



# Geant 4

## GAS ELECTRON MULTIPLIER DETECTOR STUDY

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@ Savonlinna Summer School



# OUTLOOK

## I. Background

- Multi Wire Proportional Chamber (Georges Charpak)
- Micro Strip Gas Chamber (Anton Oed)
- Gas Electron Multiplier (Fabio Sauli)

## II. General Description of GEM

- Detector Layout
- GEM Foil
- Electron Multiplication

## III. Sealed GEM Detector

- Detector Geometry
- Detector components and GEANT4 Model
- Detector Simulation Response
- Model Validation



# MULTI WIRED PROPORTIONAL CHAMBER

## Detector Layout

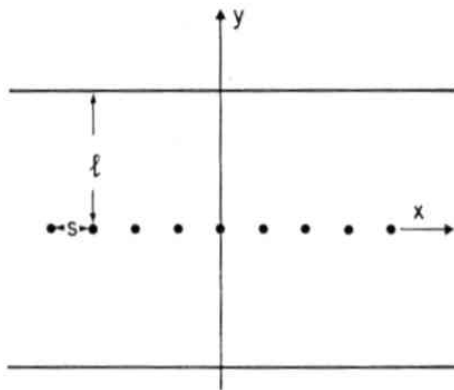


Fig.1 Principle of construction and definition of parameters in a multiwire proportional chamber.

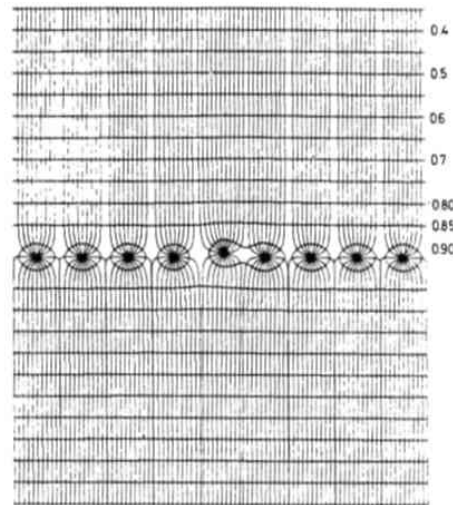
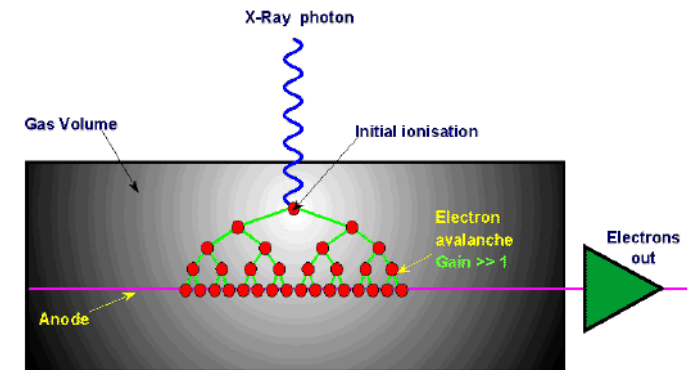


Fig.2 Electric field equipotentials and field lines in a multiwire proportional chamber.

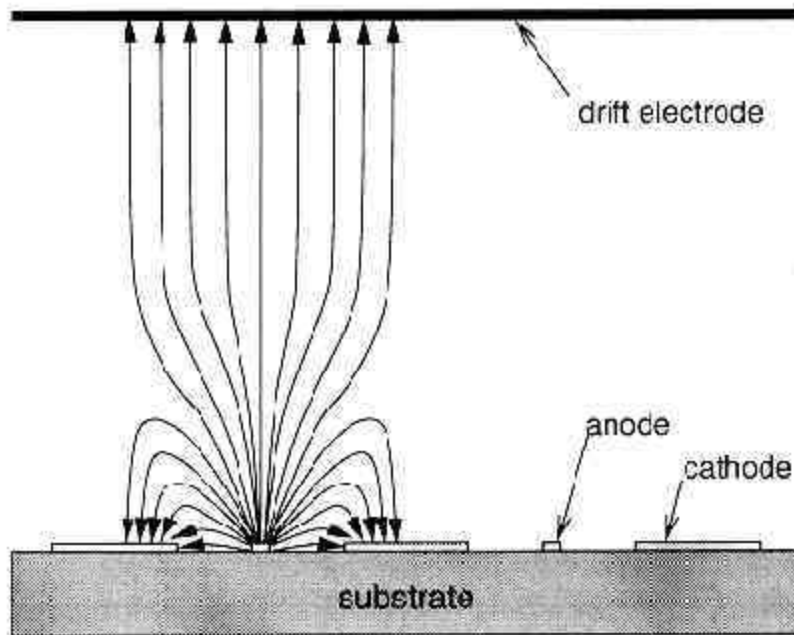
## Gas Amplification process



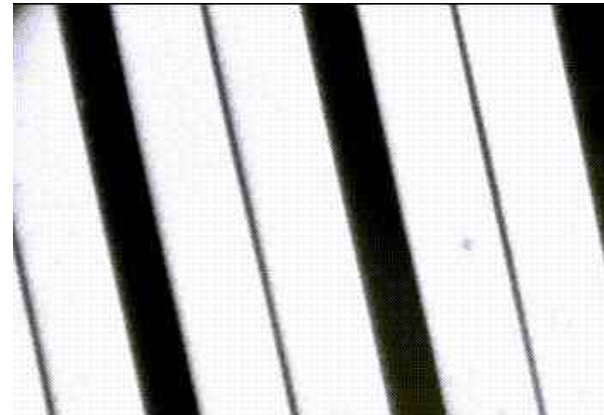


# MICRO STRIP GAS CHAMBER

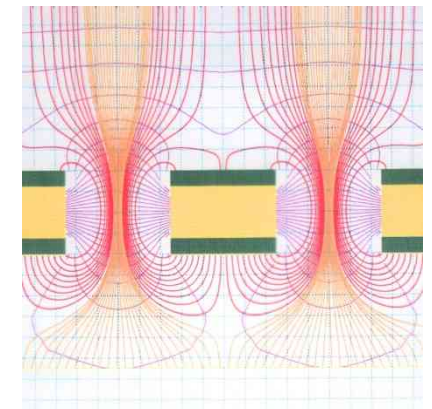
## Detector Layout



## Electrodes Configuration



## Amplification foil





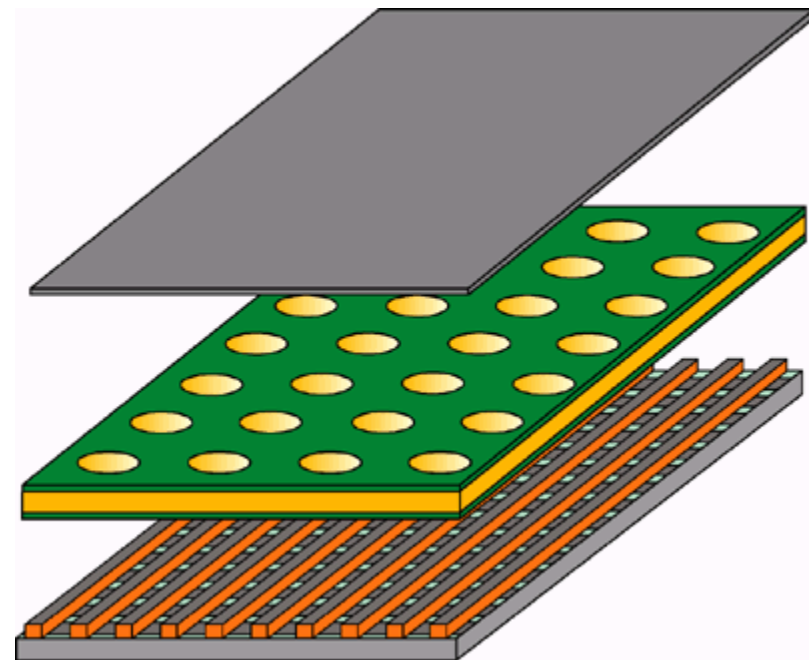
# GAS ELECTRON MULTIPLIER

Detector Layout:

Drift Cathode

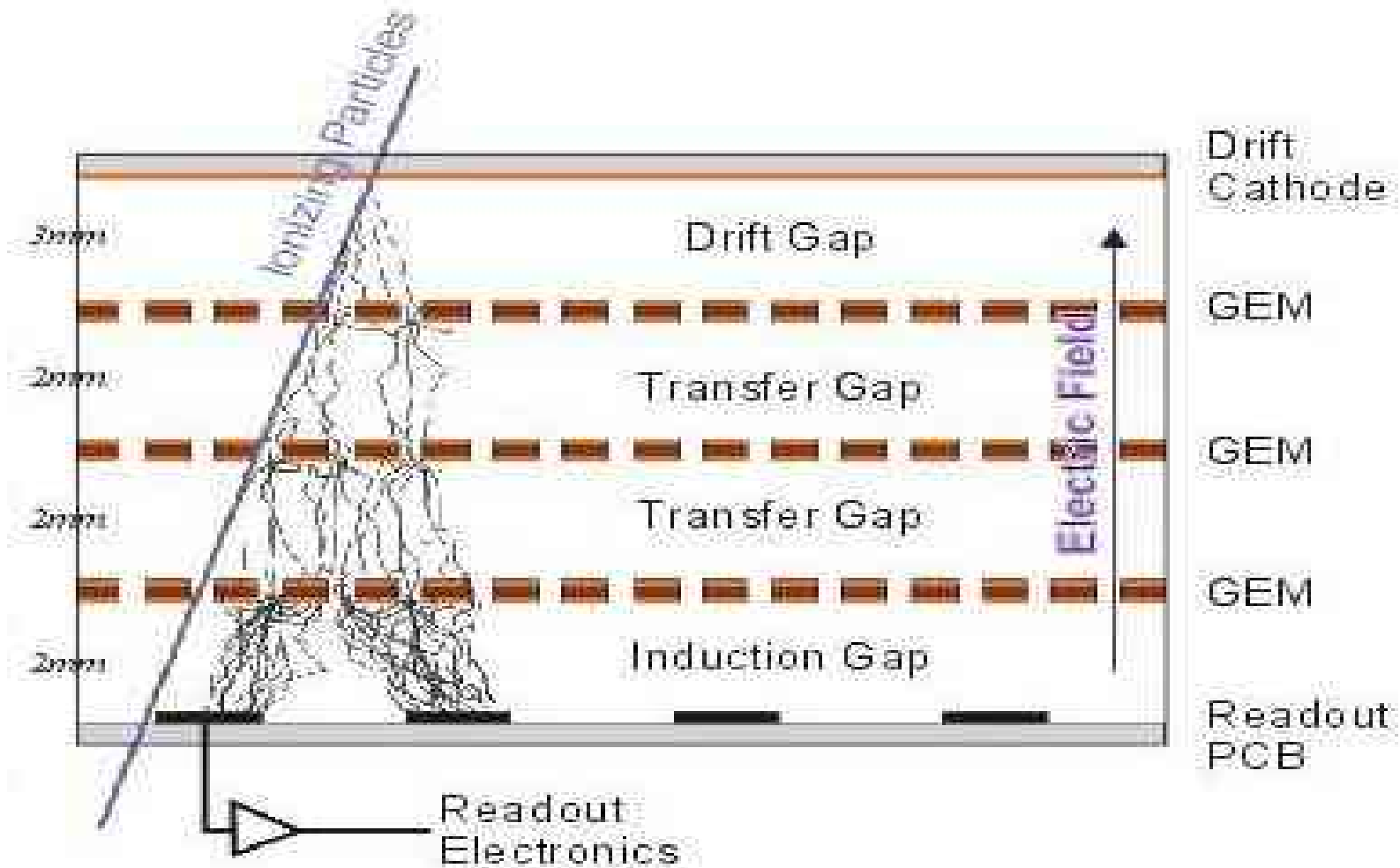
GEM foil

Readout Strips



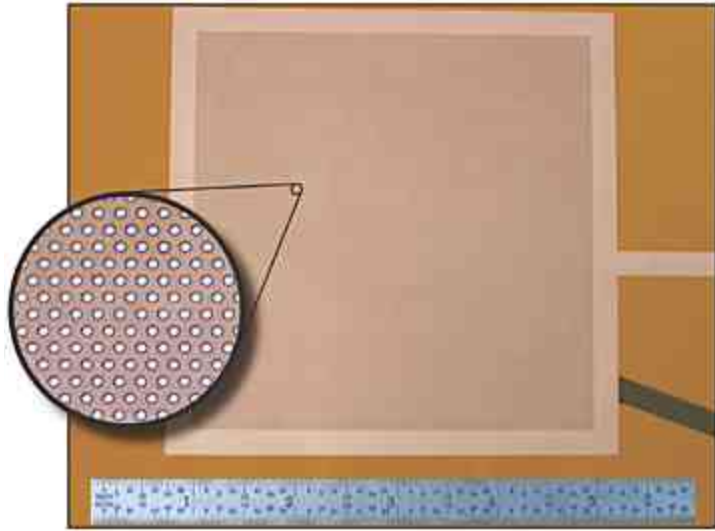


# GEM GENERAL DESCRIPTION

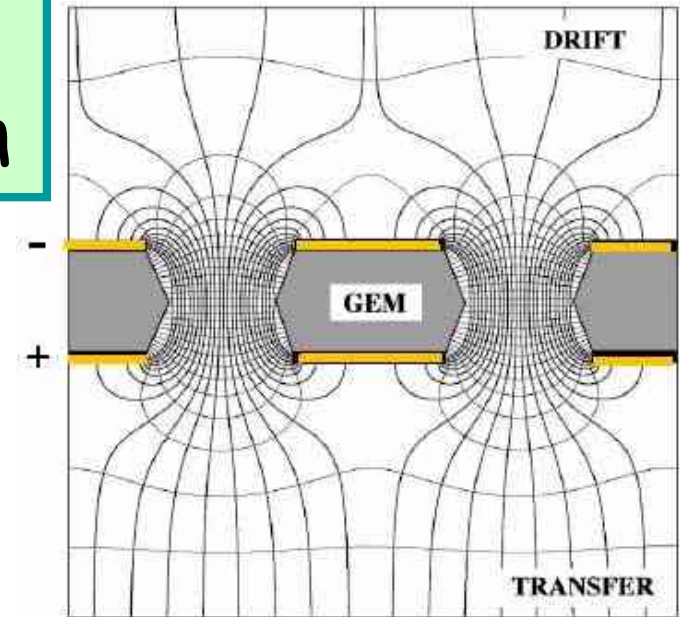




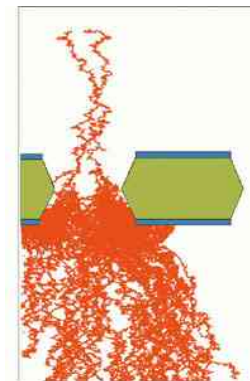
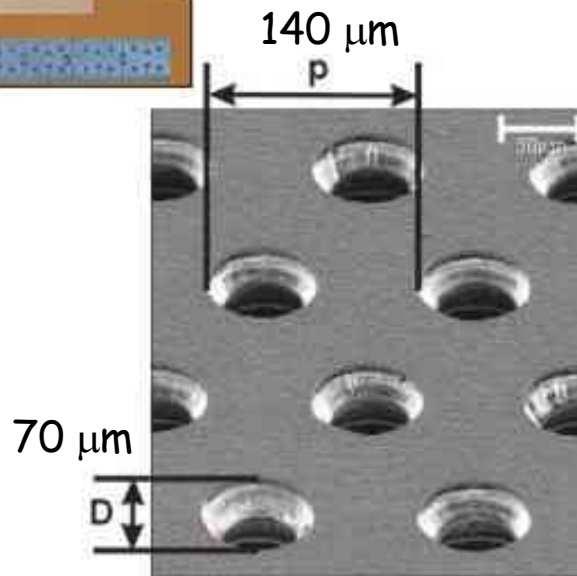
# GEM FOIL



Field Configuration



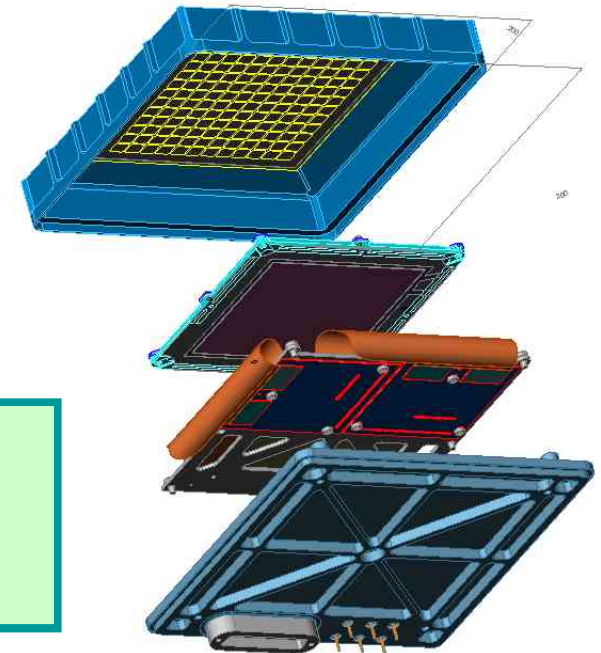
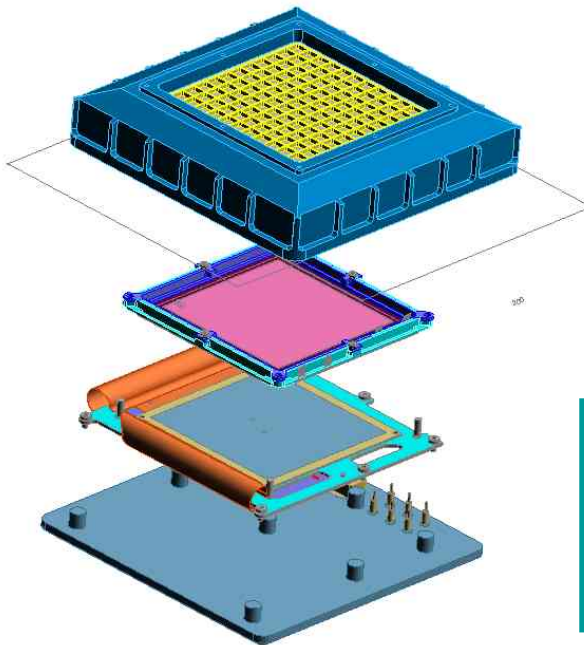
Foil structure detail



Electron Avalanche



# SEALED GEM DETECTOR



GEM detector for  
Space Applications





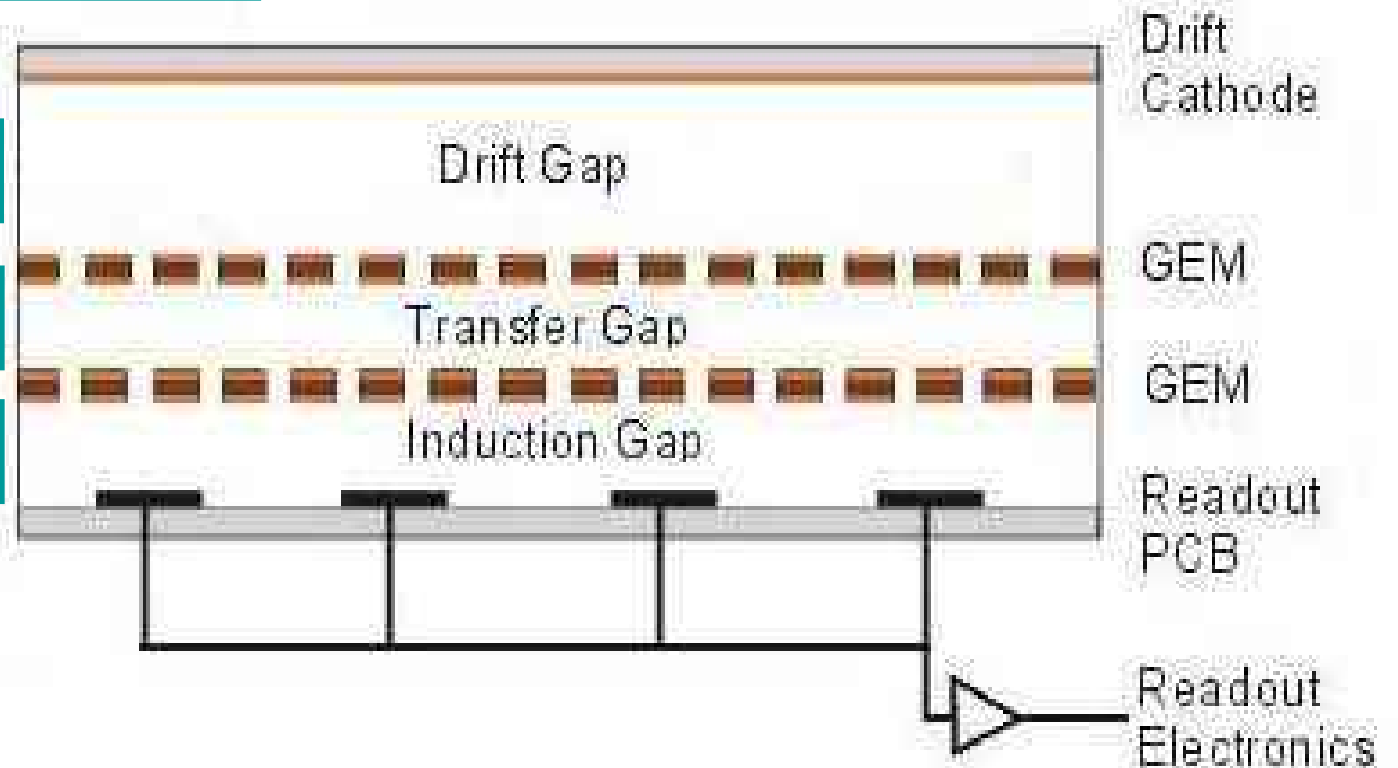
# DETECTOR GEOMETRY

Sensitive Detectors:

Drift Zone SD

Transfer Zone SD

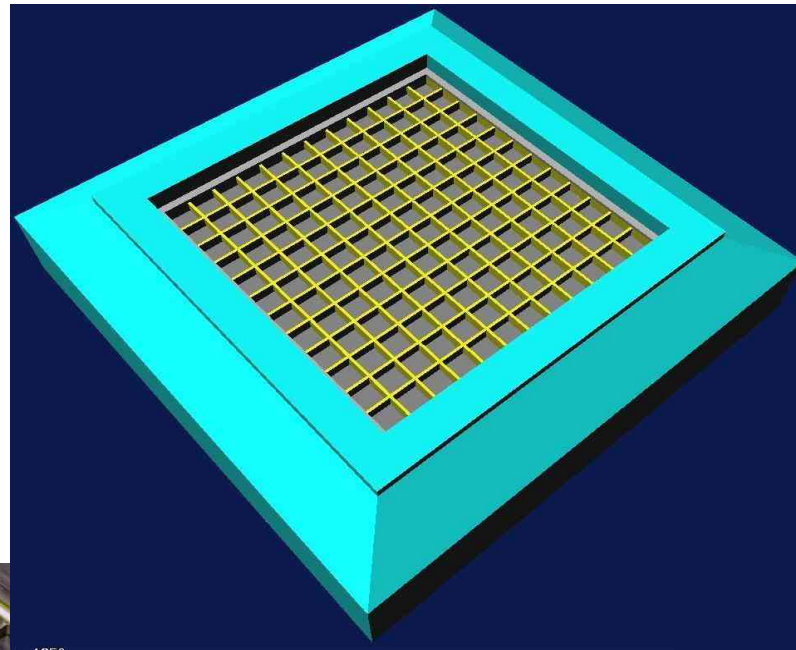
Induction Zone SD



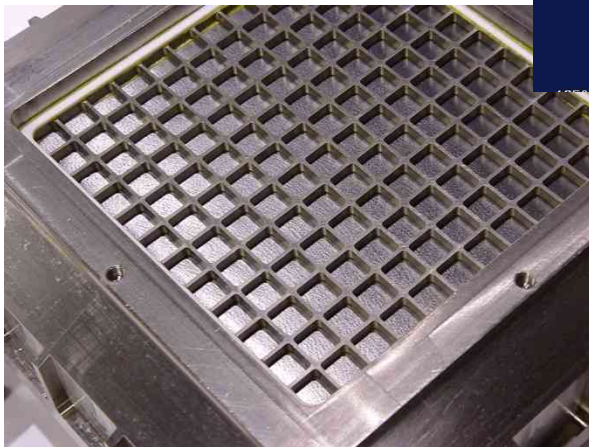
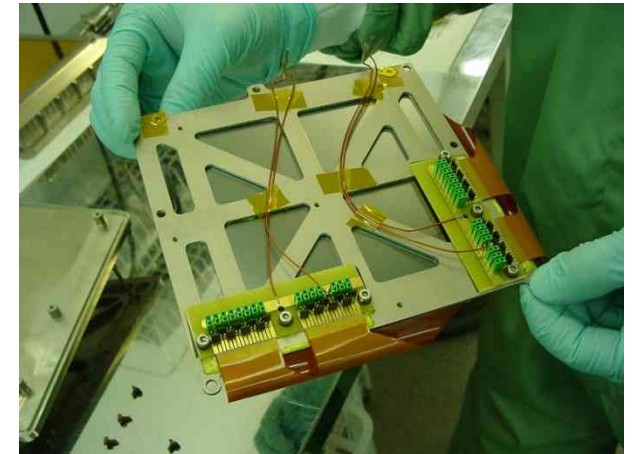


# DETECTOR COMPONENTS

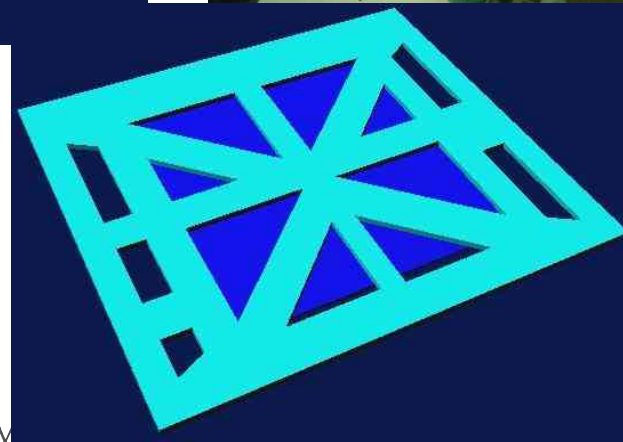
GEANT4  
Model



Frame  
Supporter



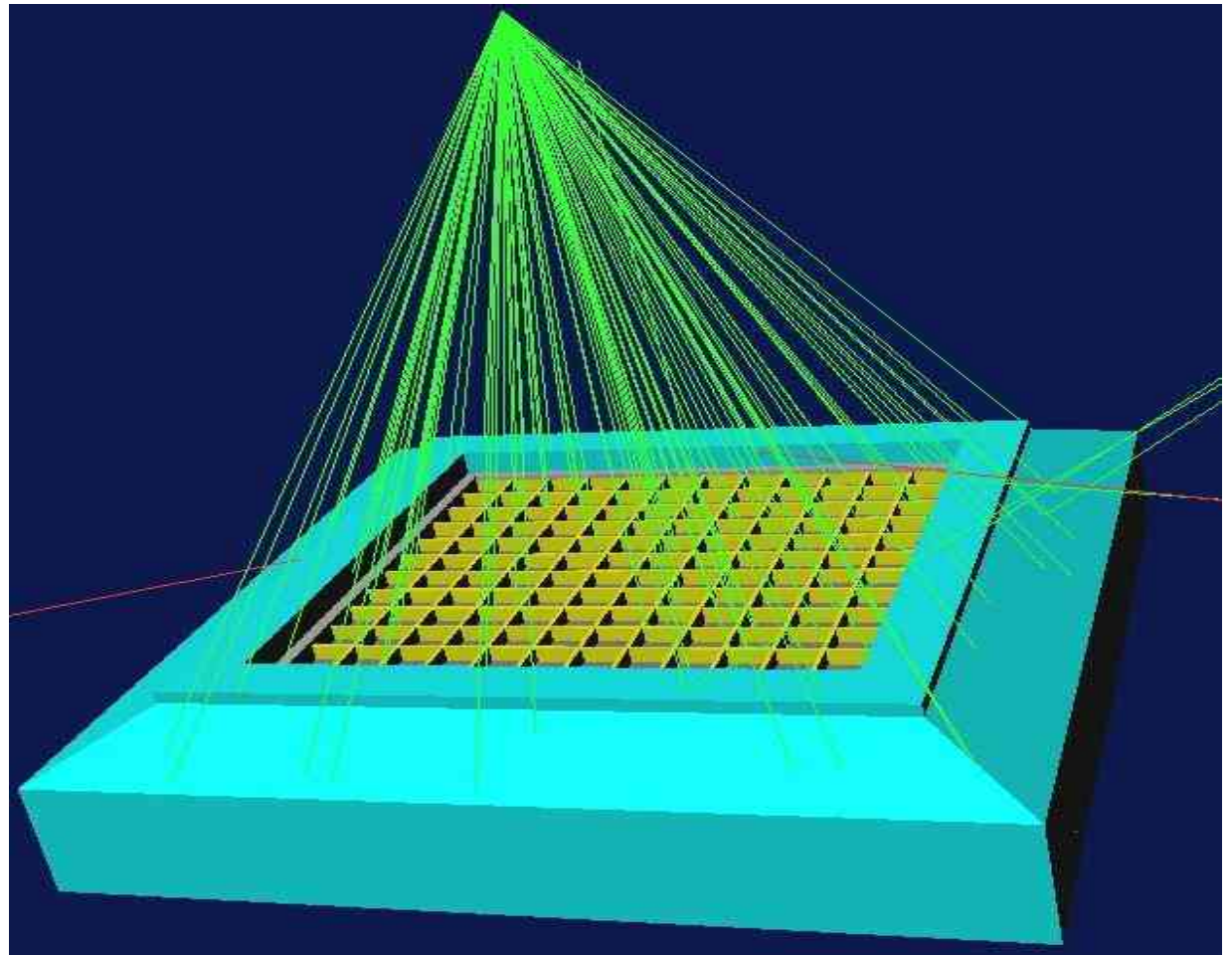
Top Cover





# IRRADIATION SETUPS

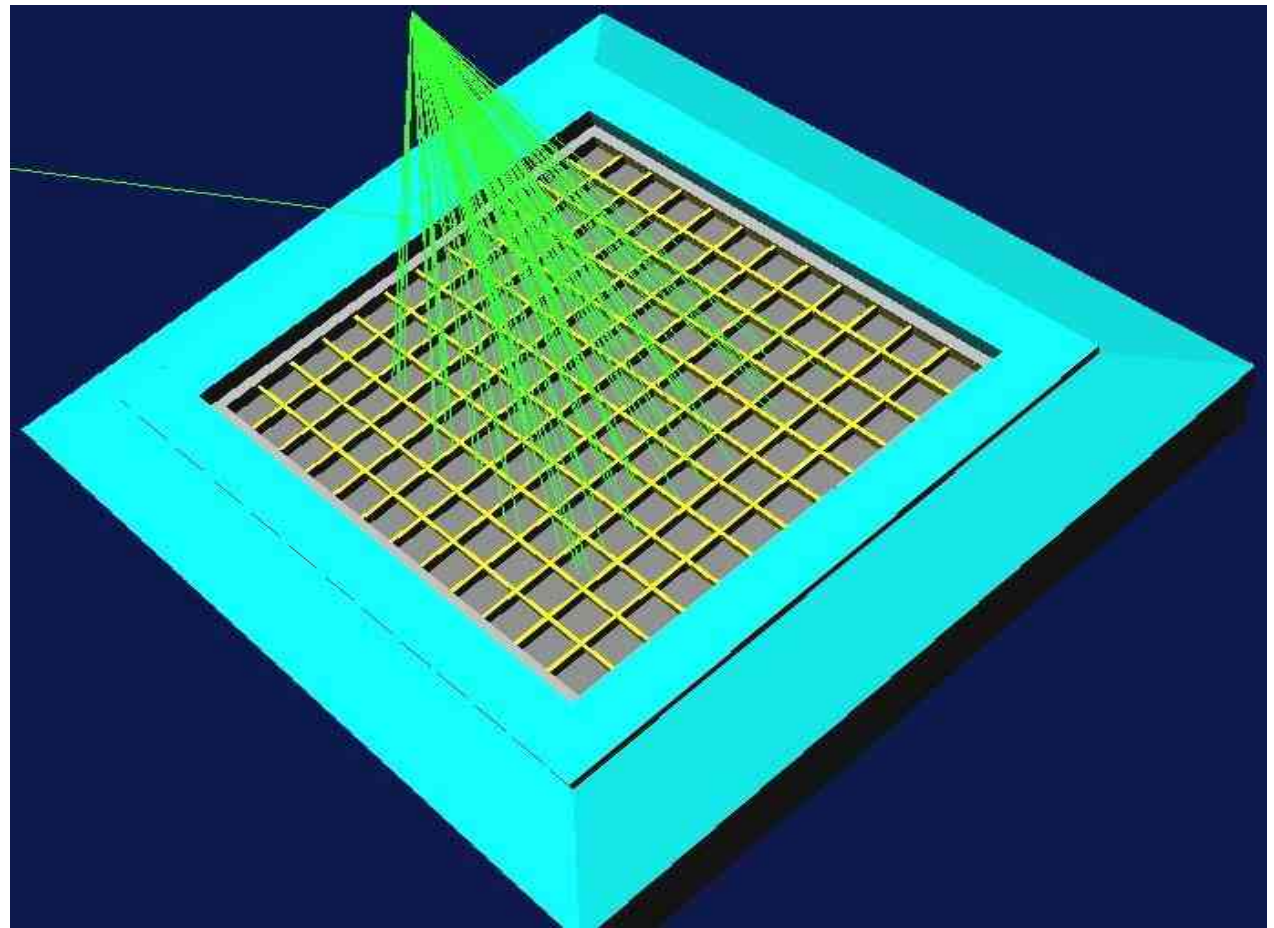
Whole detector





# IRRADIATION SETUPS (cont.)

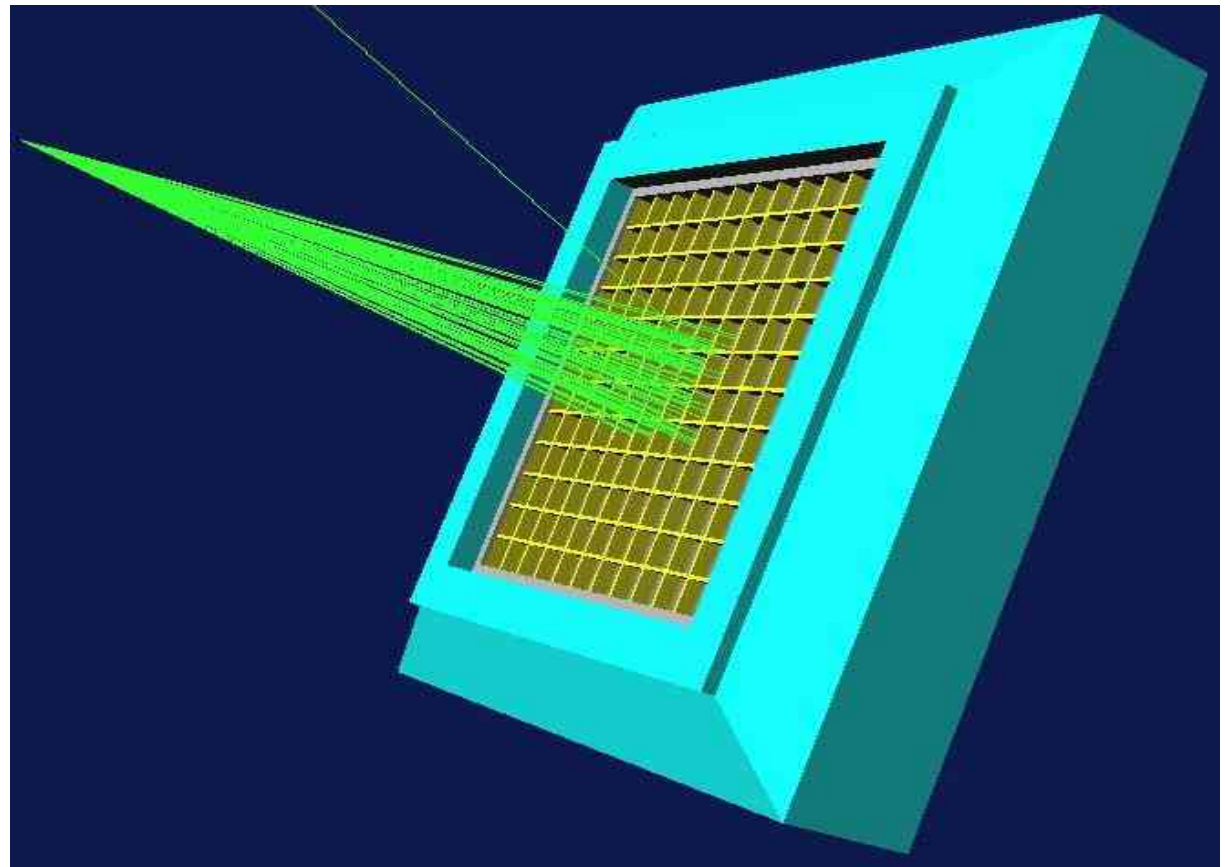
Active Area





# IRRADIATION SETUPS (cont.)

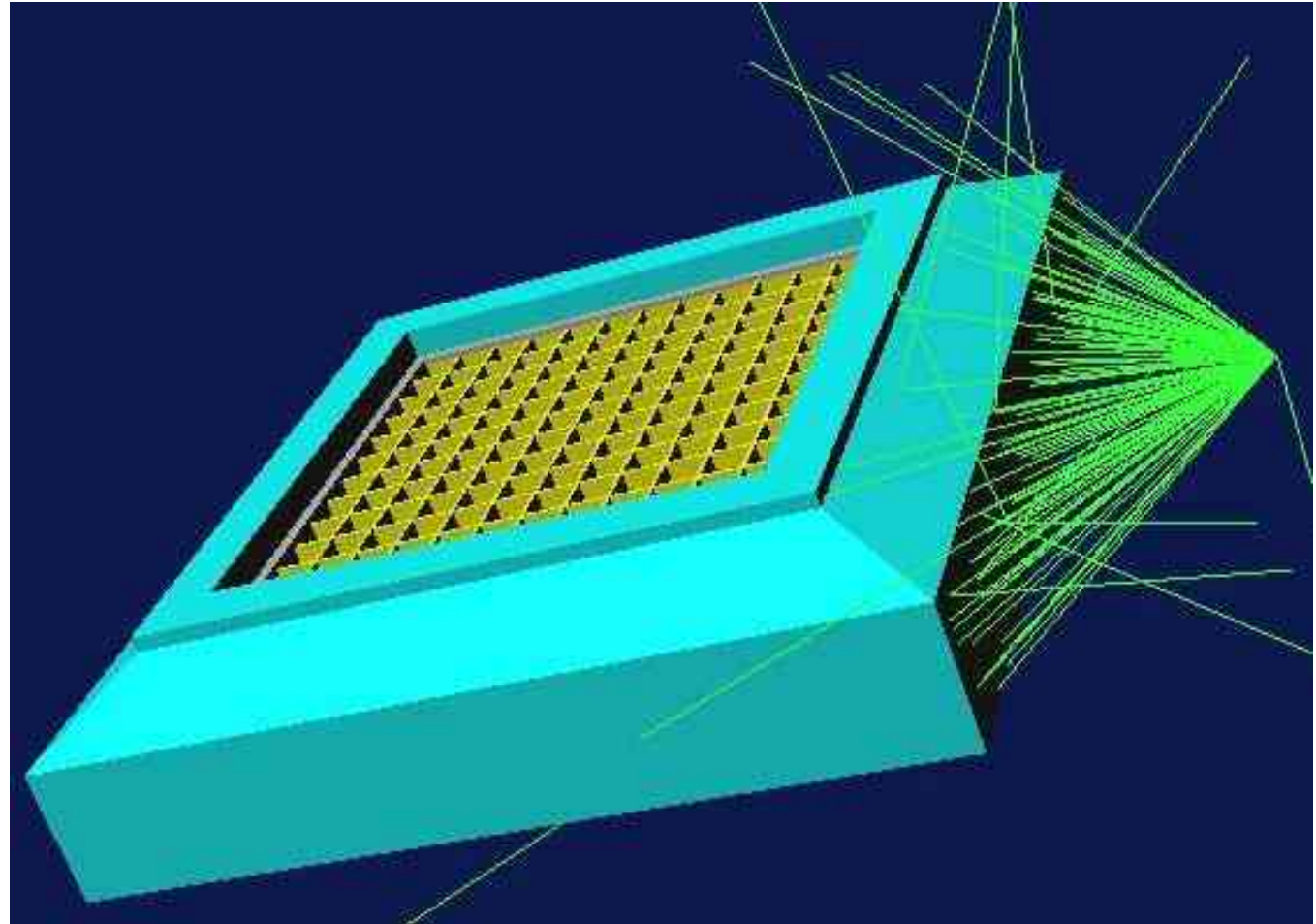
Well Collimated





# IRRADIATION SETUPS (cont.)

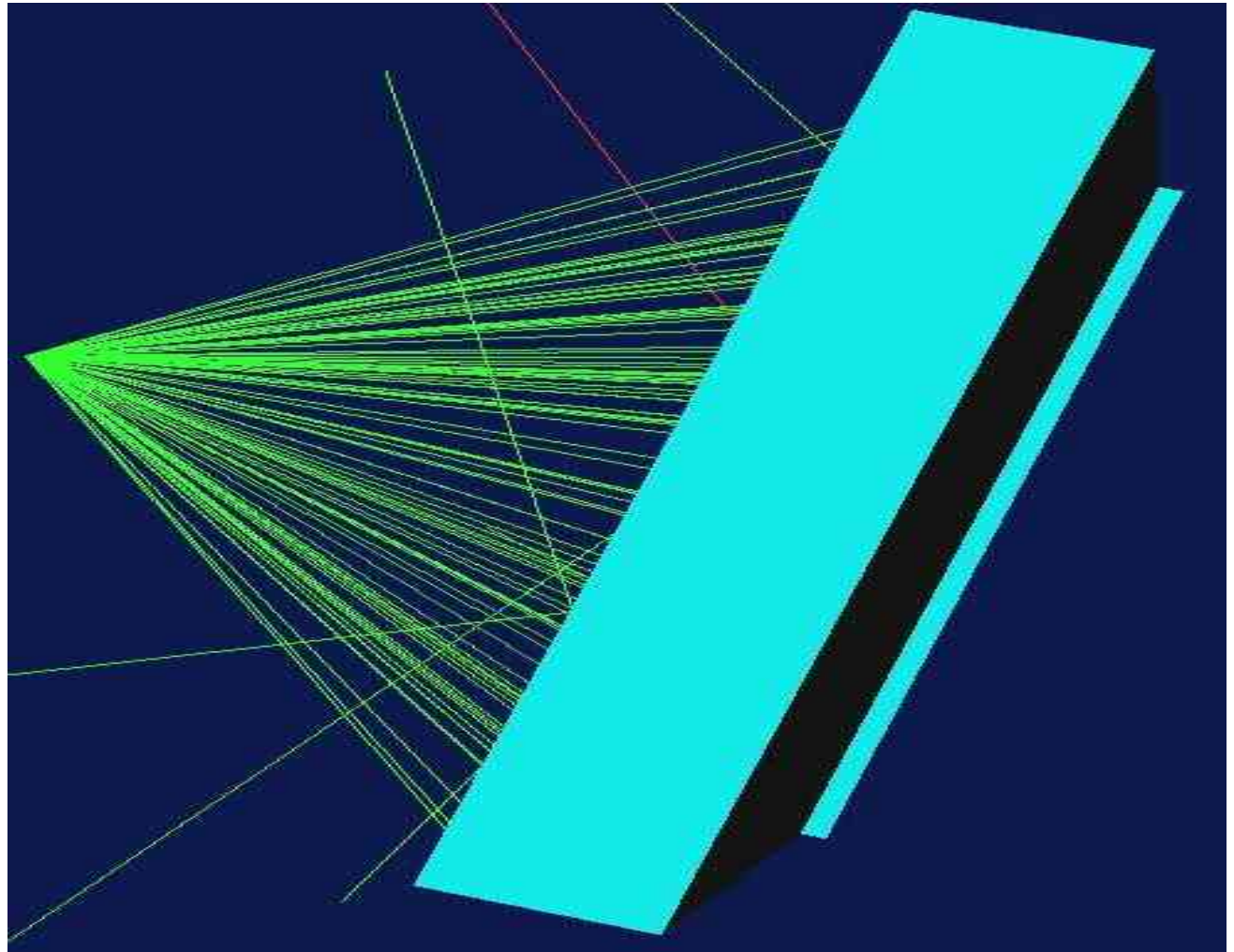
Lateral





# IRRADIATION SETUPS (cont.)

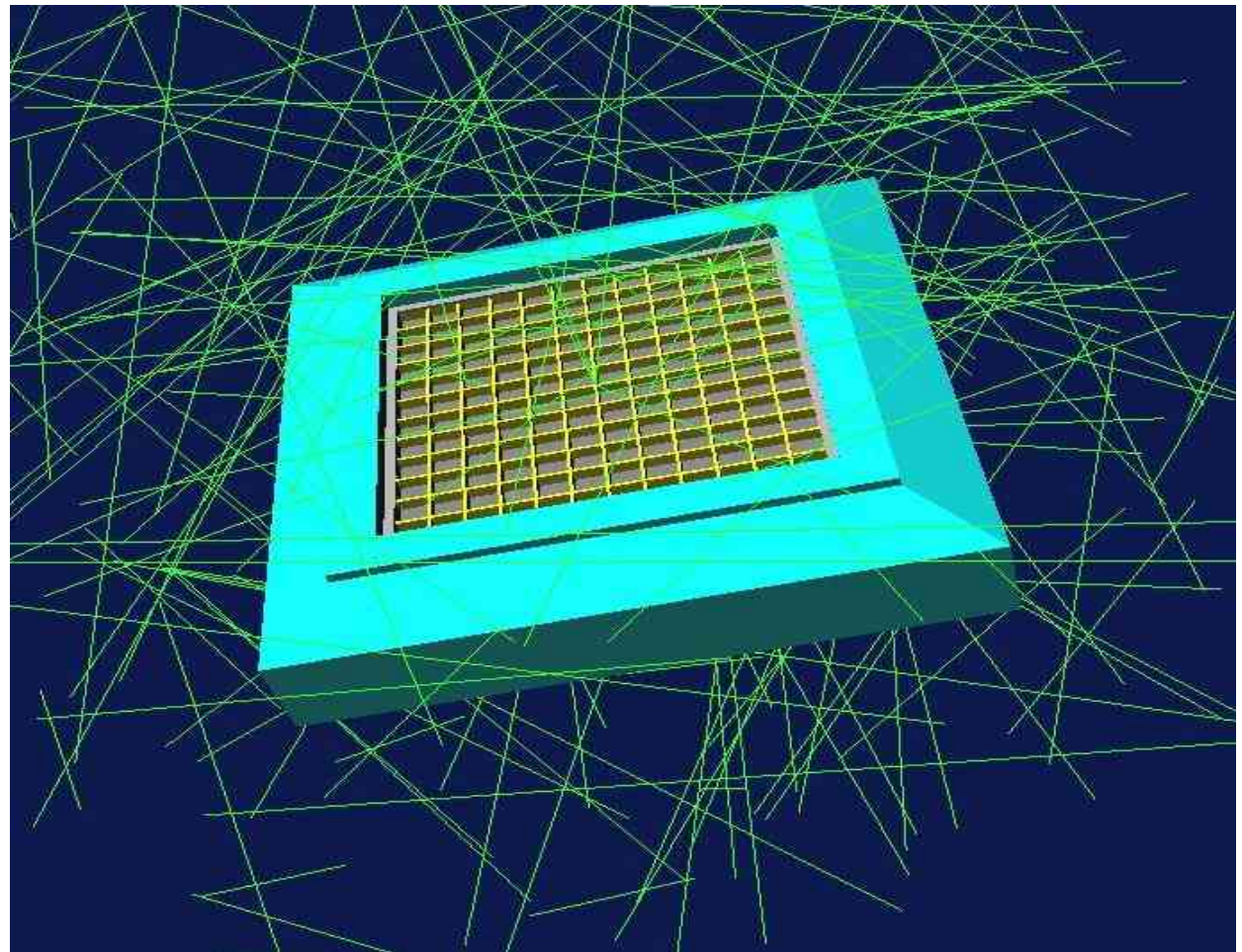
Bottom





# IRRADIATION SETUPS (cont.)

Isotropic

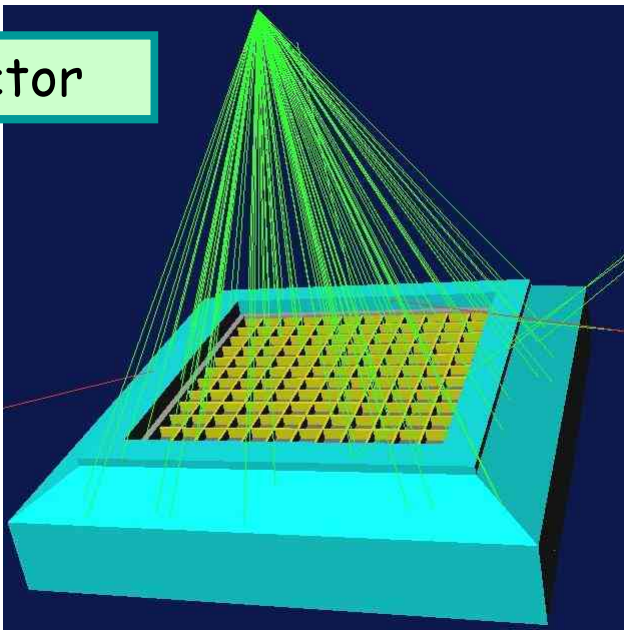




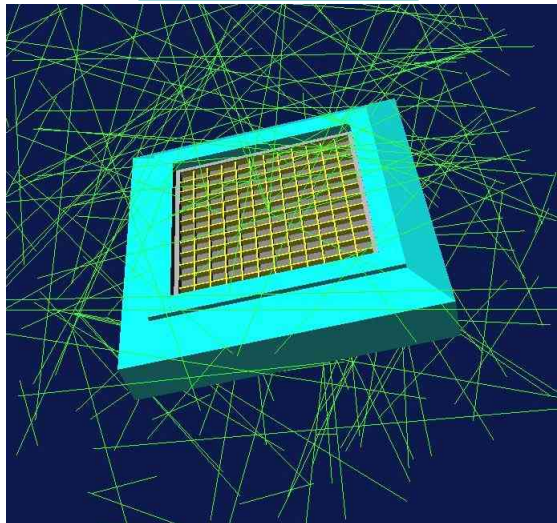


# IRRADIATION SETUPS (cont.)

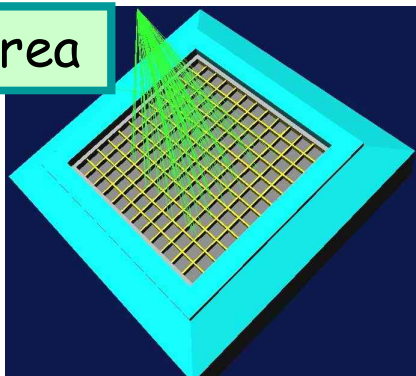
Whole detector



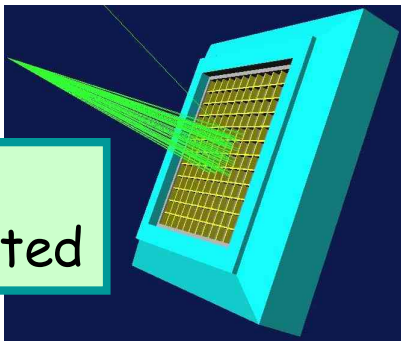
Isotropic



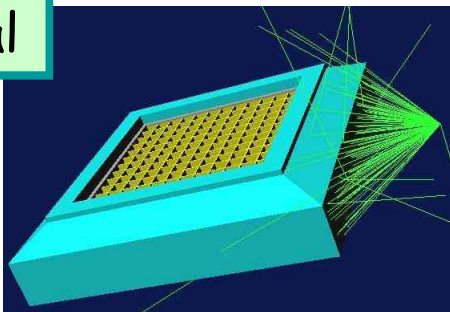
Active Area



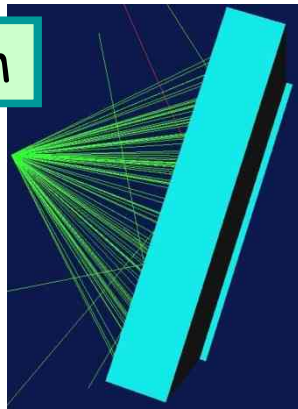
Well Collimated



Lateral



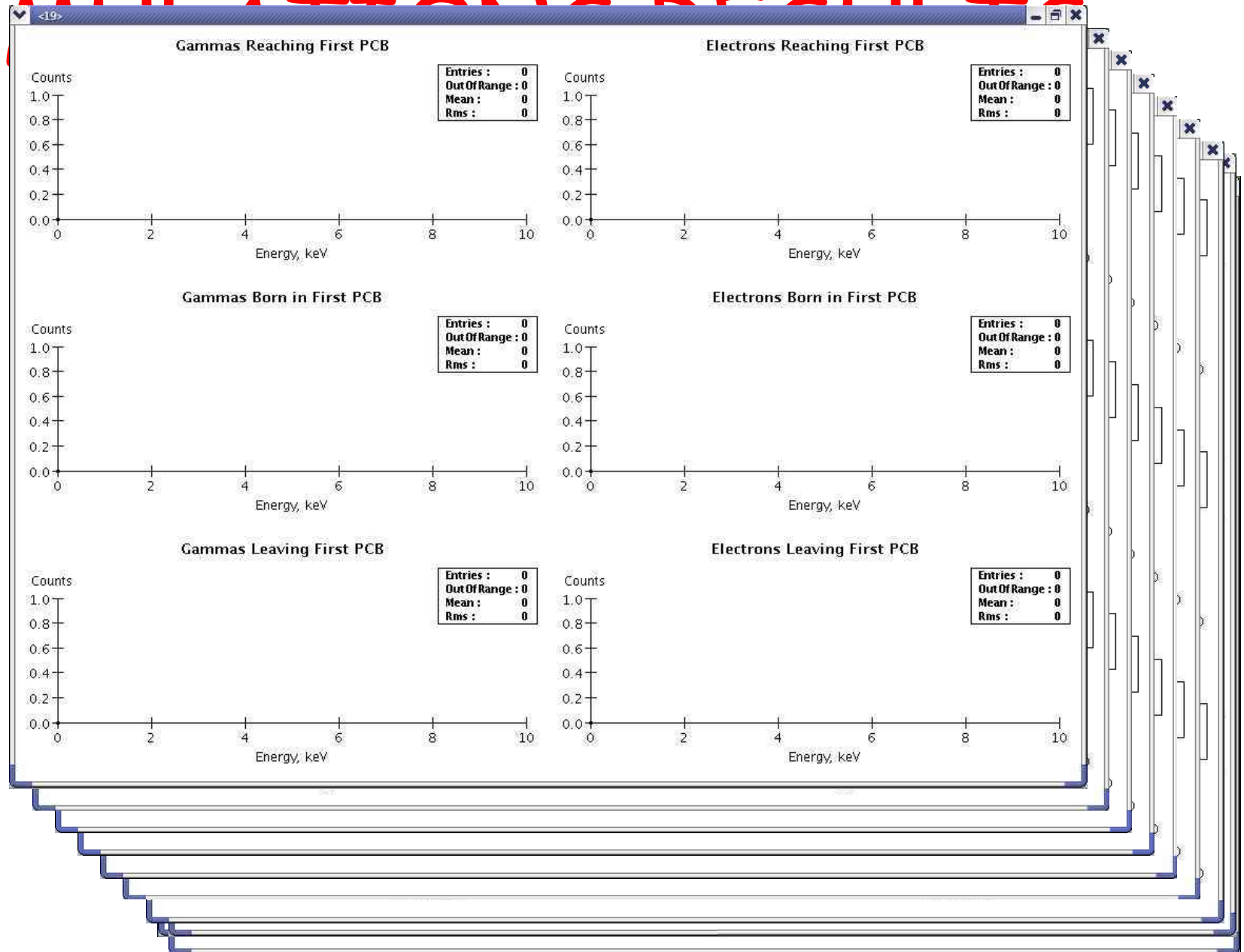
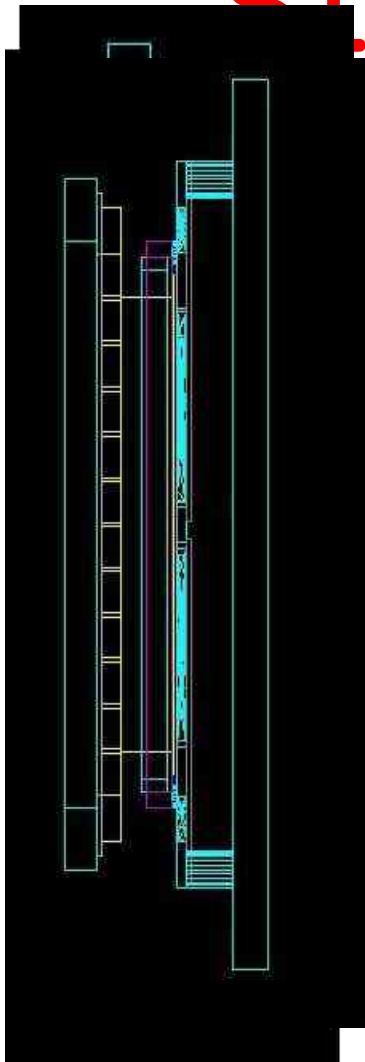
Bottom





# GAS ELECTRON MULTIPLIER DETECTOR STUDY

STANDARD MODEL OF PARTICLES





# GEM VALIDATION

Sealed Gas Electron Multiplier

$^{55}\text{Fe}$ :  $E_{\gamma} = 5.9 \text{ keV}$

