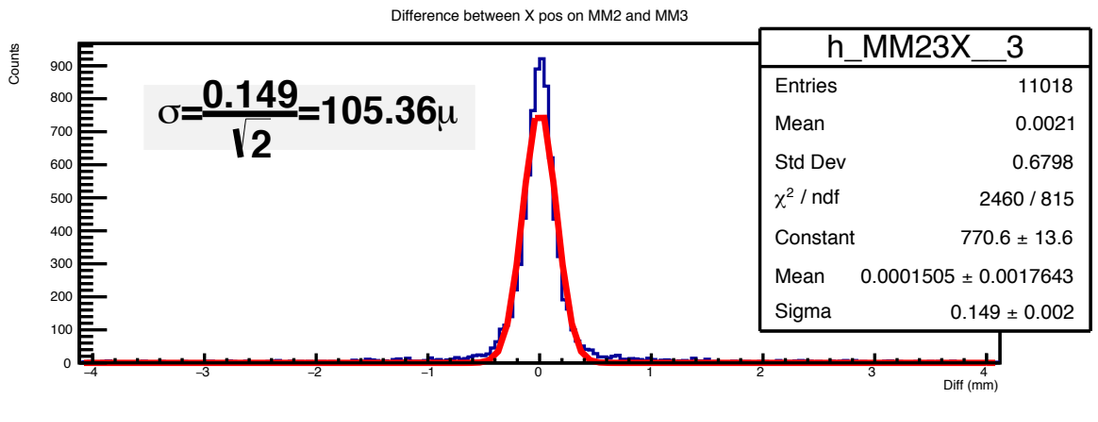
    Y ~ 16 strips

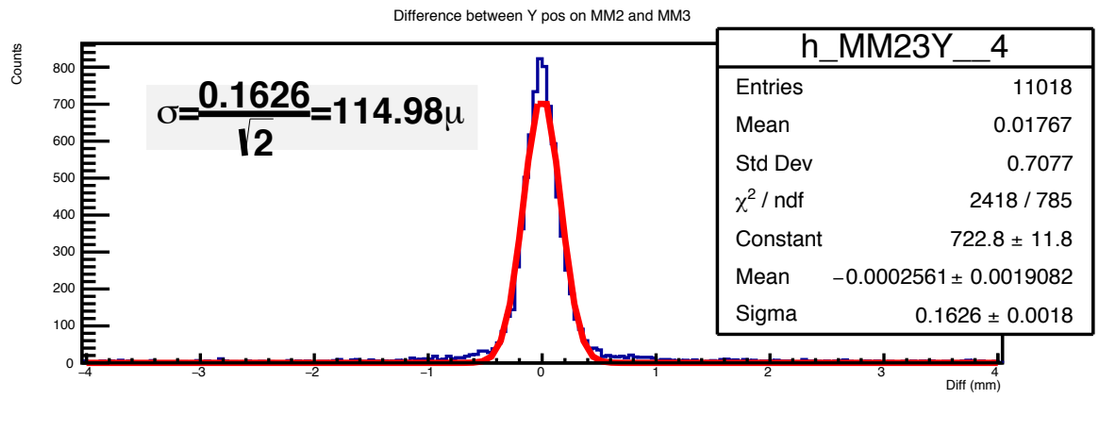
Efficiency of X much lower than Y possibly due to smaller inner width between Y strips which restricts reasonable signal induction to the X strips from the Resistive layer.

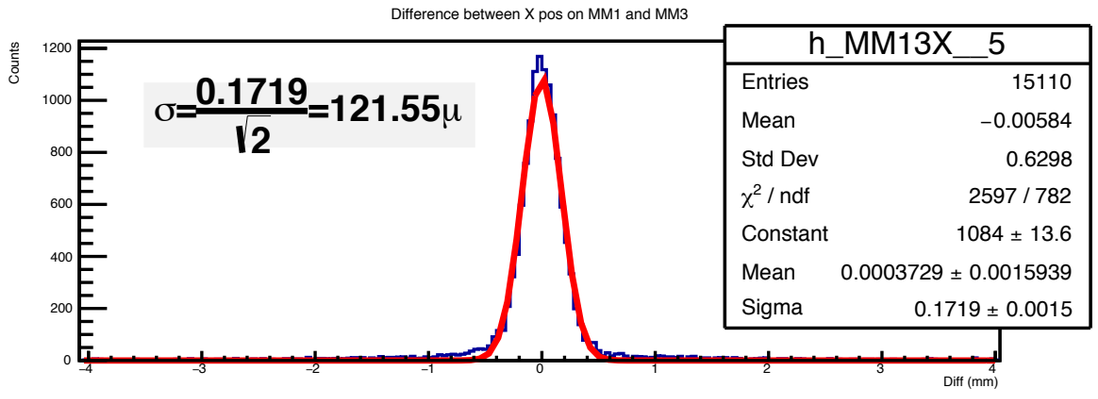
MM Tracker Results from beam run

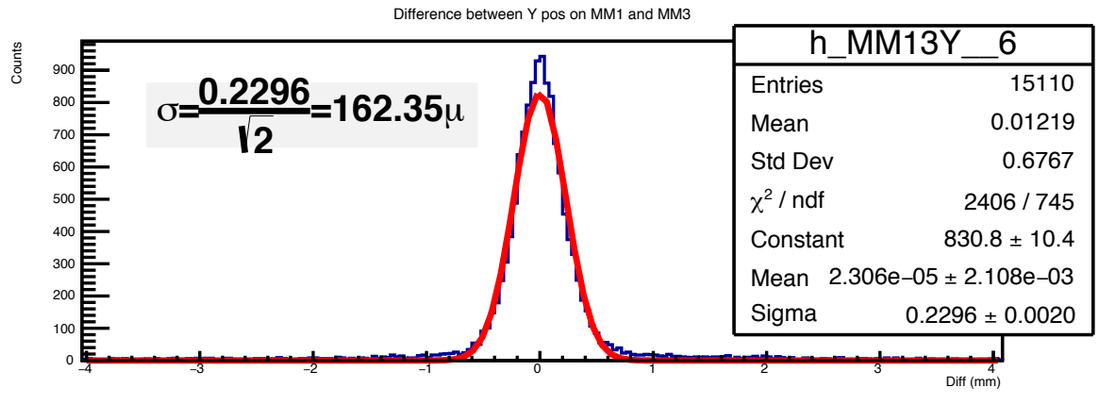








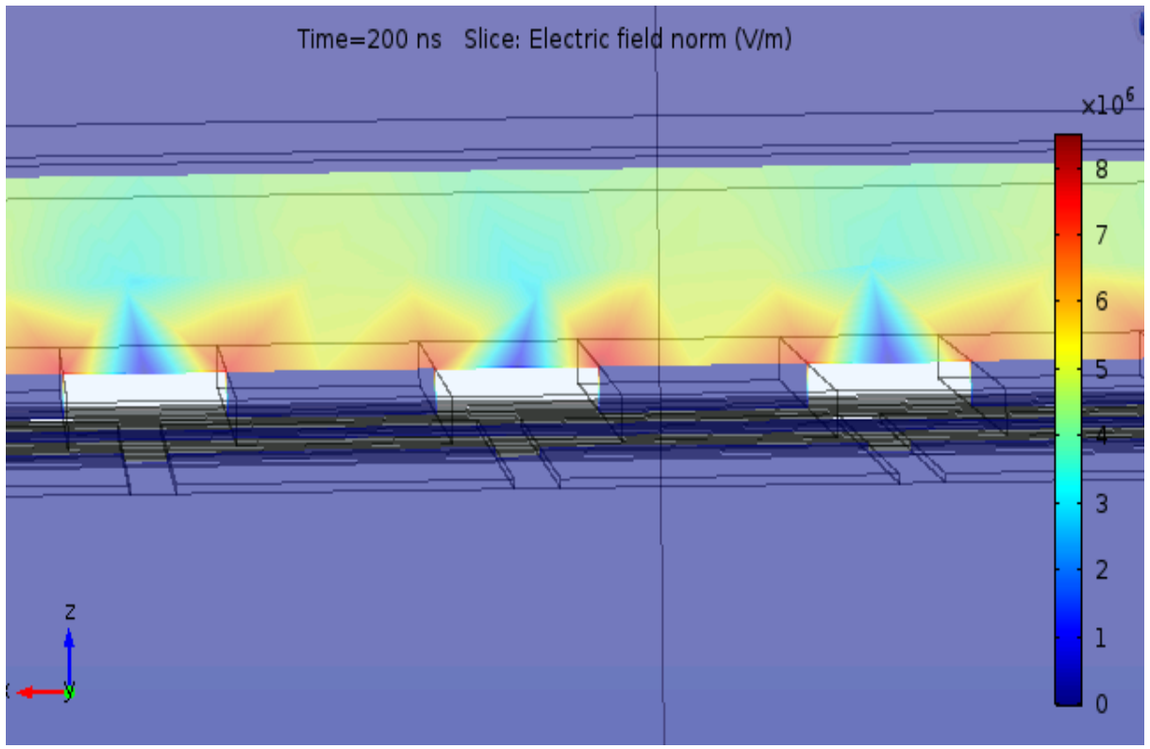




Resolution of Micromegas comparing hit points on two modules.

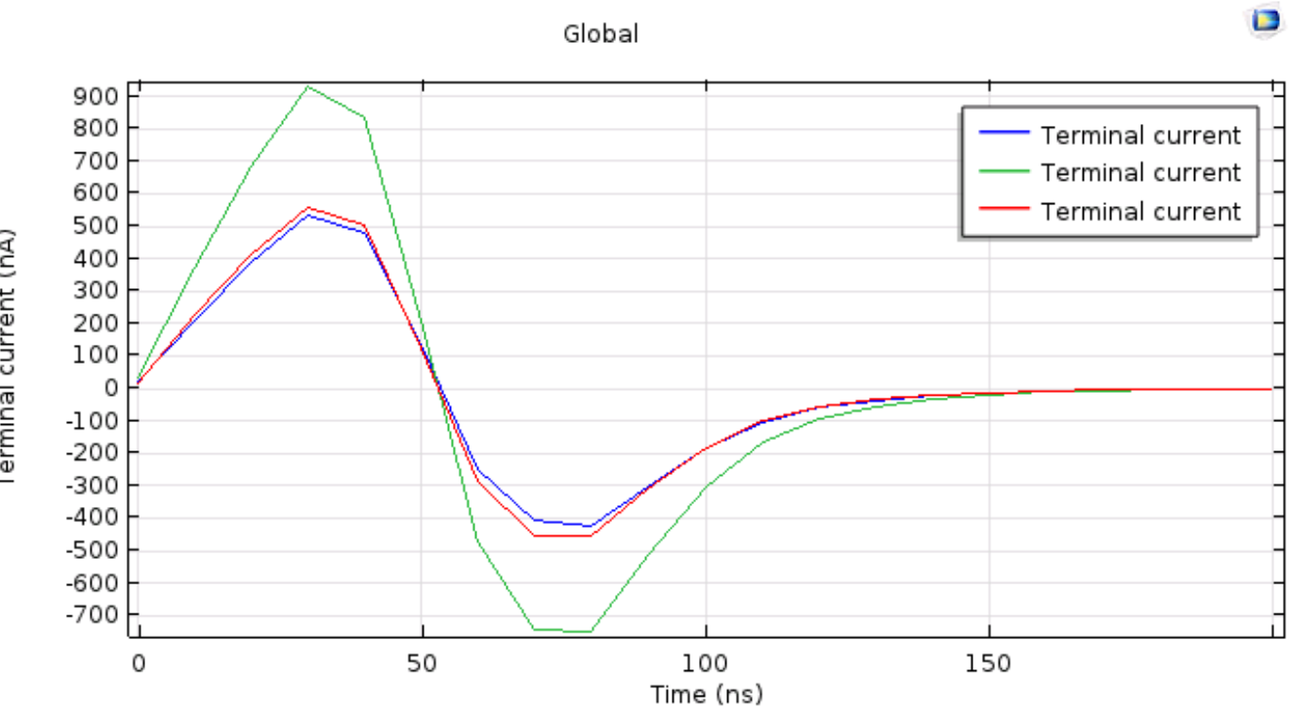
$\sigma_{MM} \sim \boldsymbol{\sigma}_{plot}/\sqrt{2}$ **~ 120 μm.**

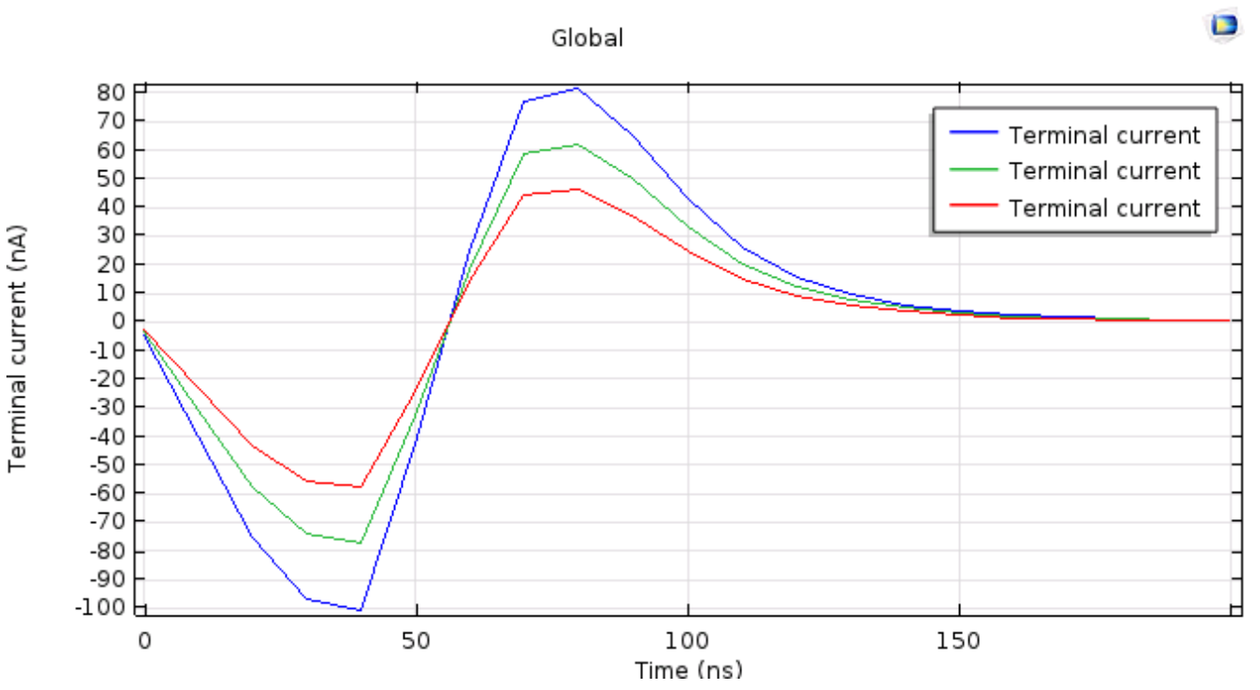
COMSOL simulation of the charge induction for resistive MM



An attempt to simulate the charge induction for resistive MM modules is being made by our group using COMSOL to better understand the optimum strip width/gaps etc. required before producing other modules to have better efficiencies.

Simulation by B.Radics





Micromegas Tracker Summary from beam run

- ***Resolution of modules ~ 124 μm without field.***
- ***Efficiency of detection in X much lower than Y.***
- ***Possible reason is the small inner strip width of the Y layer which restricts reasonable induction of the charge signal from the resistive strip to the farthest readout strip.***
- ***Attempt to simulate charge induction using COMSOL ongoing to better understand the detector behaviour.***

THANK YOU…