

# IMPLEMENTATION OF THE CODE FOR THE SIMULATION OF THE RESPONSE OF A TRIPLE-GEM TRACKER AND ITS COMPARISON TO THE EXPERIMENTAL DATA



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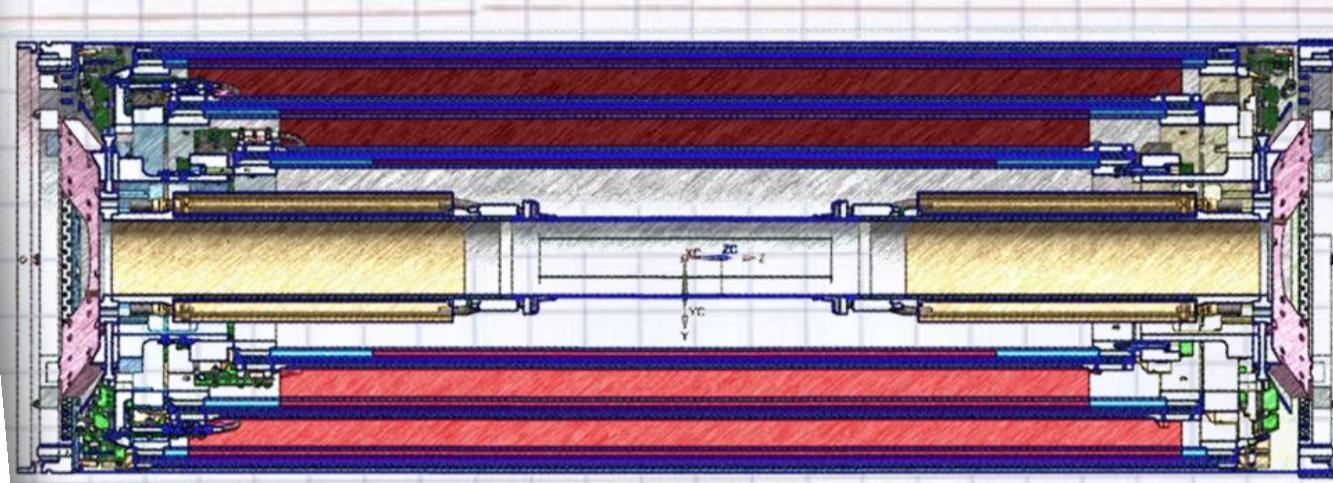
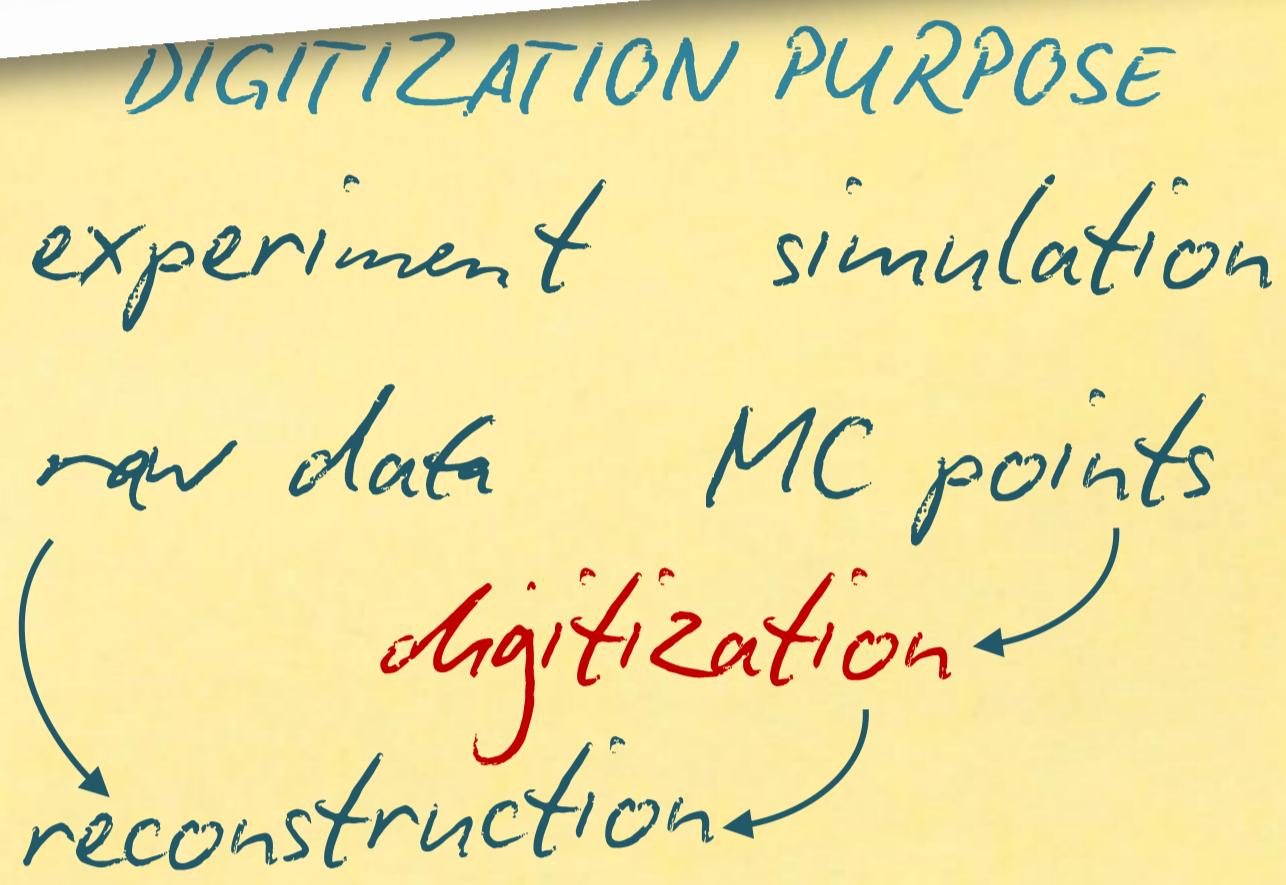


HORIZON 2020 European Commission



Remember!

The simulation is the hidden component of the design and realization of a detector



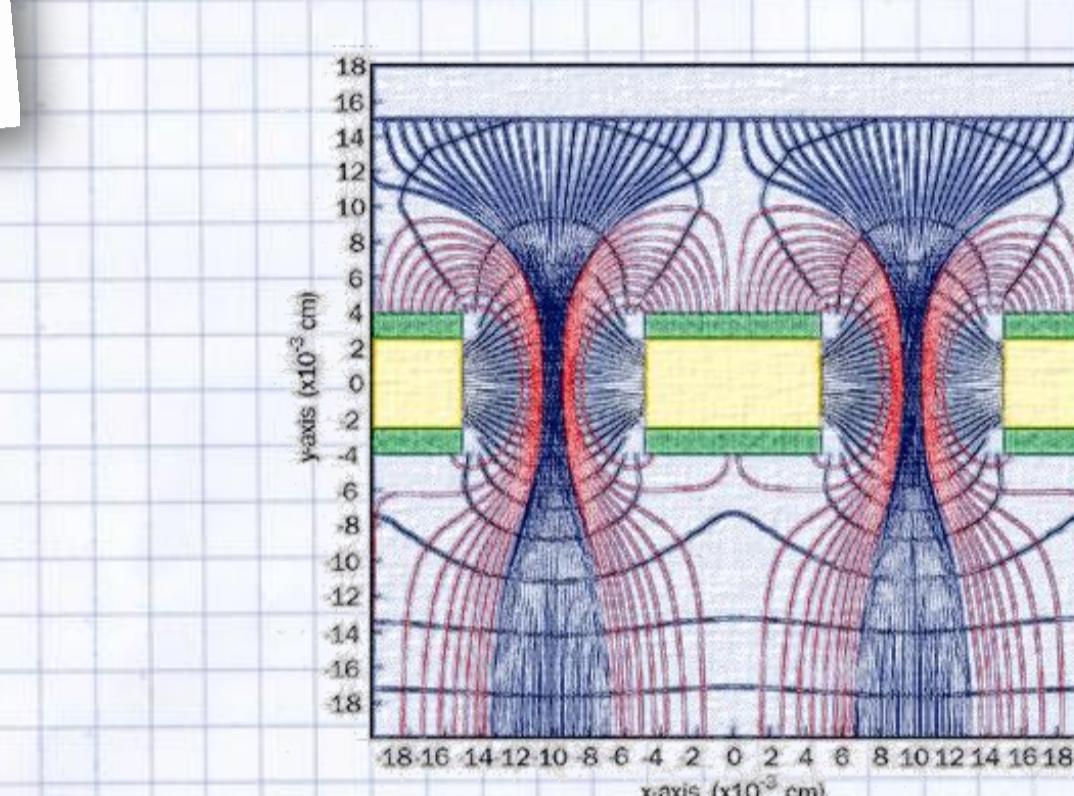
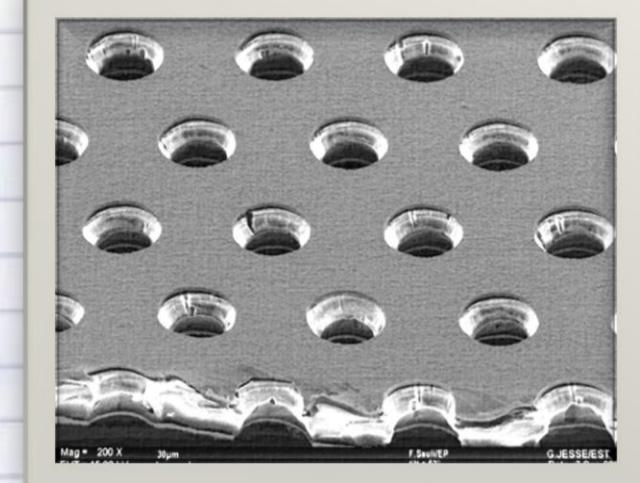
The Cylindrical Gas Electron Multiplier Internal Tracker

NEW Inner Tracker for the BESIII experiment  
three layers of cylindrical triple GEM  
based on the GEM technology

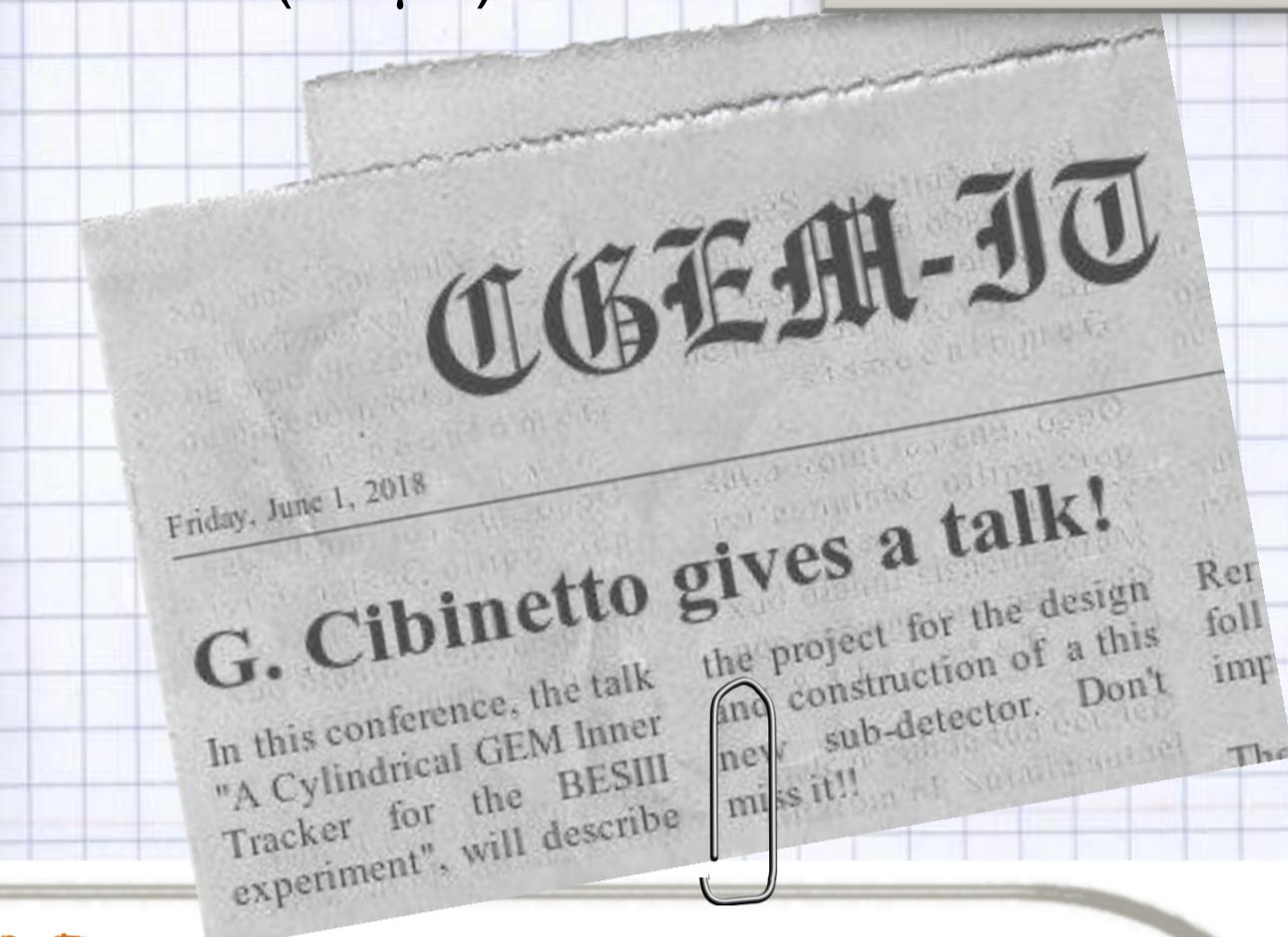
GEM

Invented by F. Sauli, 1997

- kapton foil (50  $\mu\text{m}$ )
- copper coated (3/5  $\mu\text{m}$ )
- pierced by thousands of holes (50  $\mu\text{m}$ )



The application of a potential of some hundred Volts on the copper layers creates within the holes an electric field of some tens of kV/cm  $\rightarrow$  avalanche multiplication



## PHYSICS SIDE

IONIZATION

ELECTRIC field  
Gas diffusion  
MAGNETIC field

GEM high electric  
field in holes

ANODIC STRIPS

e- generation

e- drift

MULTIPLICATION

SIGNAL INDUCTION

## MODEL SIDE

POISSON STATISTICS

GARFIELD/ANSYS  
SIMULATIONS TO GET THE  
ELECTRON POSITION

POLYAS DISTRIBUTION  
(THREE MULTIPLICATION  
STAGES)

RAMO'S THEOREM  
APV-25 CR-RC

*W. Bonivento et al., IEEE Transaction on nuclear science, vol. 49, 4 (2002)*

## STANDALONE CODE

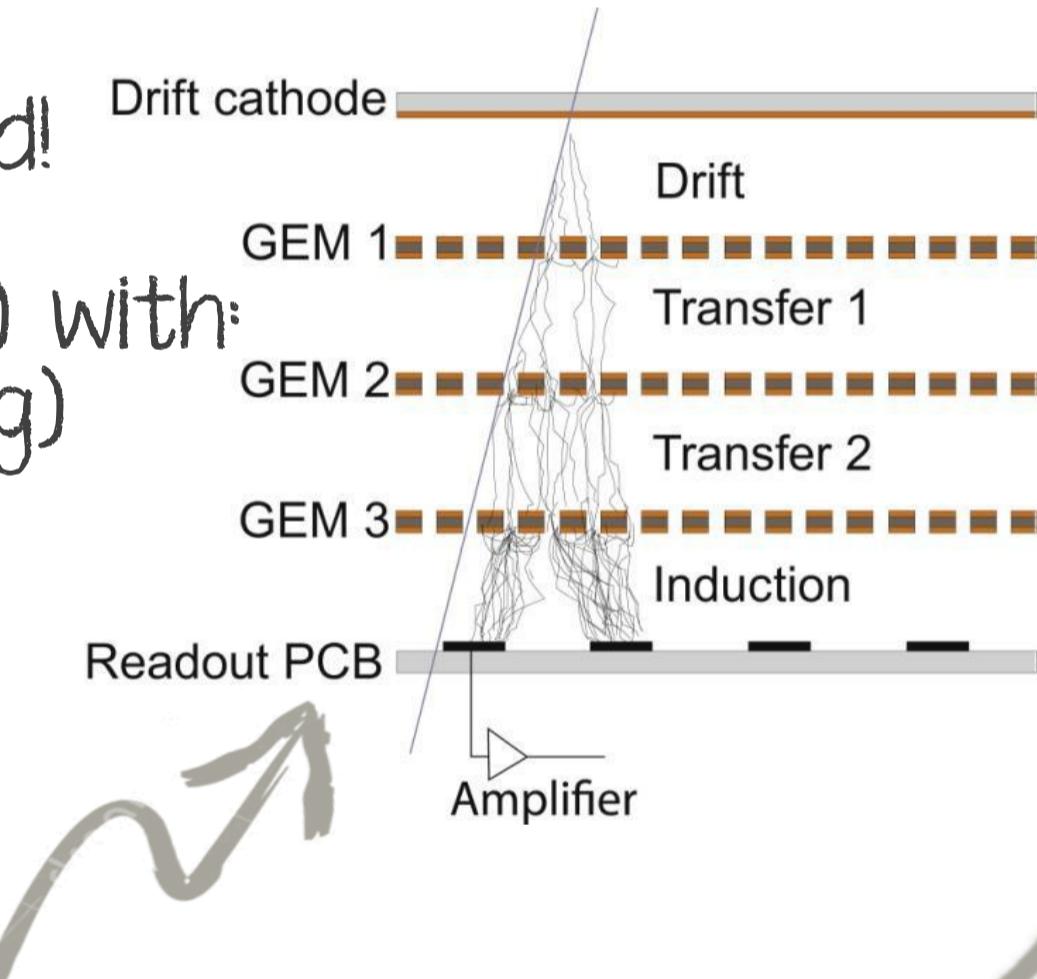
Generation of primary ionization  
 $\rightarrow$  secondary electrons  
 $\rightarrow$  avalanche multiplication

Follow each electron of the cloud!

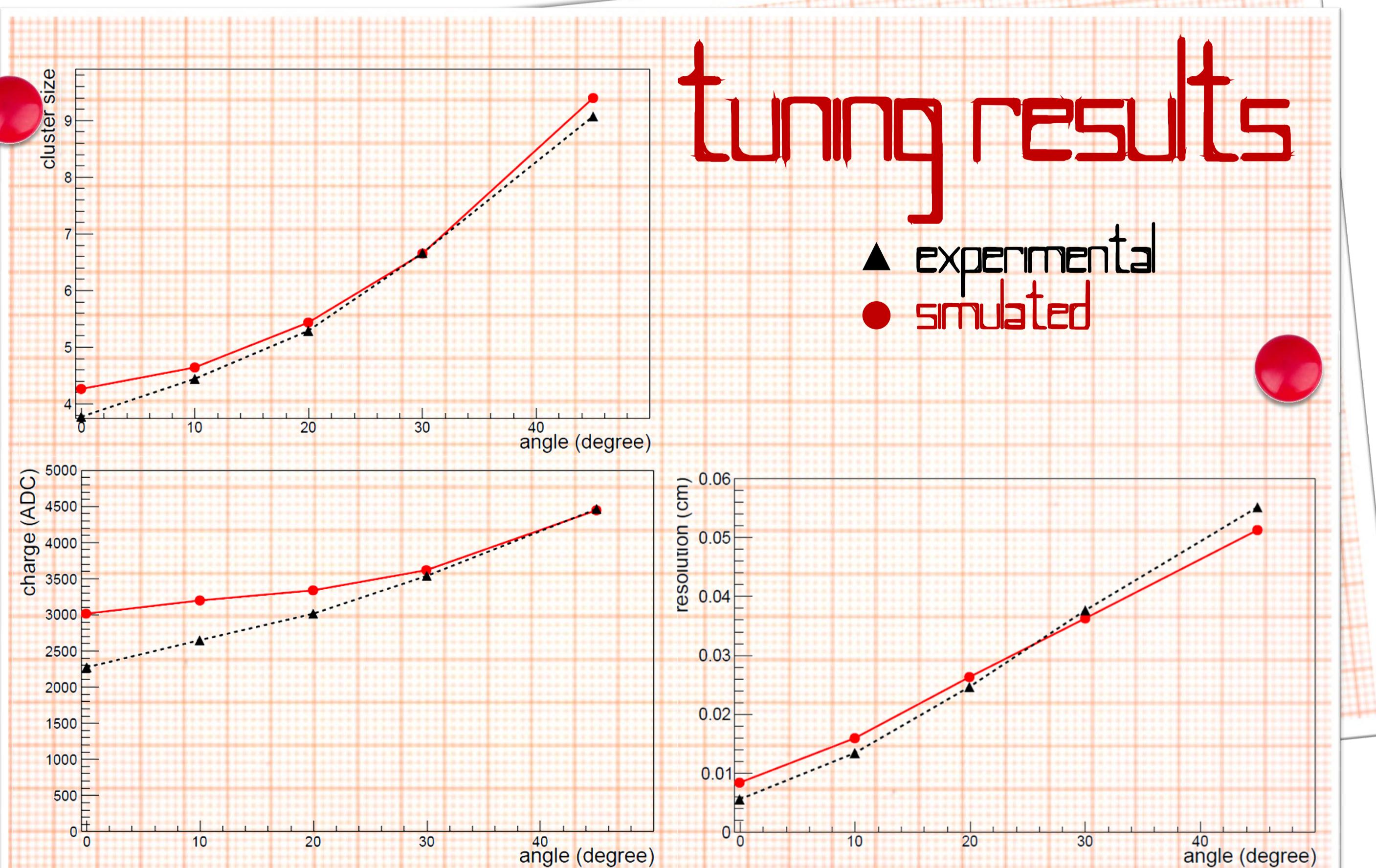
Drift to anode (position/time) with:  
 \* Diffusion (Gaussian smearing)  
 \* Magnetic field (shift)

Formation of the signal with:  
 \* Induction  
 \* Electronic noise  
 \* Capacitive effects

g t s

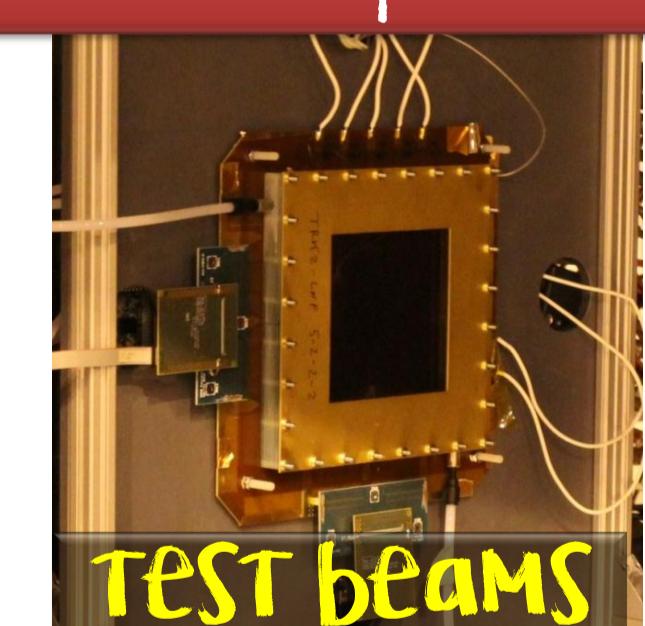


To refine the code response, we changed the simulation conditions and compared simulated and experimental values of some sentinel parameters



EVALUATION OF THE PARAMETERS WITH GARFIELD

IMPLEMENTATION OF THE STANDALONE CODE



10  $\times$  10 cm<sup>2</sup> triple gem  
x/v strips  
strip pitch 650  $\mu\text{m}$   
gas mixture Ar:150 90:10  
asic apv-25

GREAT ACCORDANCE