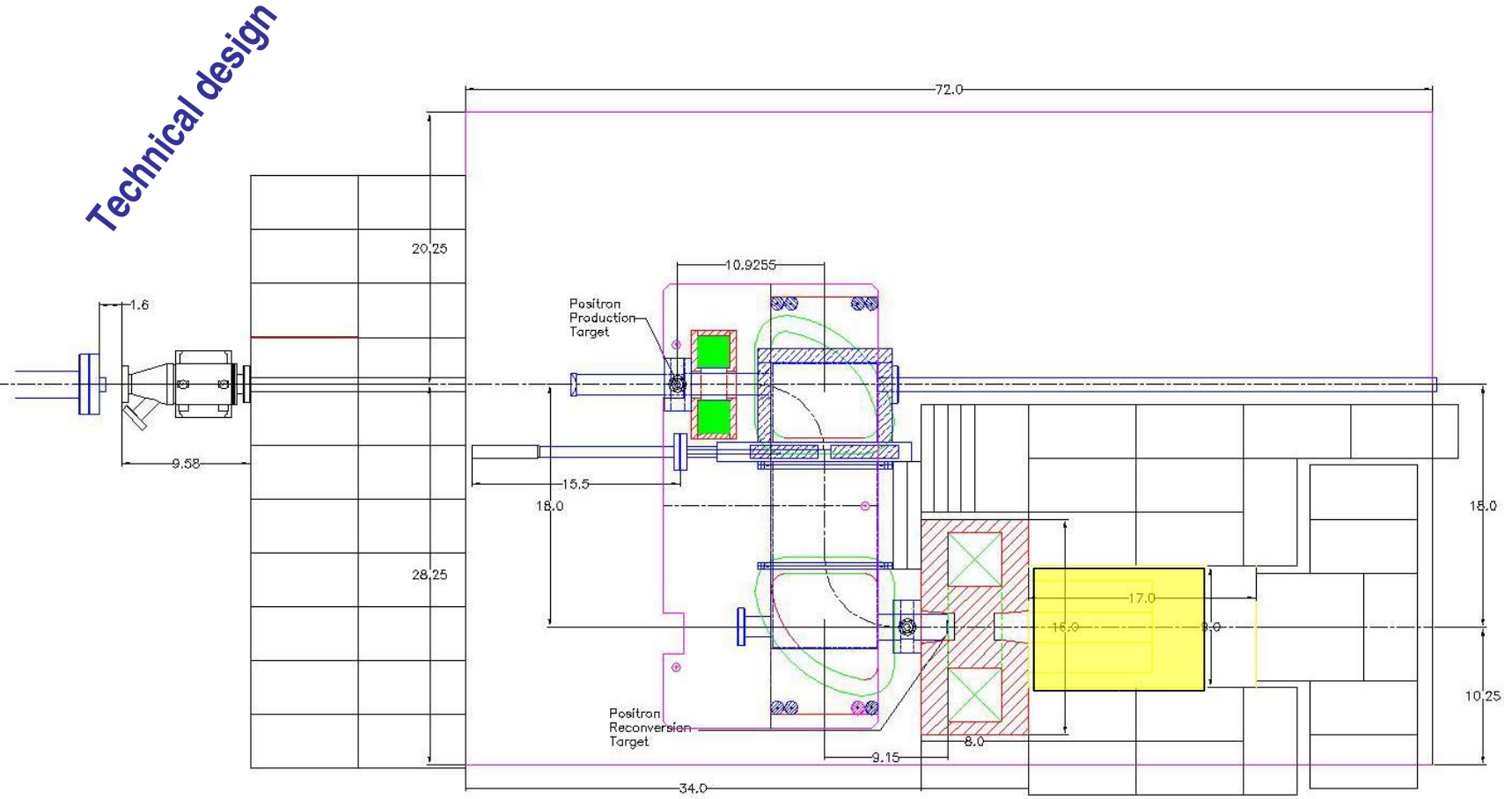
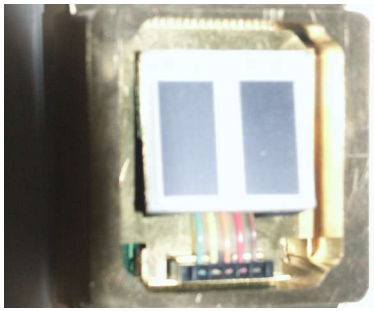
# GEANT4 simulation for the E166 experiment

## Status Positron source and Positron Table

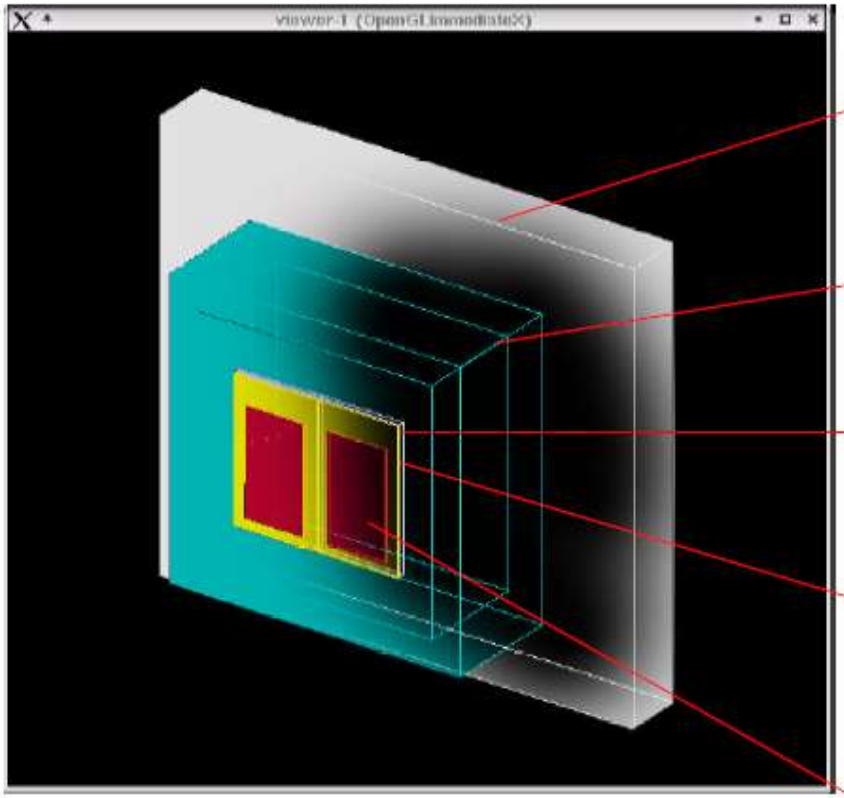
Karim LAIHEM

# E166 Experimental setup
# (Positron table at SLAC)





# Photodiodes Geant4 Geometry



Pespective view

Geant4 Geometry visualisation

Plastic Material

Metallic Box (Al)

50 x 55 x 20 mm

Ceramic

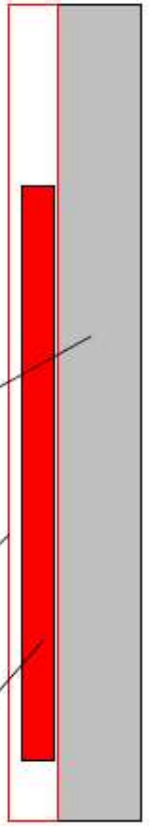
14 x 27 x 1.2 mm

Transparent Epoxy

14 x 27 x 0.6 mm

Silicon

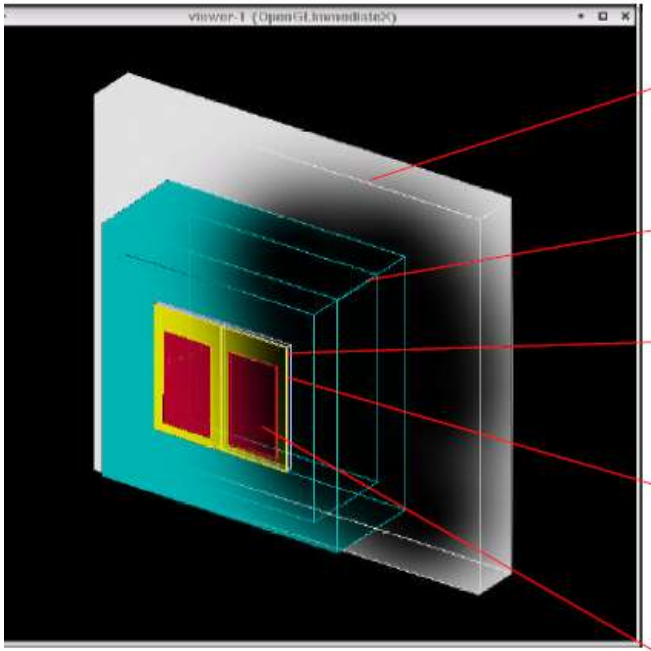
10 x 20 x 0.3 mm



Side view

Synoptic scheme

# Photodiodes - Sensitive detector



Pespective view

Geant4 Geometry visualisation

Plastic Material

Metallic Box (Al)

Ceramic

Transparent Epoxy

Silicon

All physical Processes If applicable

**without**

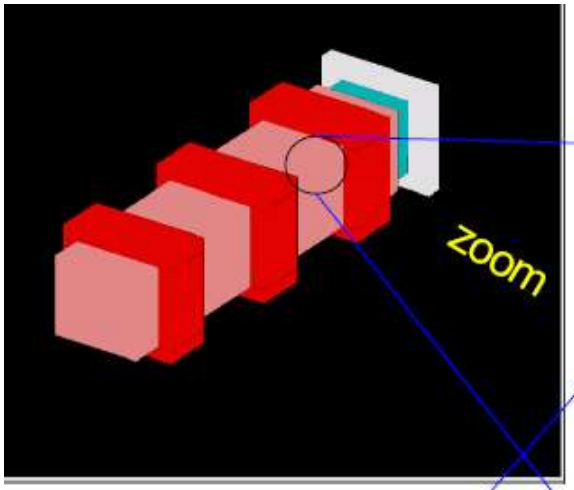
Optical photons processes

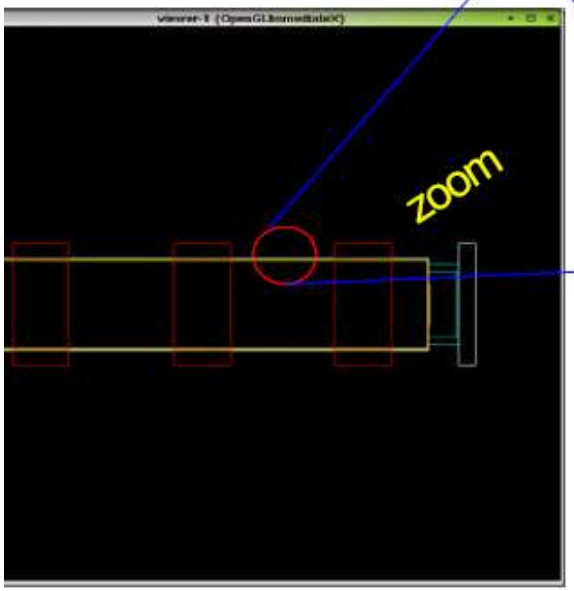
All physical Processes If applicable

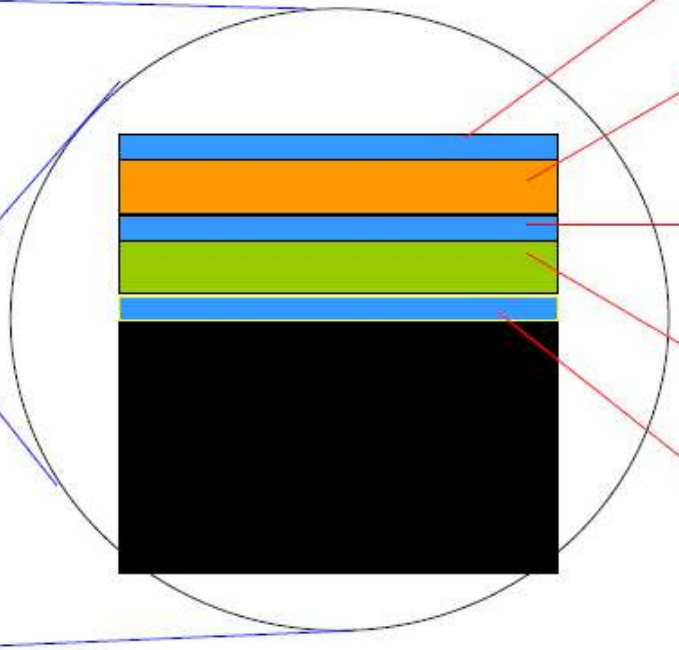
**With**

Optical photons processes

# CsI(Tl) crystal Geant4 Geometry



Air gap #2 ~ 1 μm

Cu layer = 400 μm
em Shielding

Air gap #1 ~ 1 μm

White paper = 300 μ

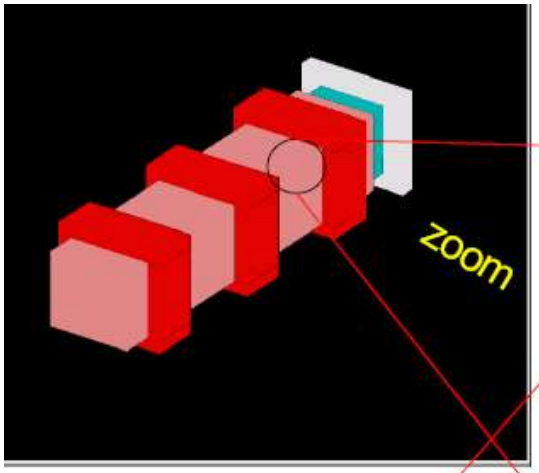
Air gap #0 ~ 1 μm

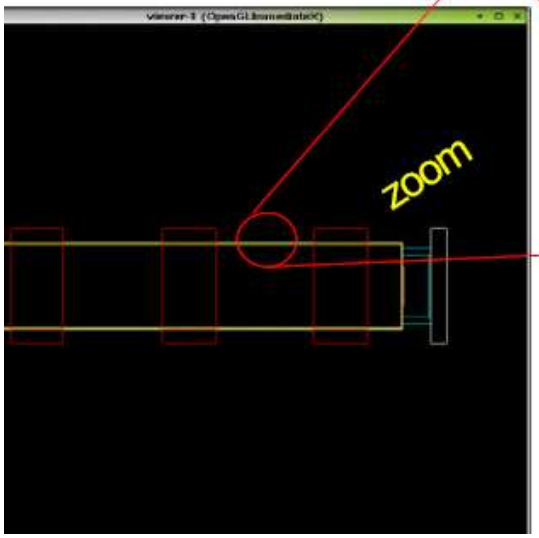
*703 μm* **In Total**

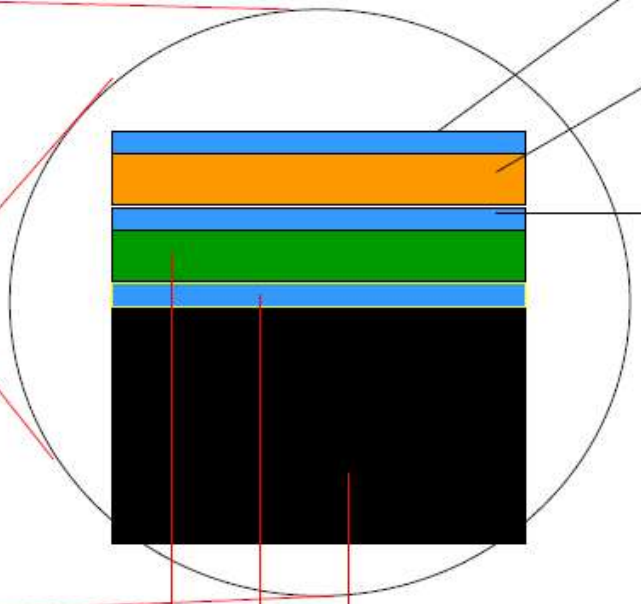
1.4 mm gap

*Between Two adjacent crystals*
*In the 9 Crystals calorimeter*

# CsI(Tl) crystal - Sensitive detector



Air gap #2

Cu layer

Air gap #1

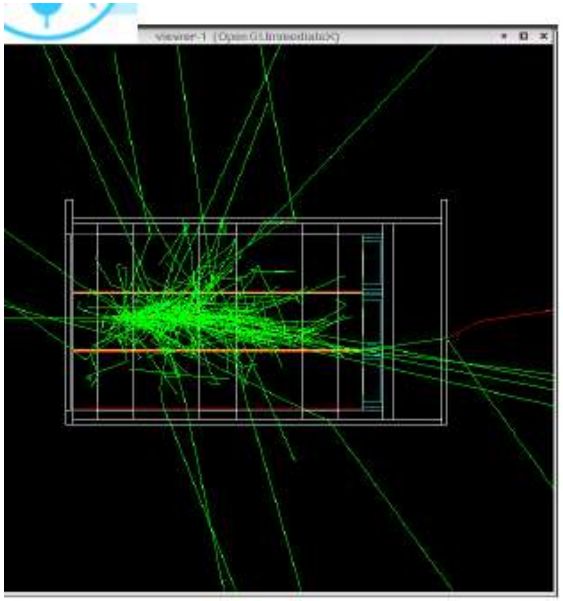
CsI(Tl)

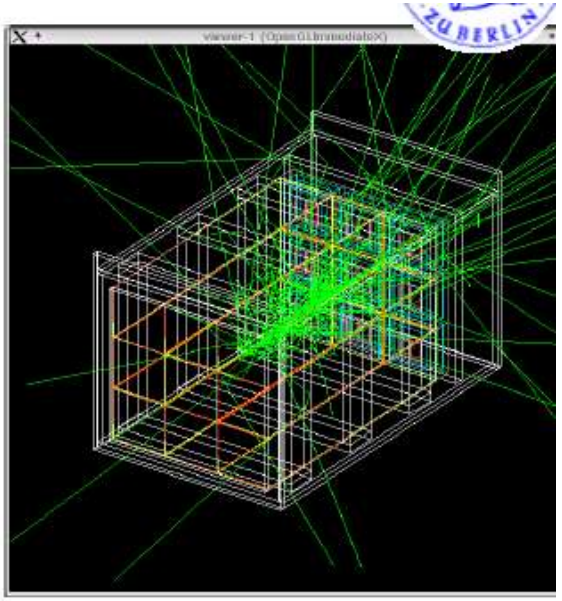
Air gap #0

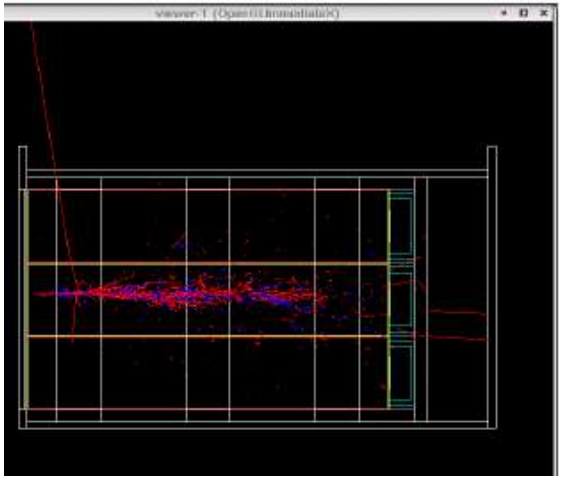
White paper

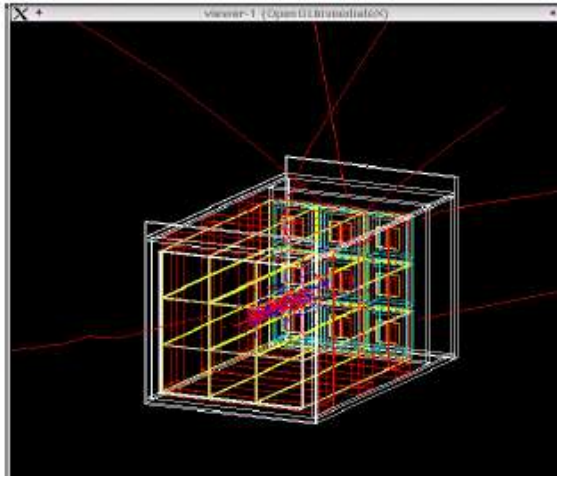
All phys
Process
If applica
**witho**
Optica
photon
process

All physical
Processes
If applicable
**with**
Optical photons
processes
**And**
Scintillation







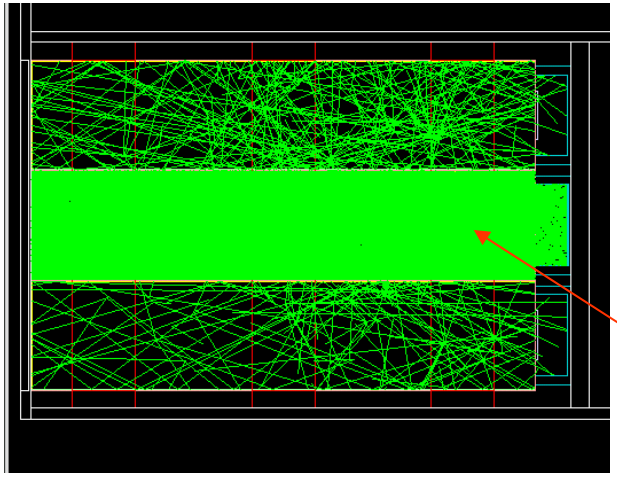


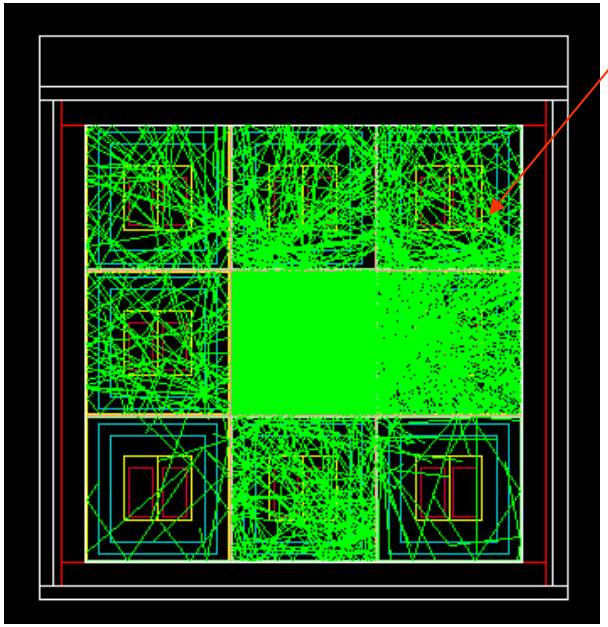
Neutral particles

Negative charged particles

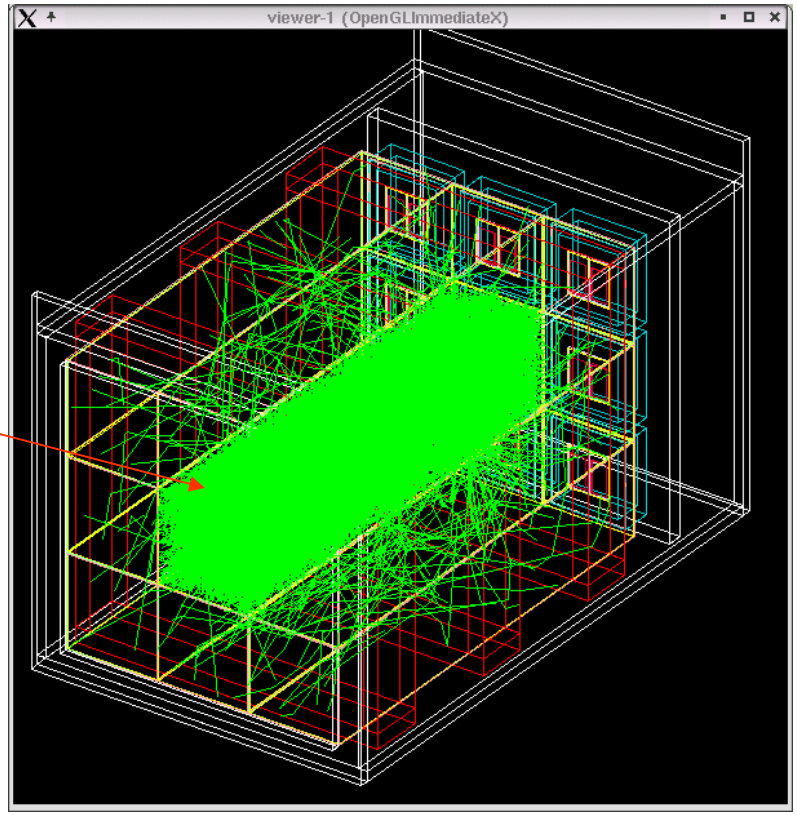
Positive charged particles

# Scintillation and optical photon





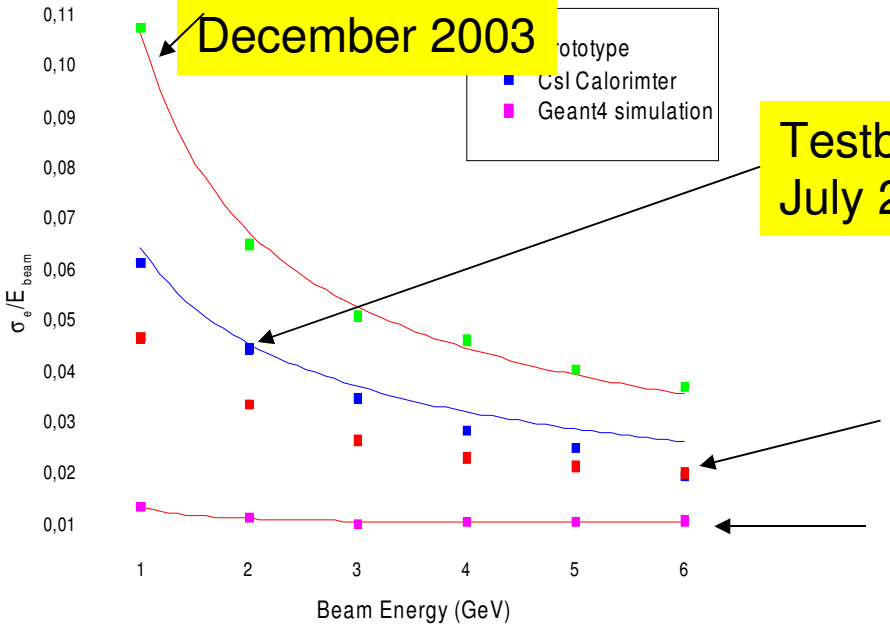
CsI(Tl)
Crystals




No WLS process for the (Tl)
No quantitative studies for the moment

It takes huge CPU time for
realistic simulation

Prototype
testbeam HH
December 2003

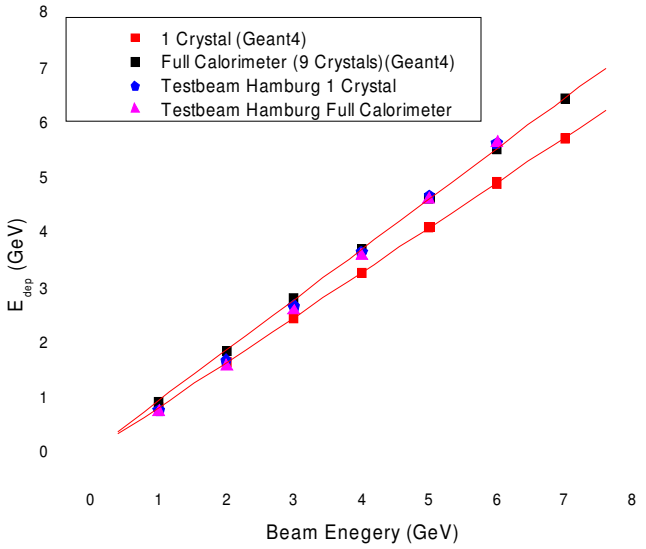



TestbeamHH
July 2004

**with**
**beam energy spred**

**without**
**beam energy spred**

Geant4 simulation

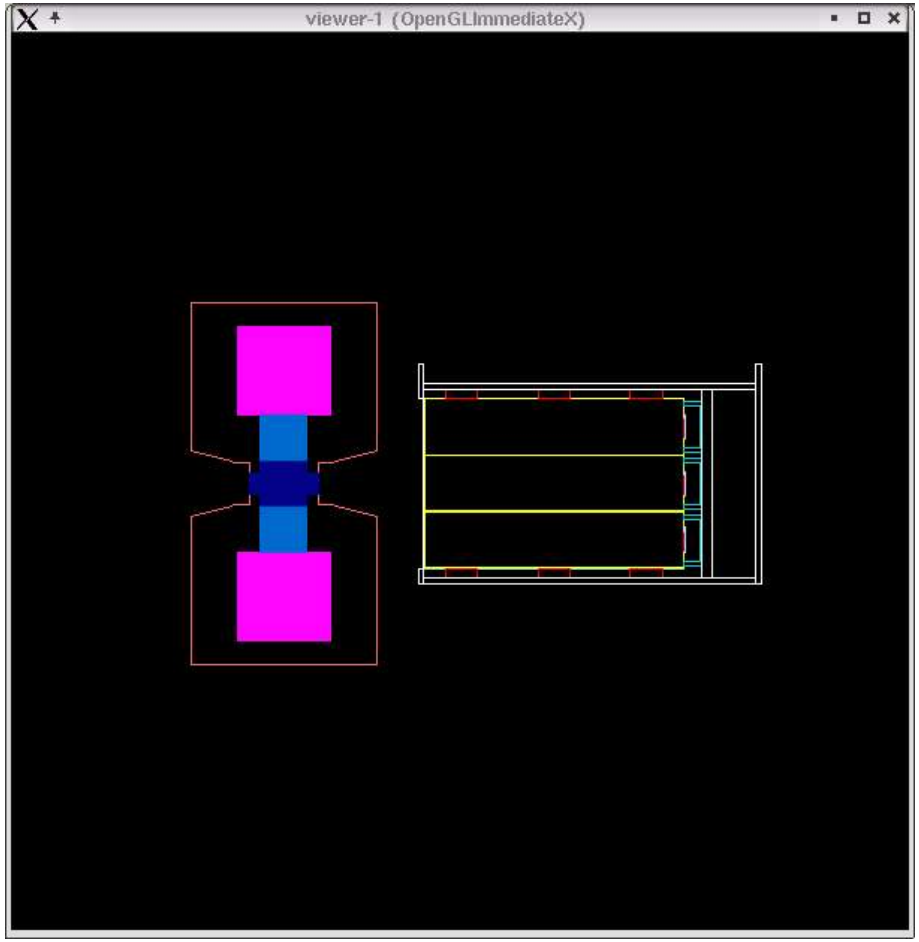


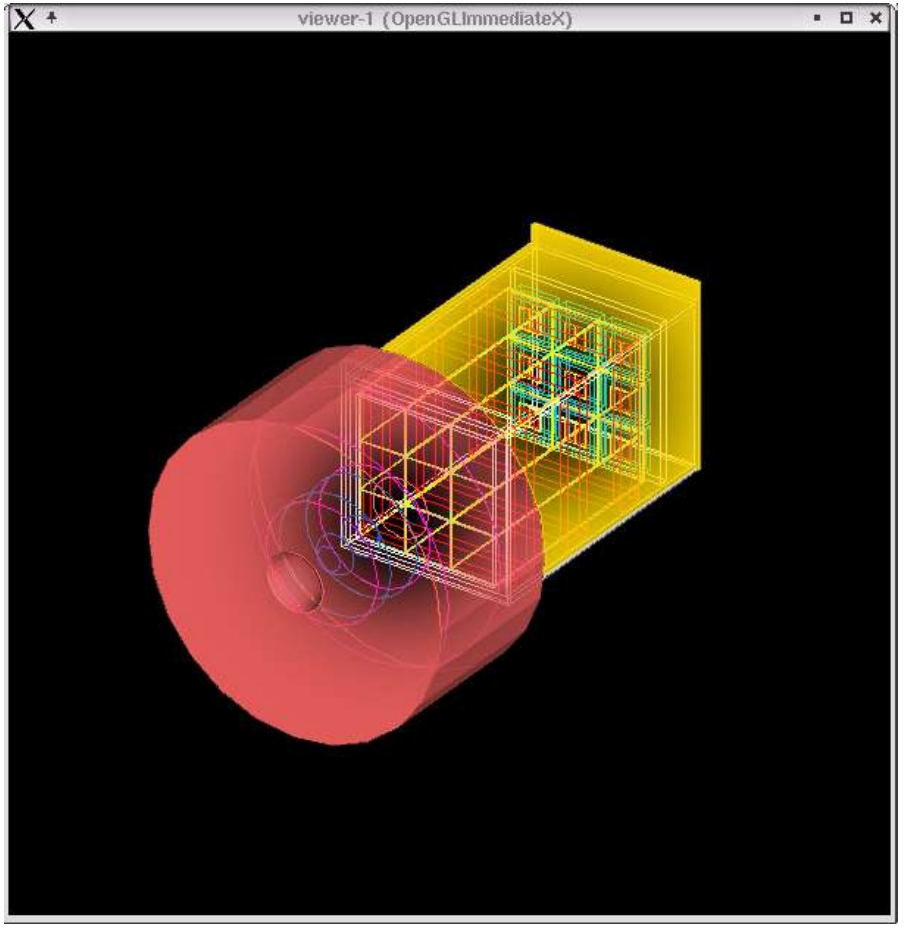

# G4 simulation vs. Testbeam Hamburg

Beam Energy (GeV)

$E_{dep}$ with respect the beam energy

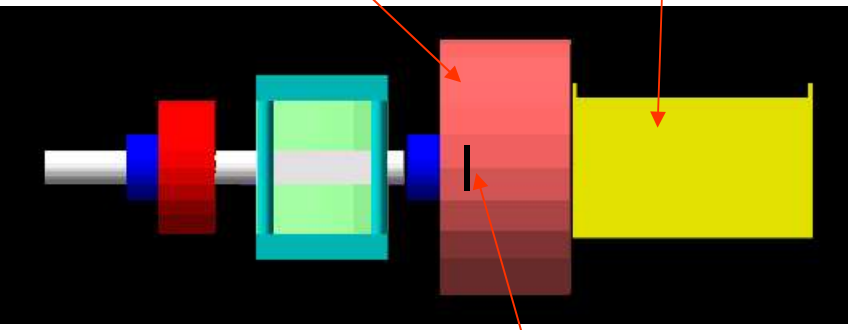
# Analyzing Magnet and CsI(Tl) calorimeter



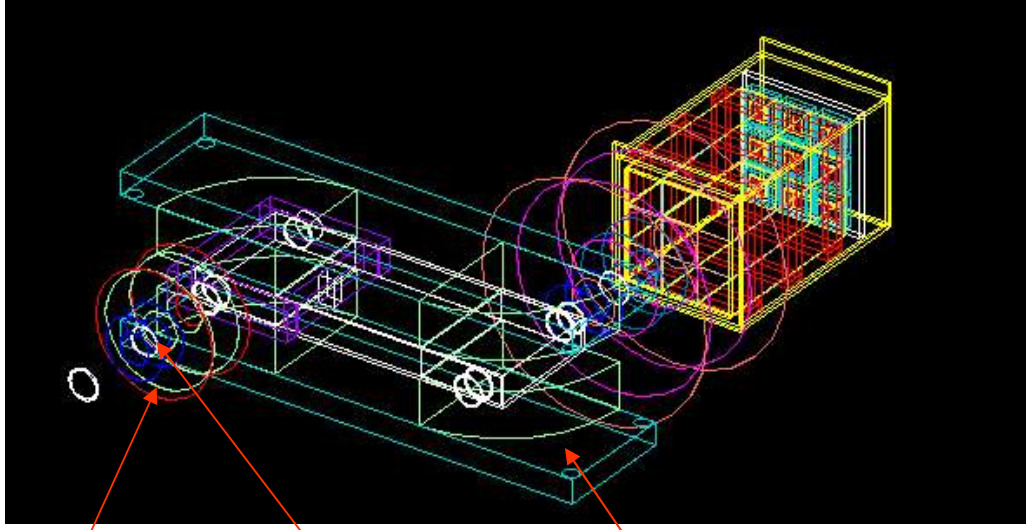
CsI(Tl) calorimeter

Analyzing magnet



Reconversion target

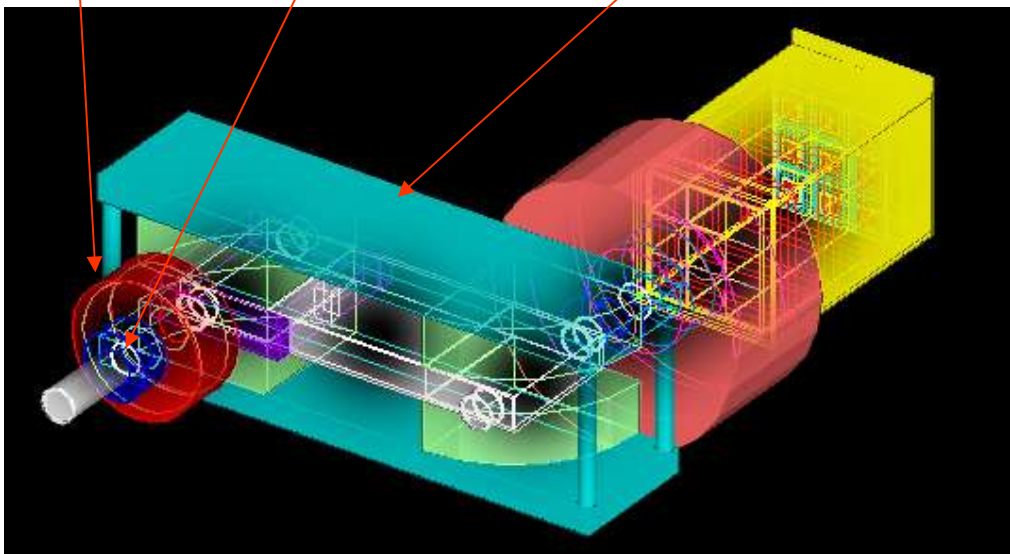
Side view



Solenoid

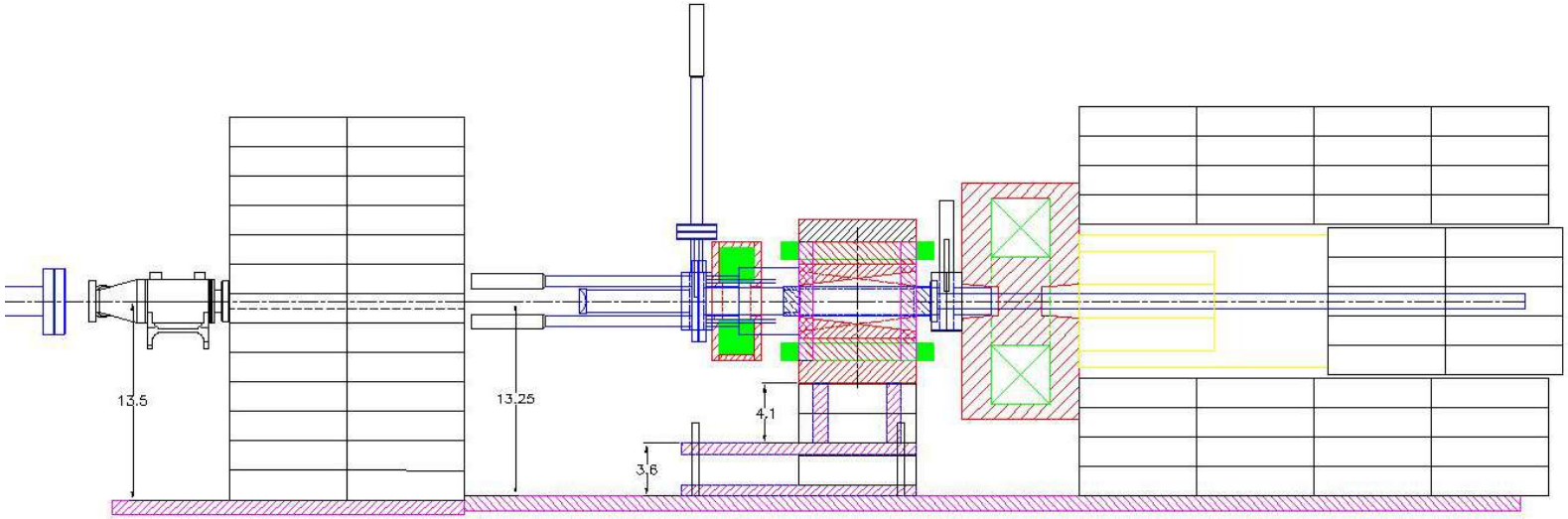
Conversion target

Spectrometer

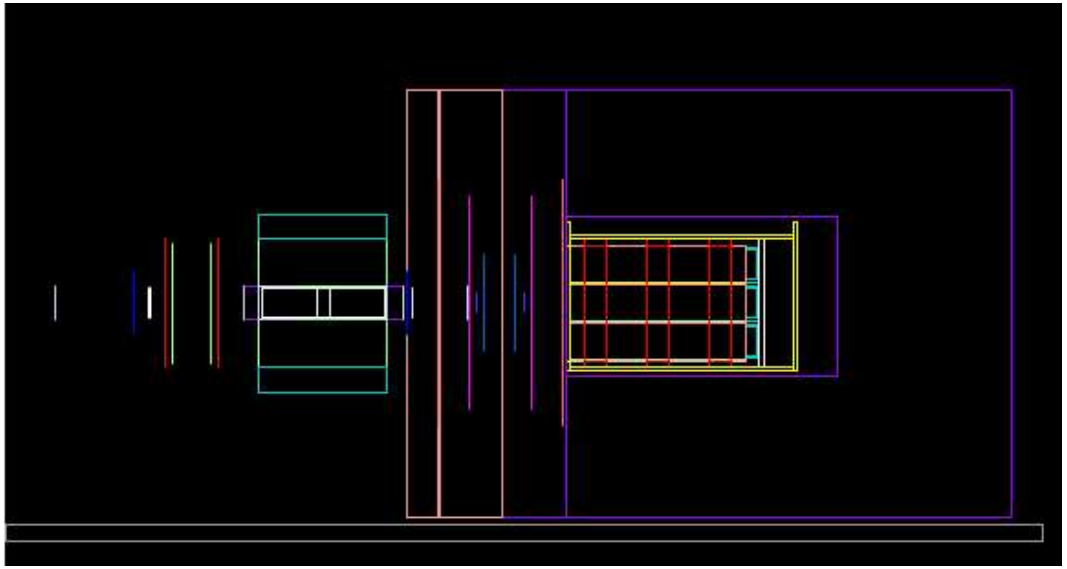


Perspective view

Technical design

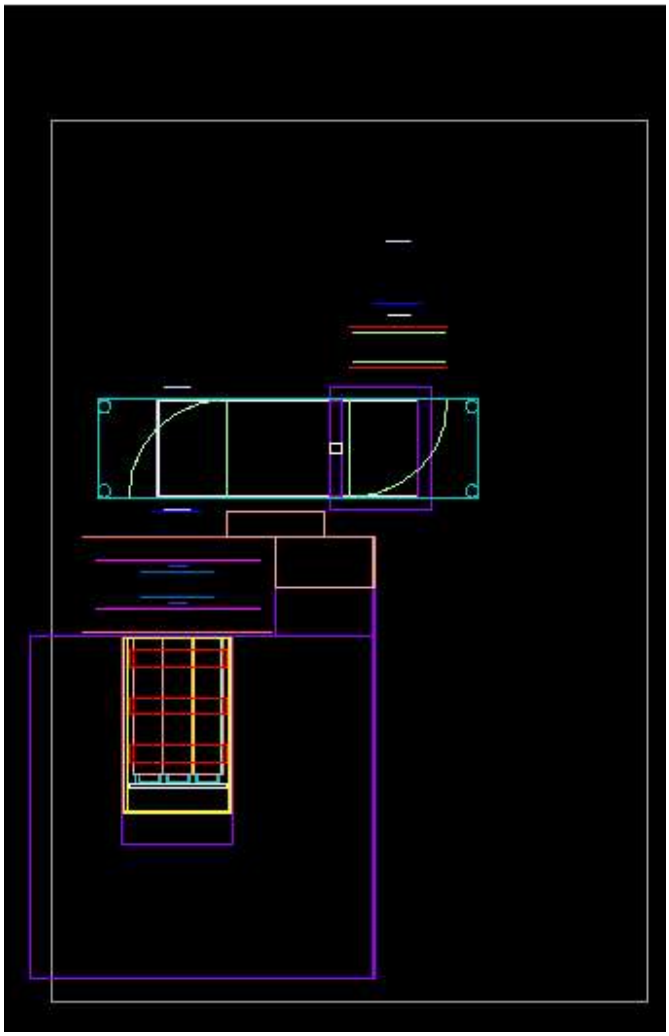



Geant4 Geometry

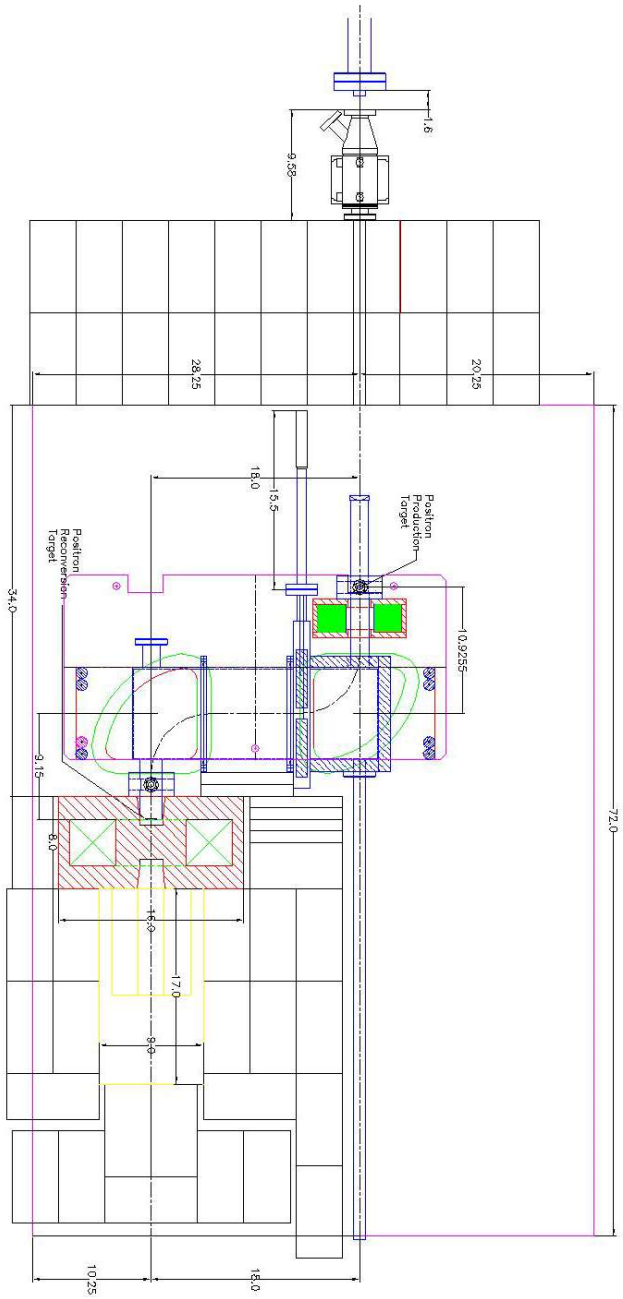


Side view

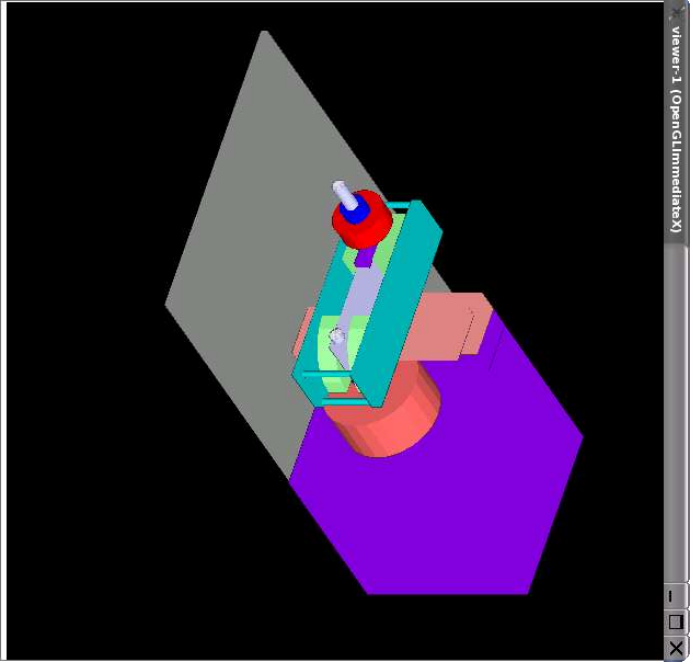
## Geant4 Geometry

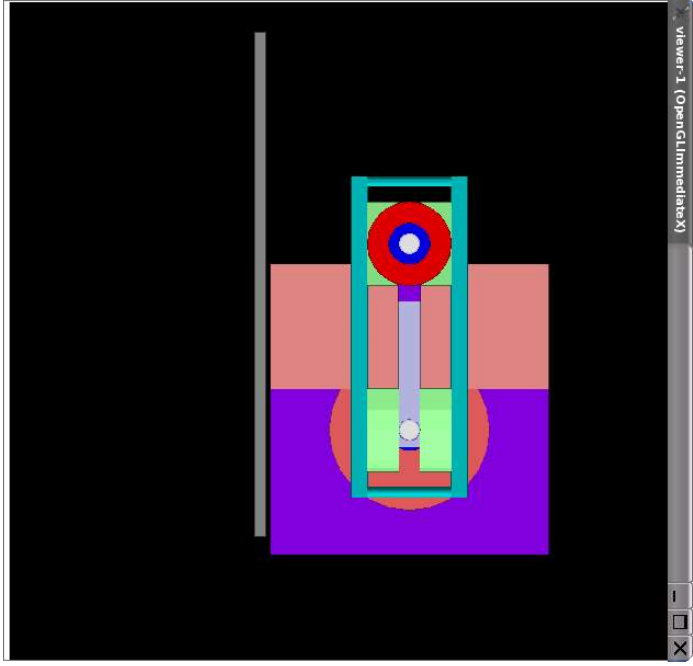


## Technical design

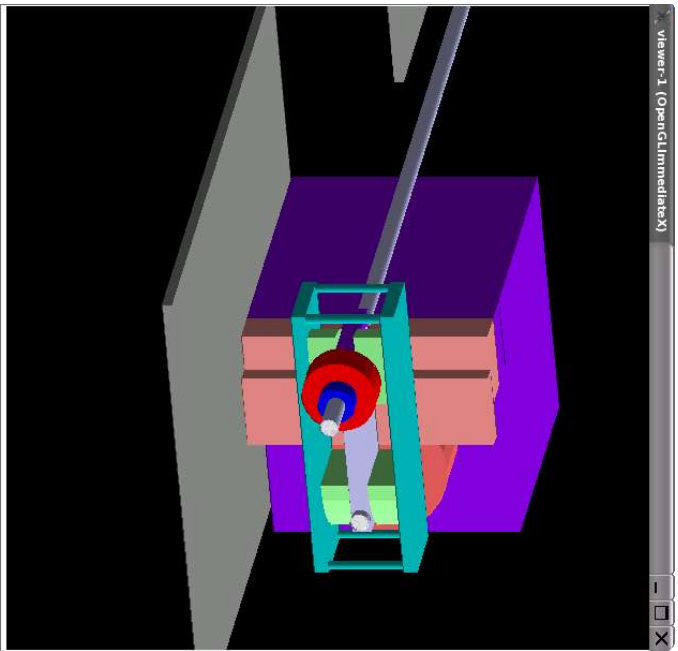


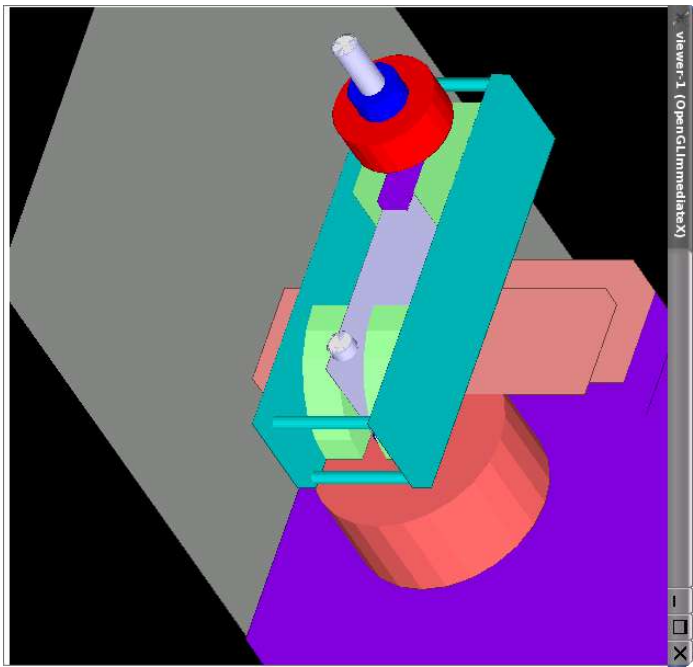

# Top view

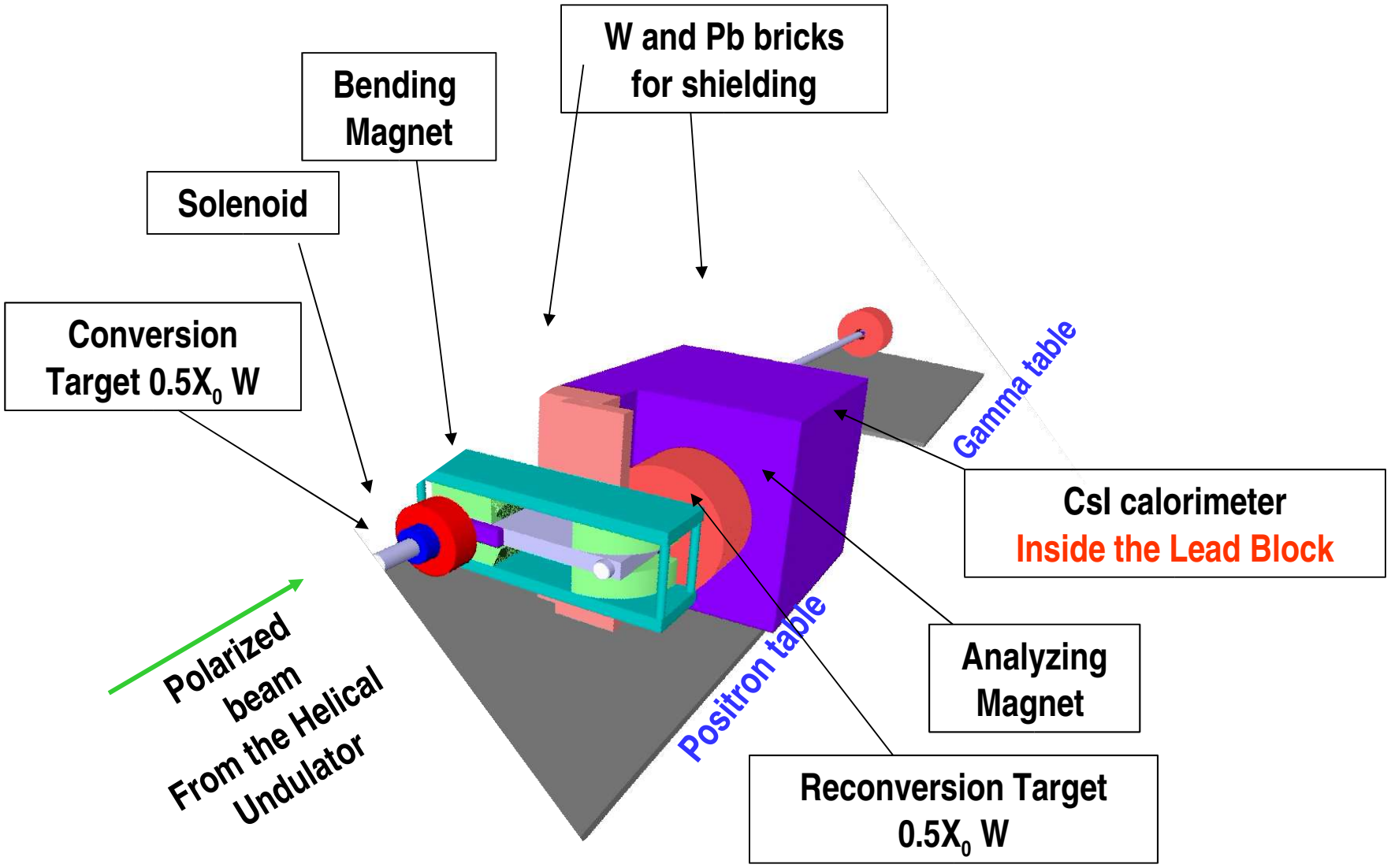


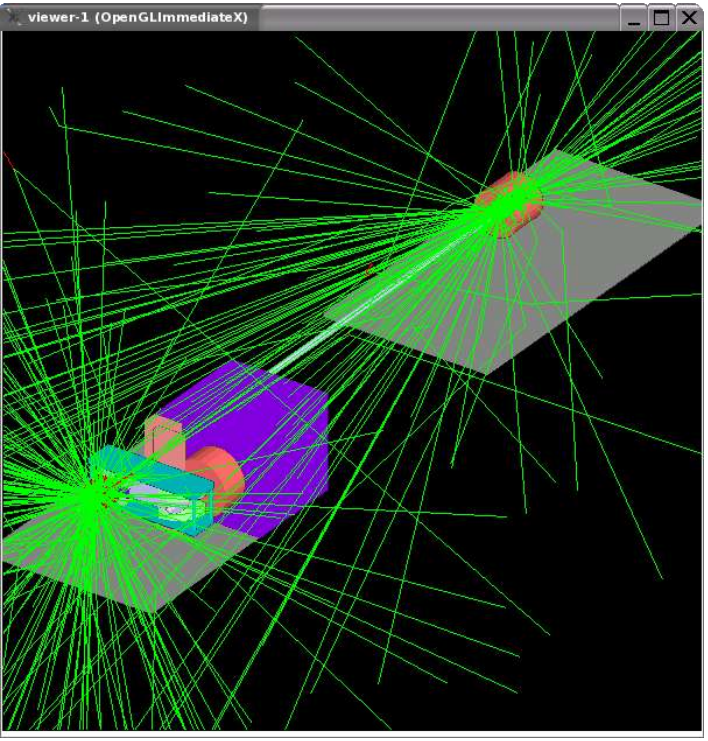

# Positron Table

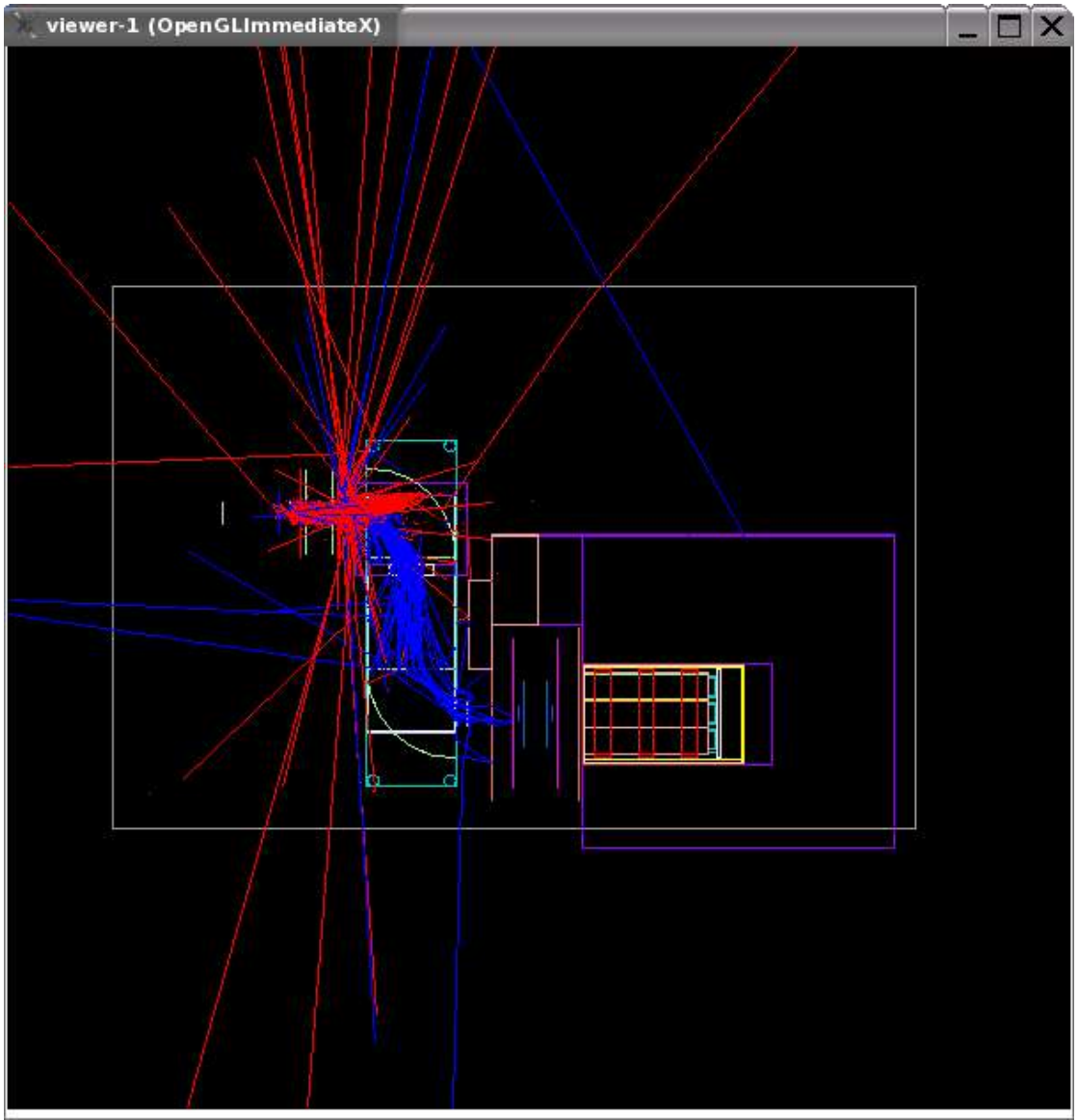


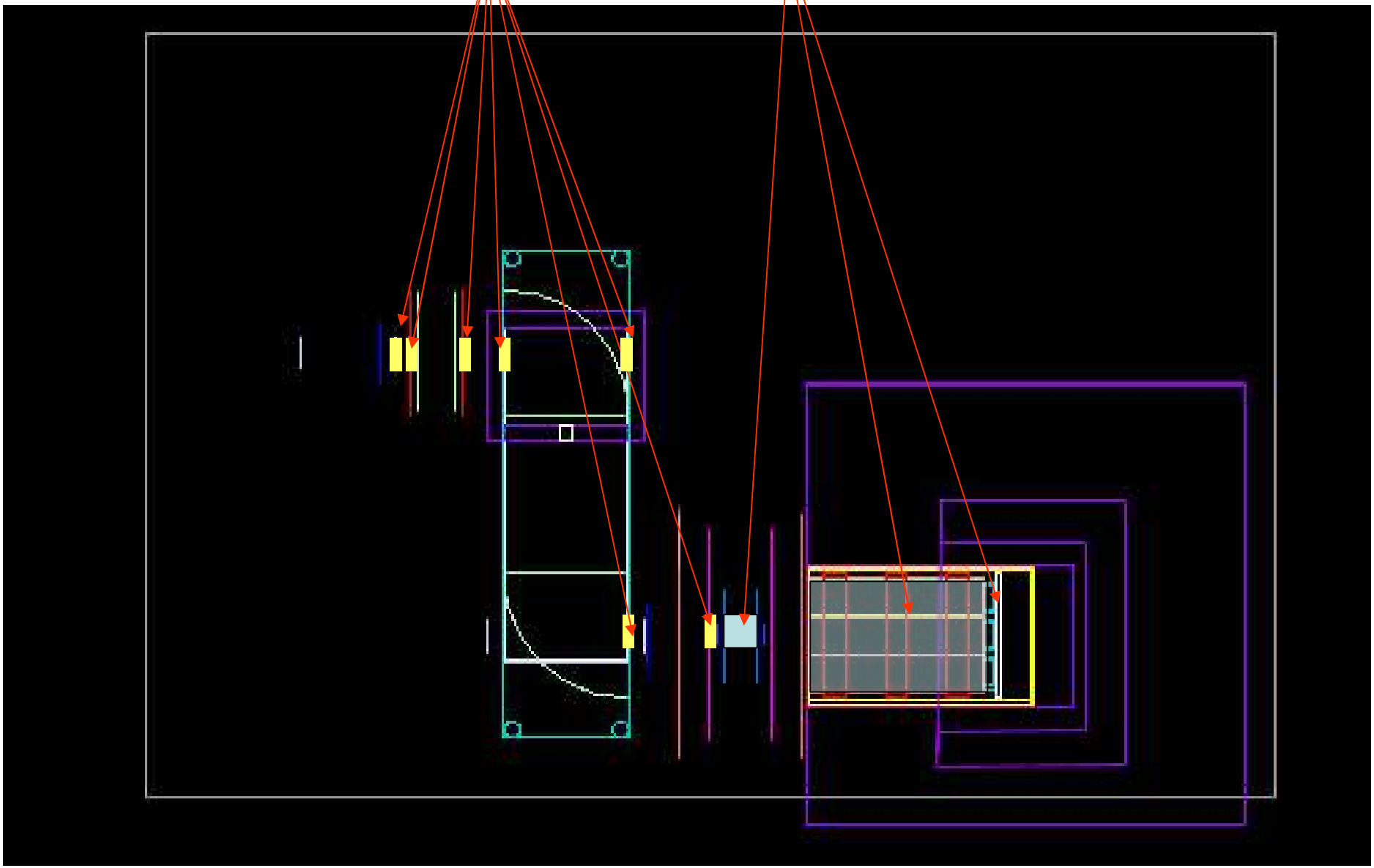

W and Pb bricks for shielding
Bending Magnet
Solenoid
Conversion Target 0.5X0 W
Gamma table
CsI calorimeter
Inside the Lead Block
Polarized beam From the Helical Undulator
Positron table
Analyzing Magnet
Reconversion Target 0.5X0 W

# Some test Runs have been started

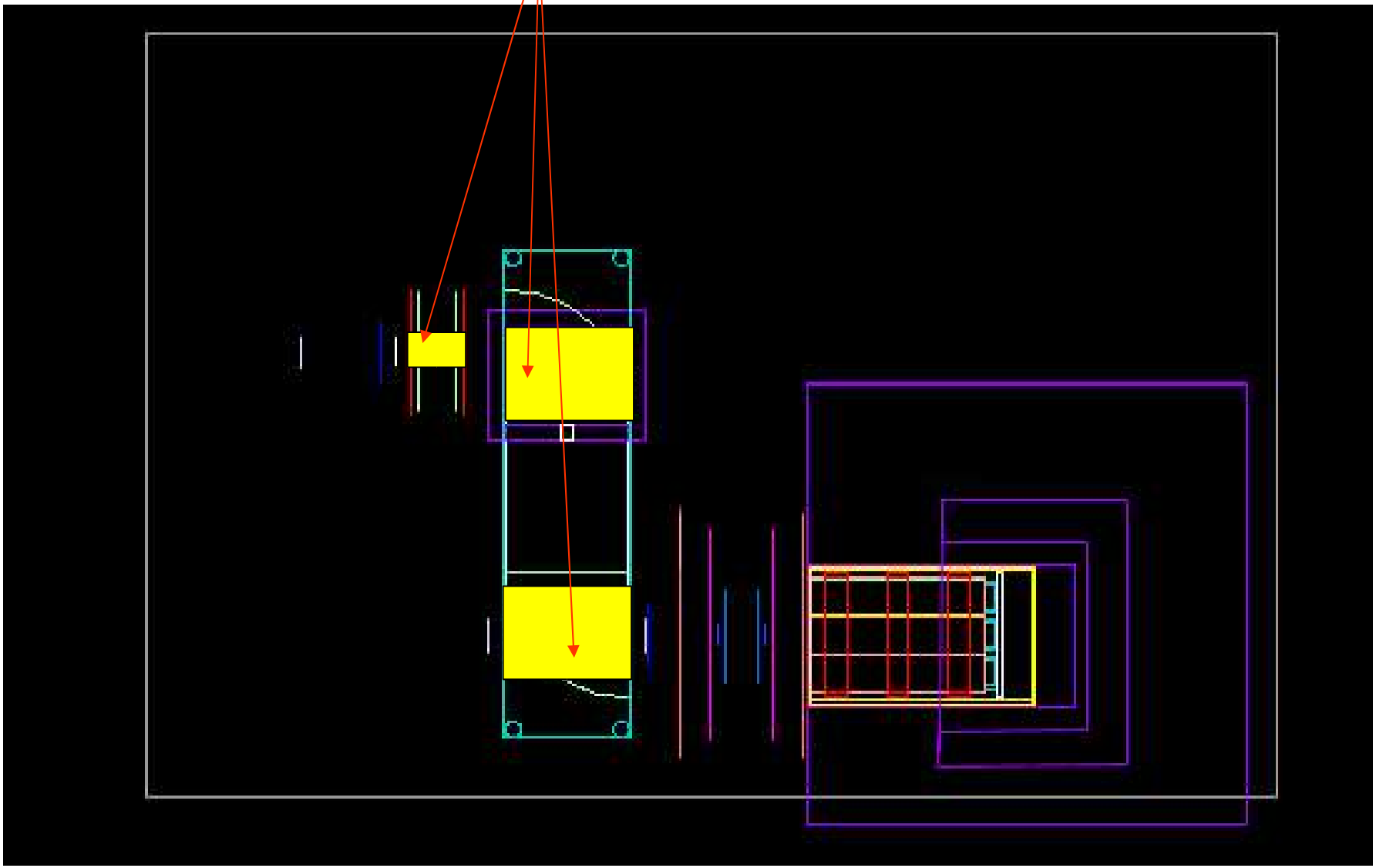


# 9 Sensitive Detectors



# 3 Magnetic Fields



# Cosmic Muons

**Two configurations (A) and (B) & (C).**

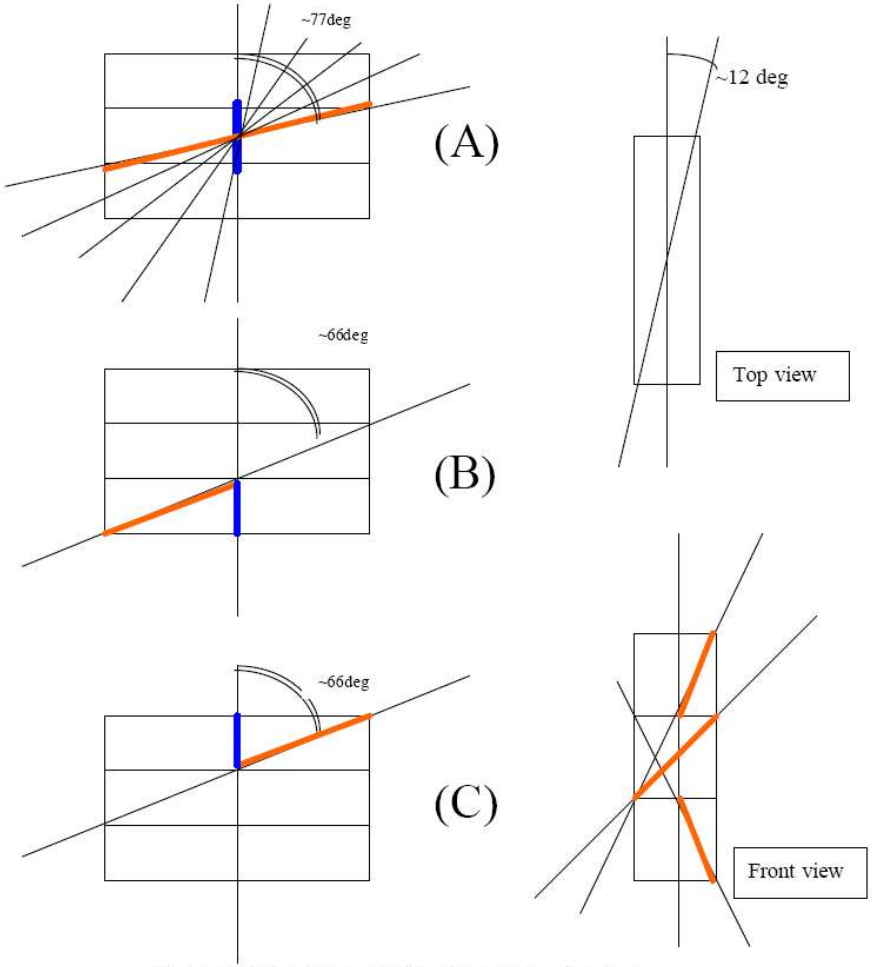



Figure 1: Different configuration in the incident muons.

# Cosmic Muons

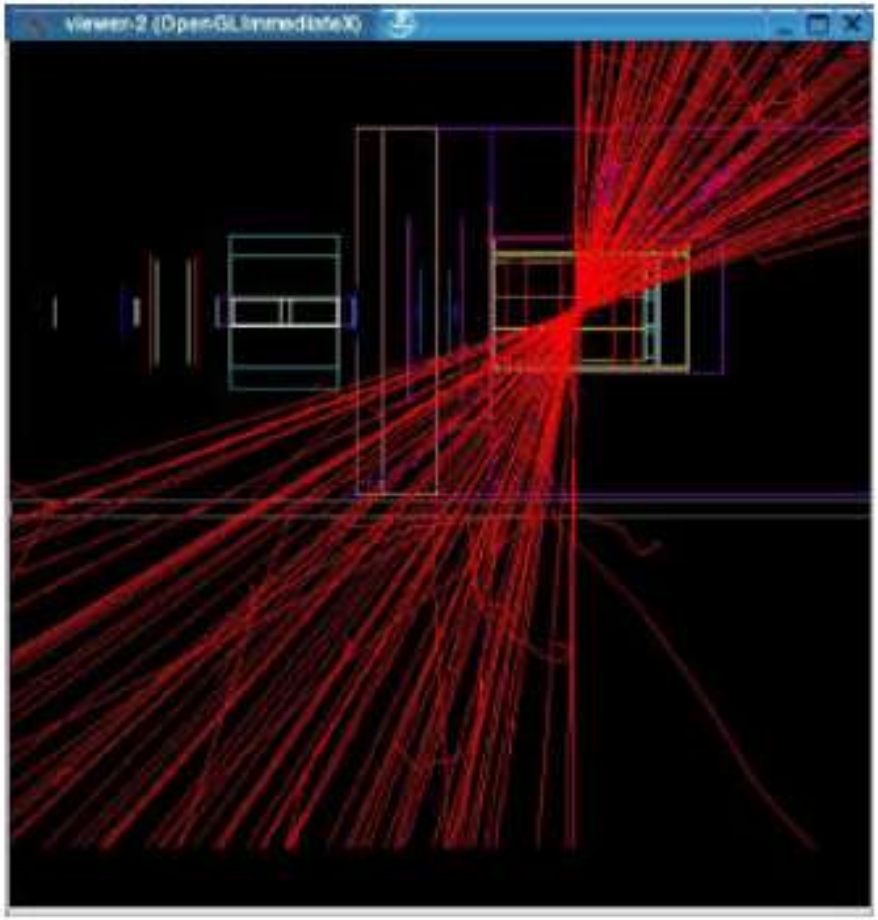


*Figure 2:*
*G4 picture (only charged particle)*

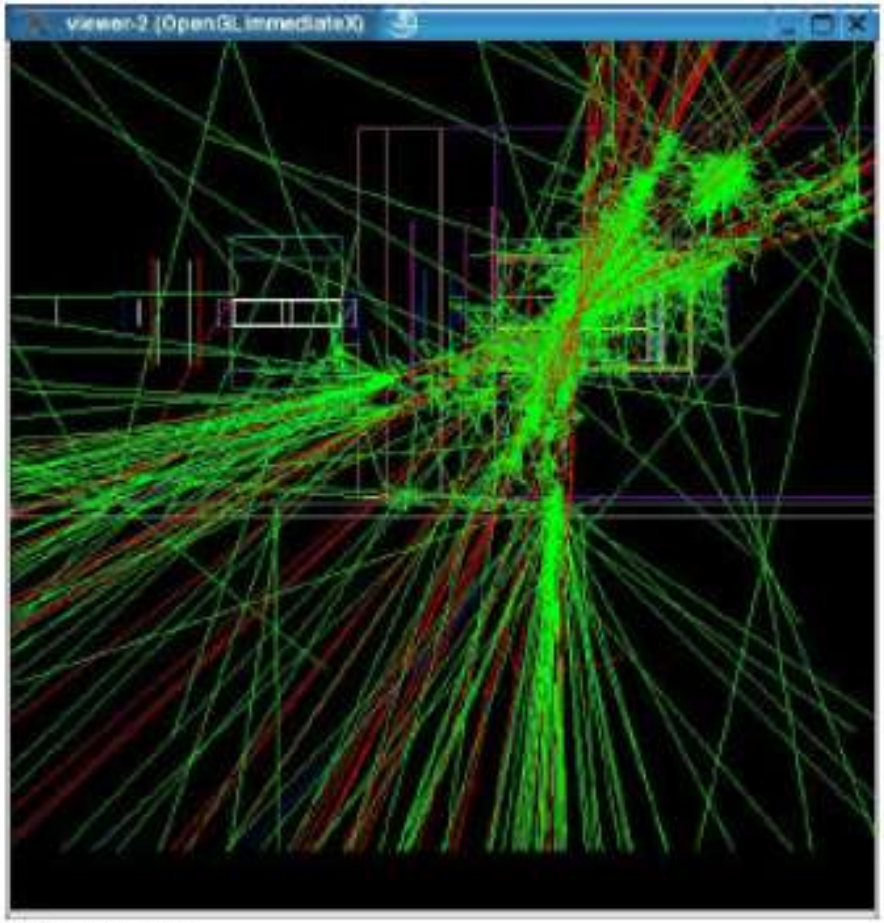


*Figure 3:*
*G4 picture ( charged particle and photons)*

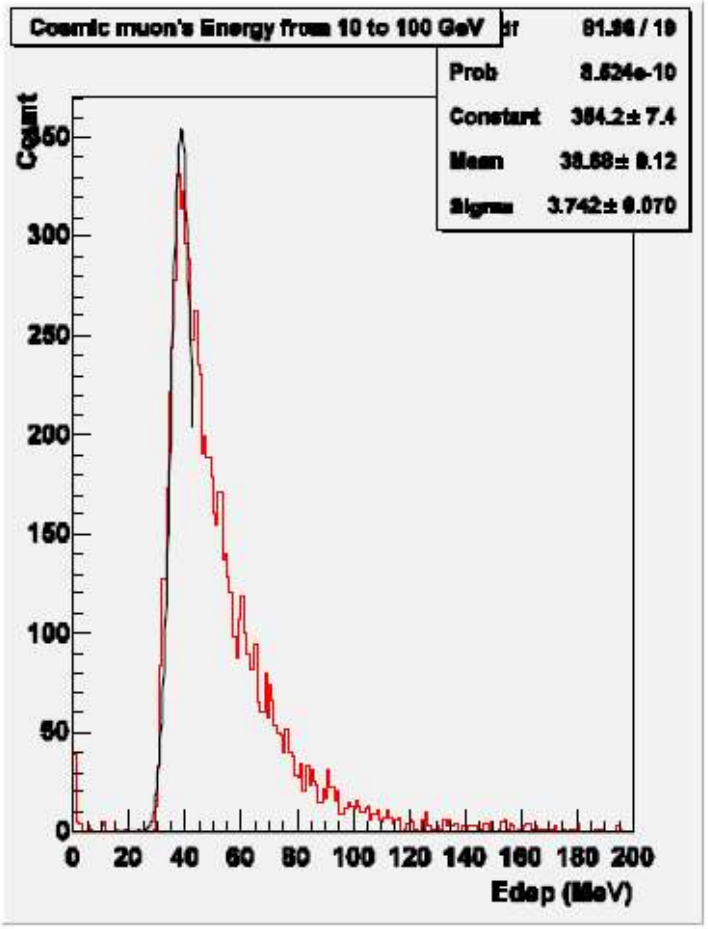



*Figure 4: Muons in the lower crystal muon's energy between 10 MeV to 100 GeV CsI(Tl) inside Lead shielding*

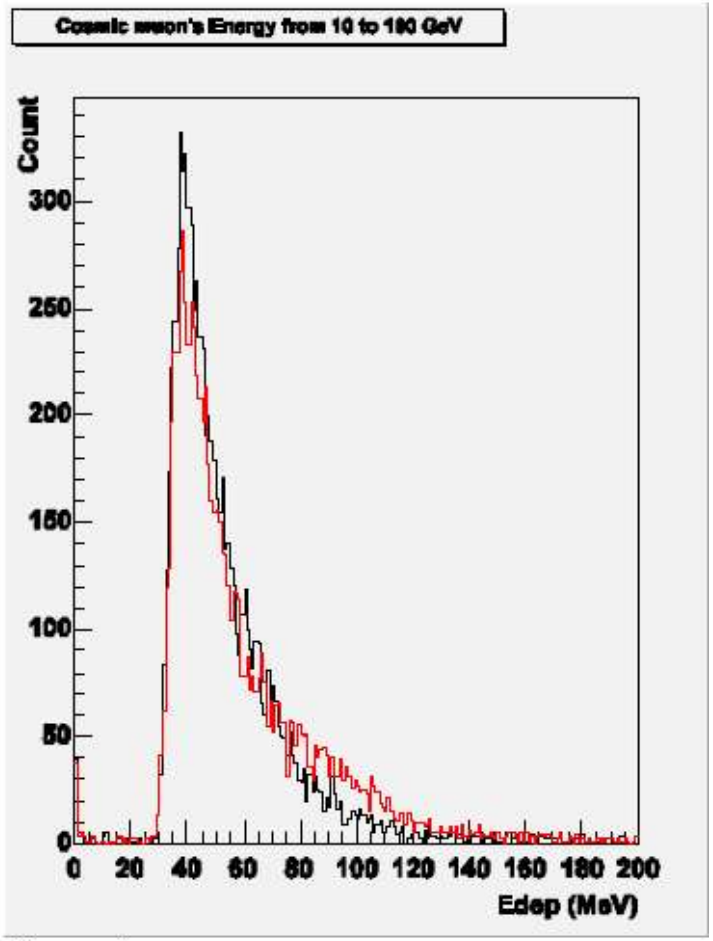



*Figure 5:*
*In red color: Muons in the central crystal.*
*In black color: Muons in the lower crystal (the upper crystal is similar to lower crystal) muon's energy between 10 MeV to 100 GeV CsI(Tl) inside Lead shielding*

## 38.9 MeV / Crystal

# Positron source for E166

## Physics list

**Gammas:**

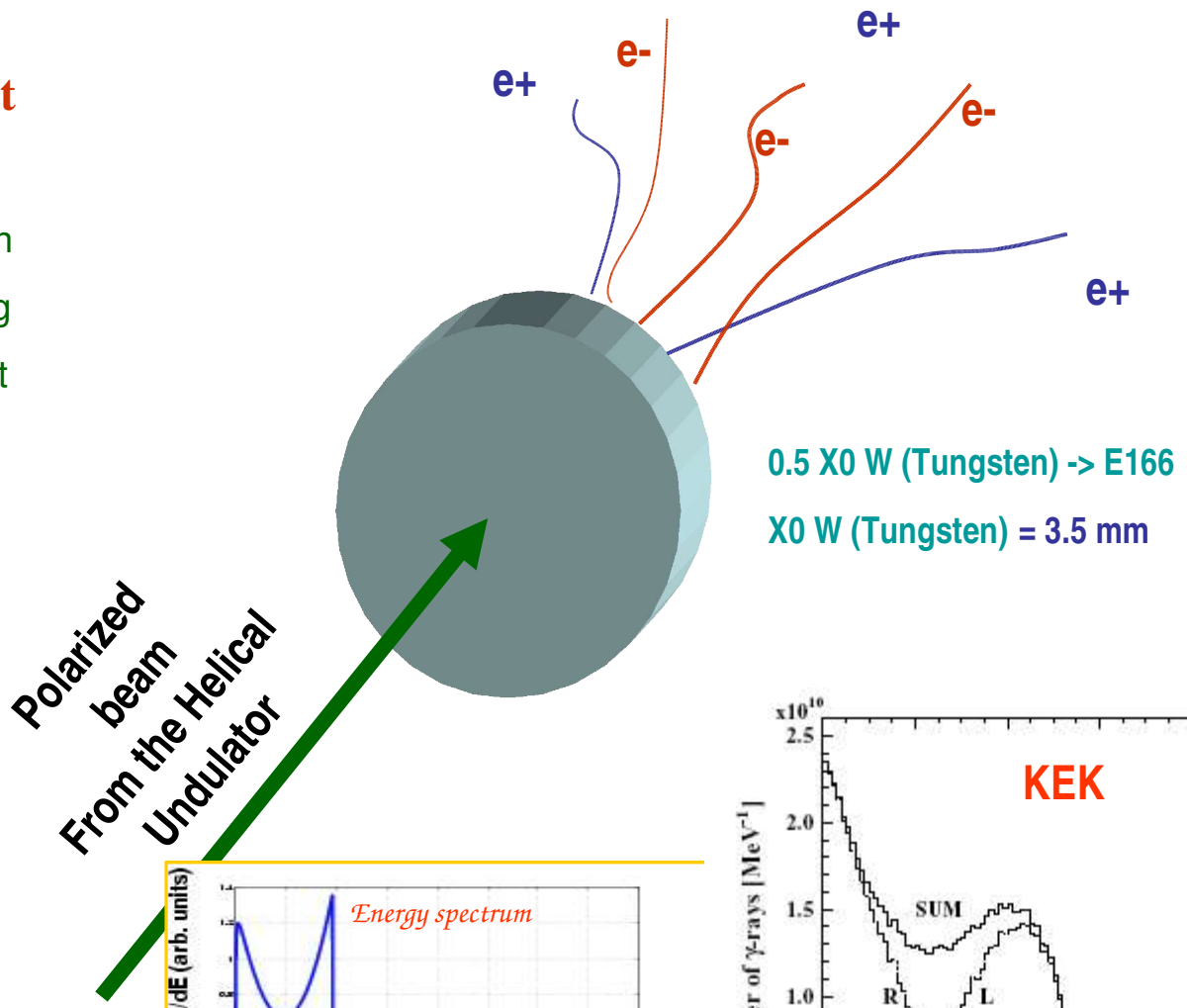
- GammaConversion
- ComptonScattering
- PhotoElectricEffect

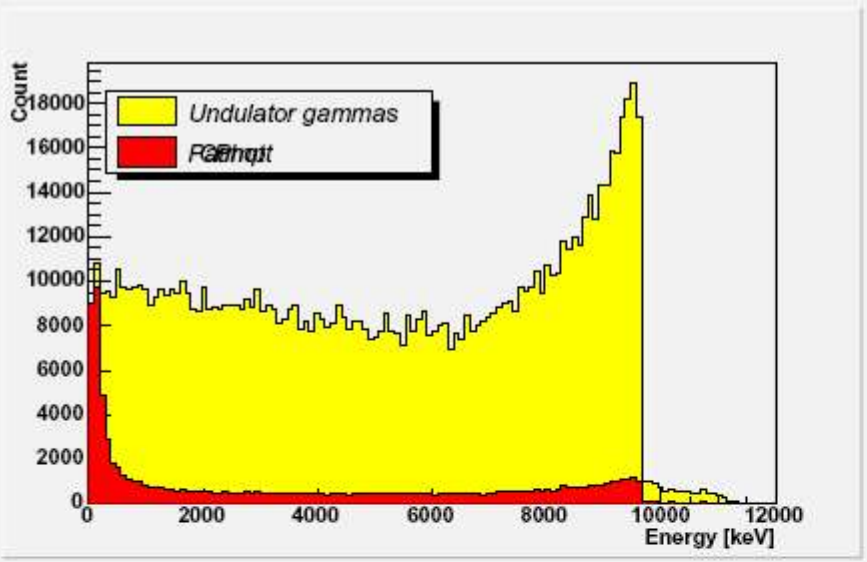
**Electrons:**

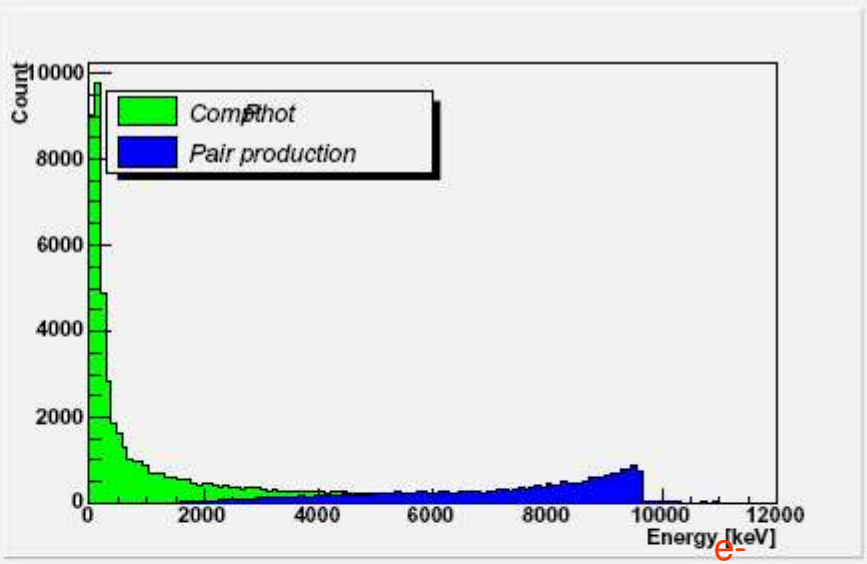
- MultipleScattering
- eIonisation
- eBremsstrahlung

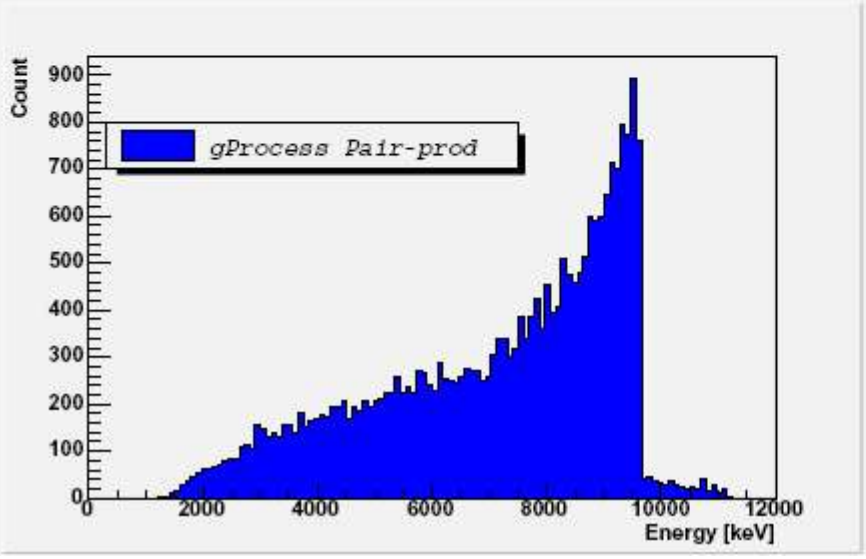
**Positrons:**

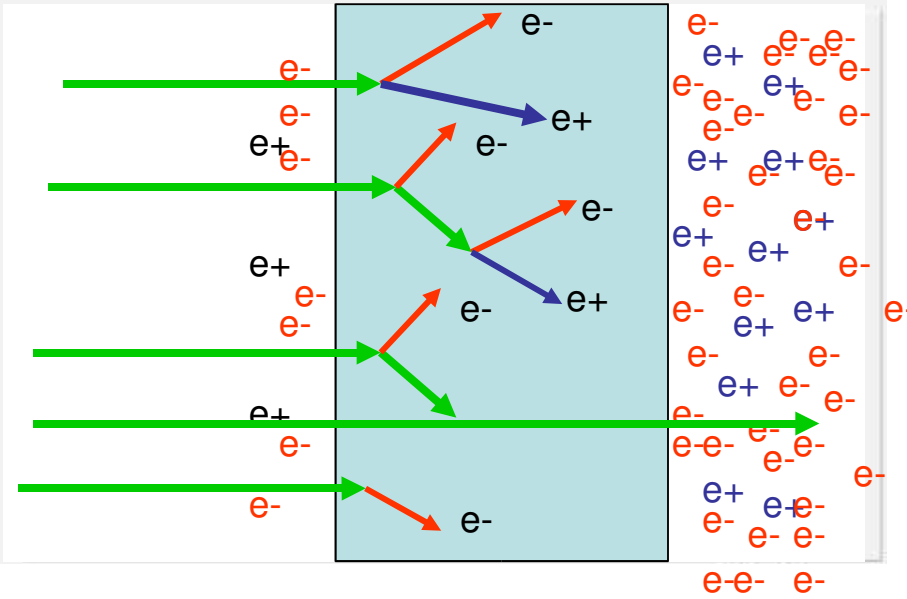
- MultipleScattering
- eIonisation
- eBremsstrahlung
- eplusAnnihilation





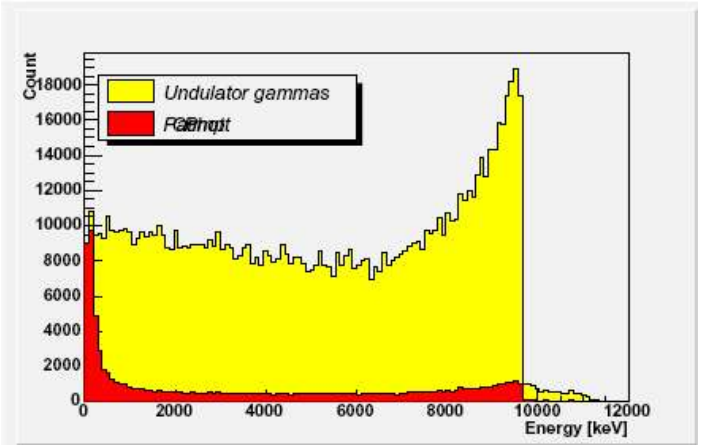



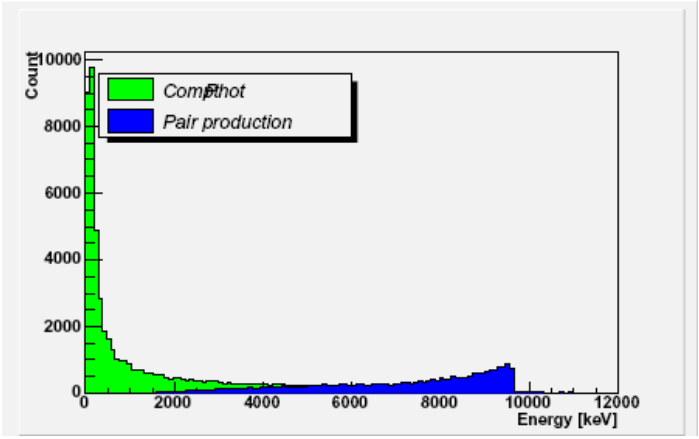

**0.2 X0 Tungsten**

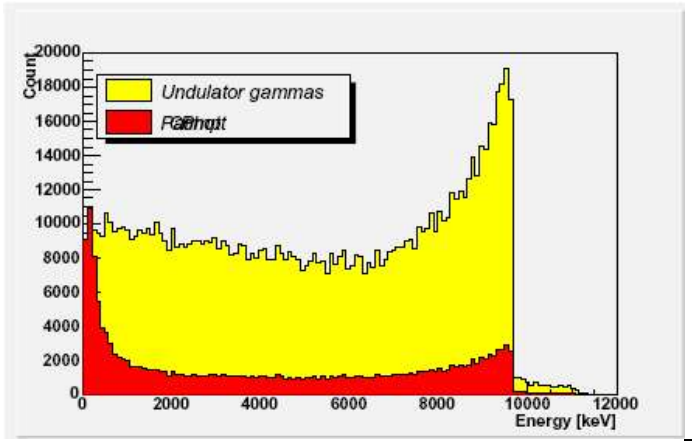
Conversion target



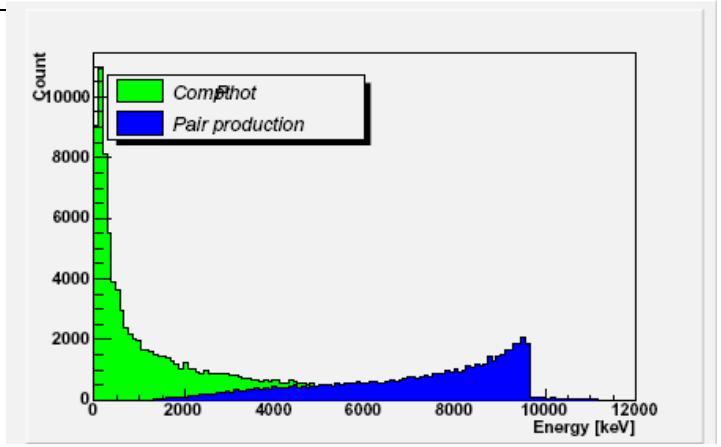

W

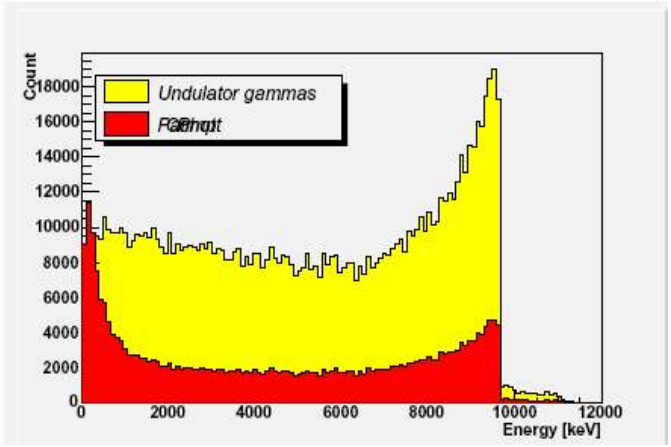
0.2 X0



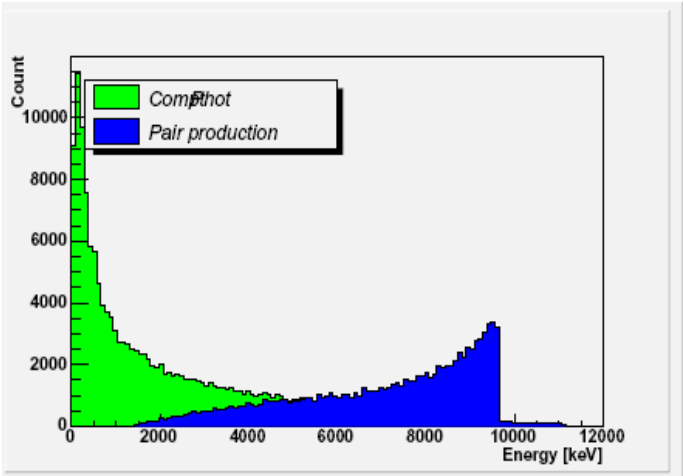



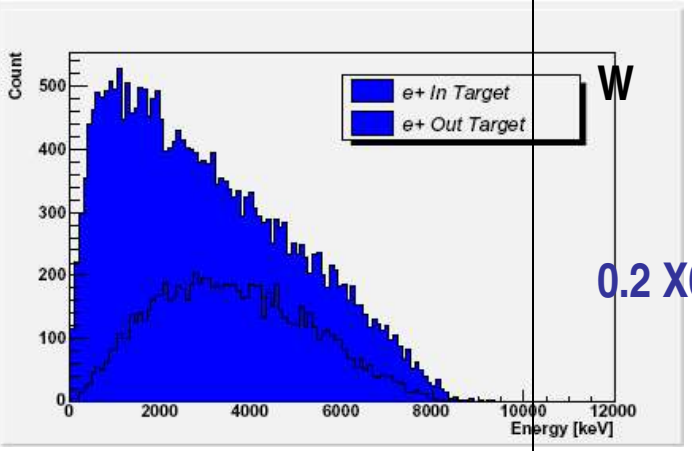

0.5 X0

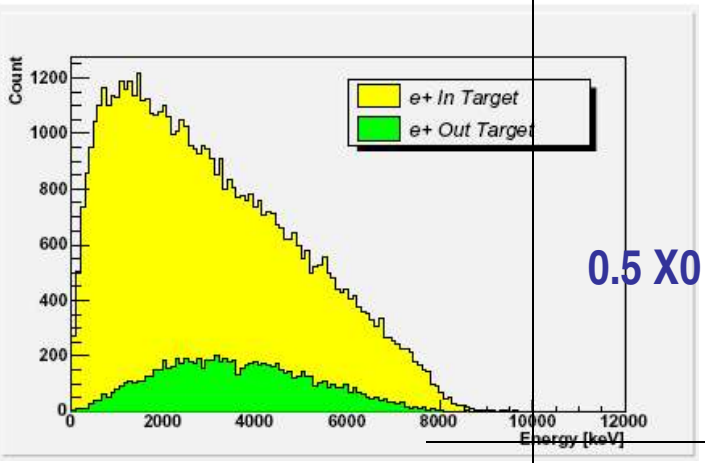


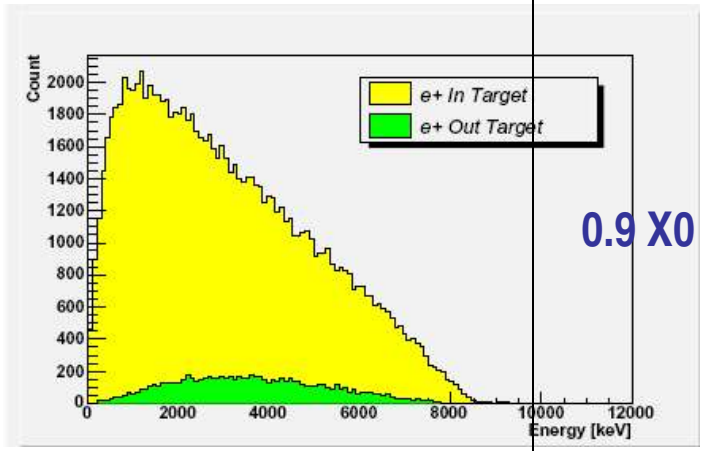



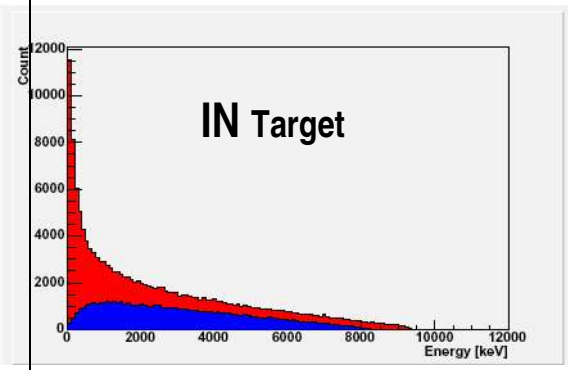

0.9 X0

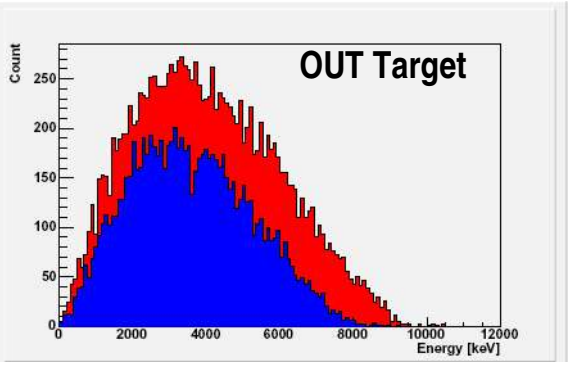




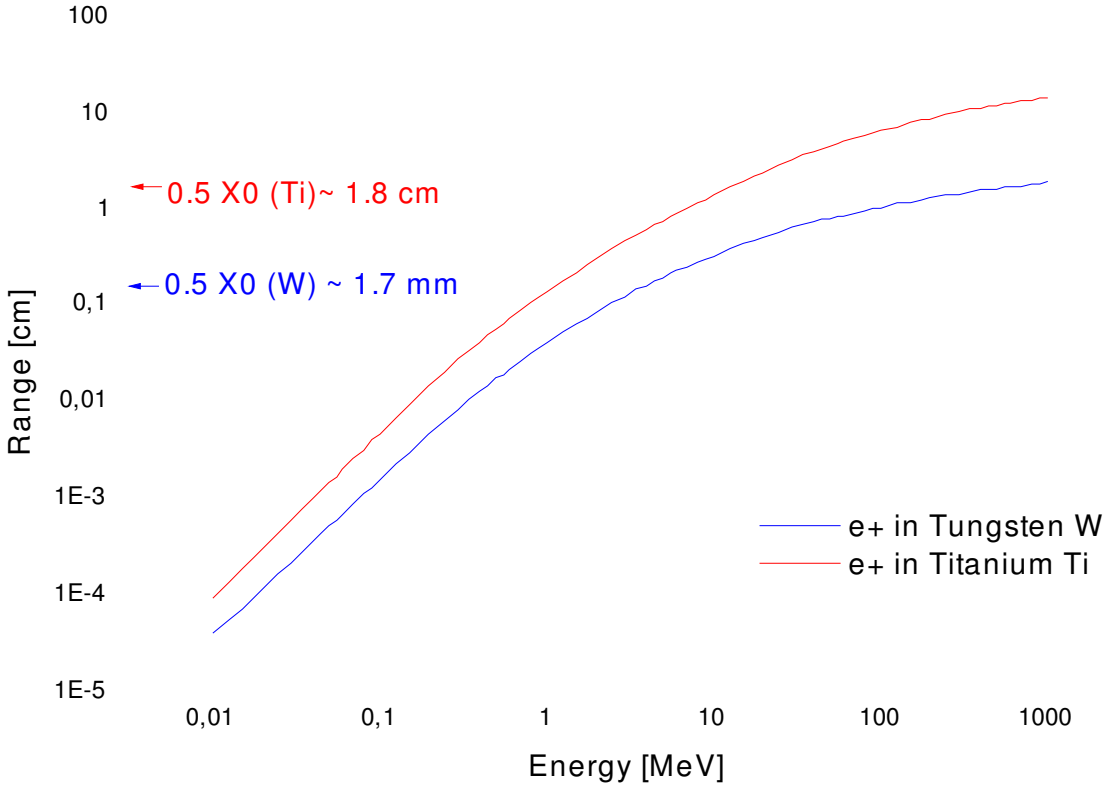



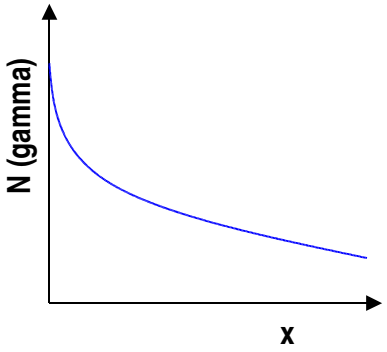



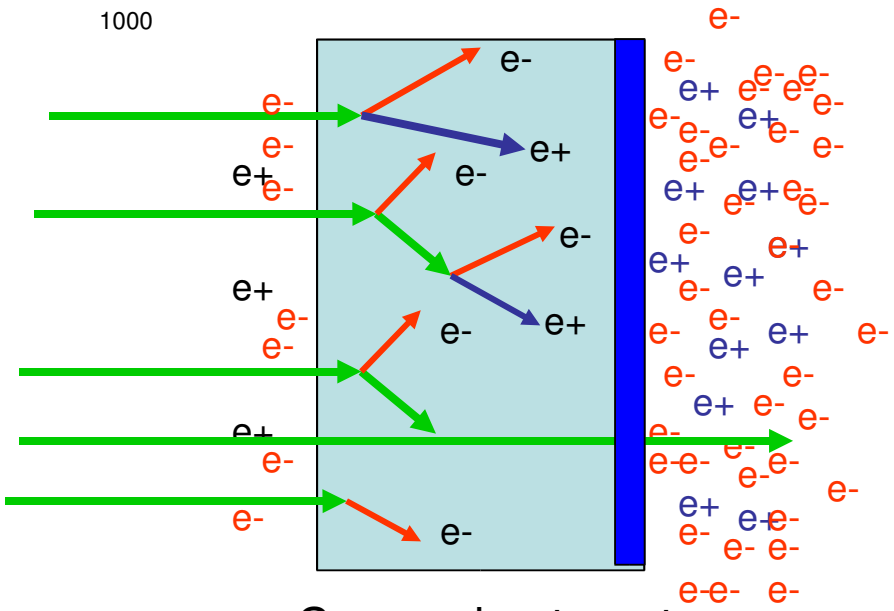

0.5 X0 Tungsten

e-

e+

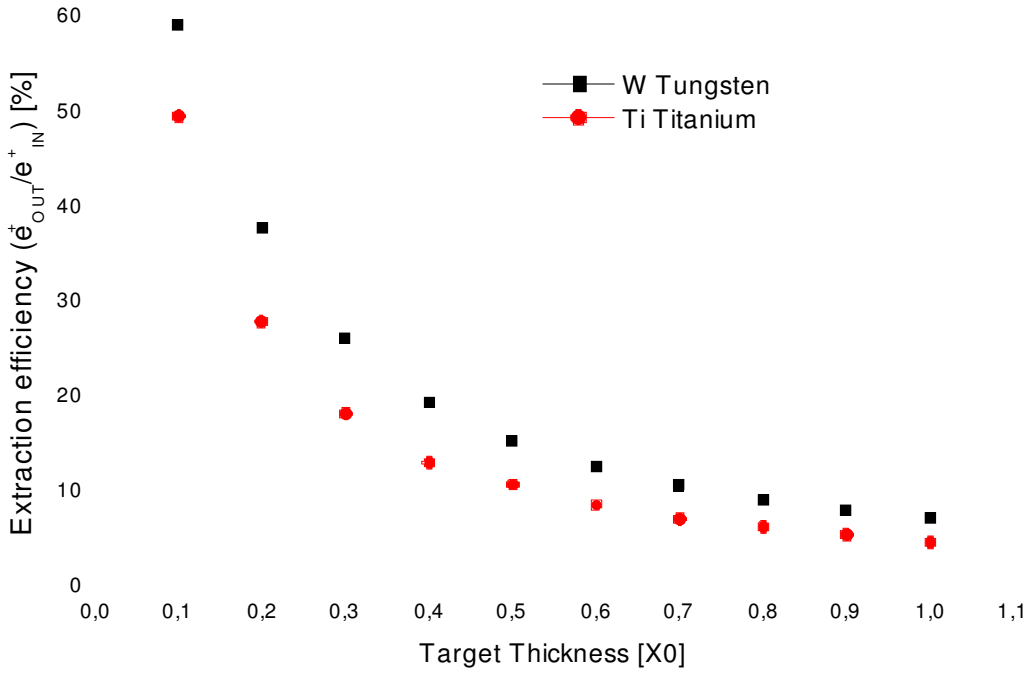



Conversion target

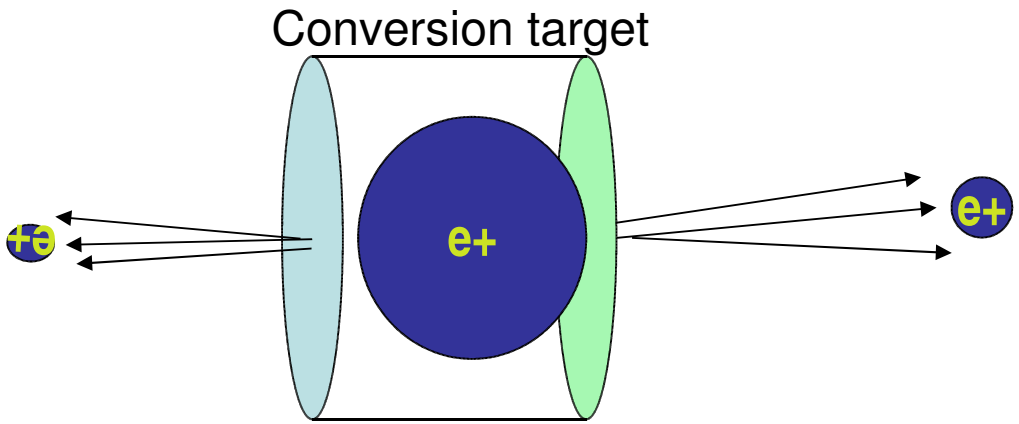
# e+ Extraction Efficiency

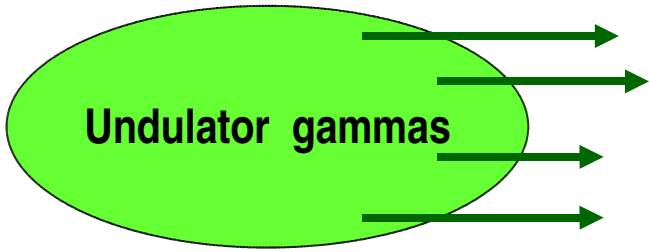



0.5 X0 W (Tungsten) -> E166

X0 W (Tungsten) = 3.5 mm

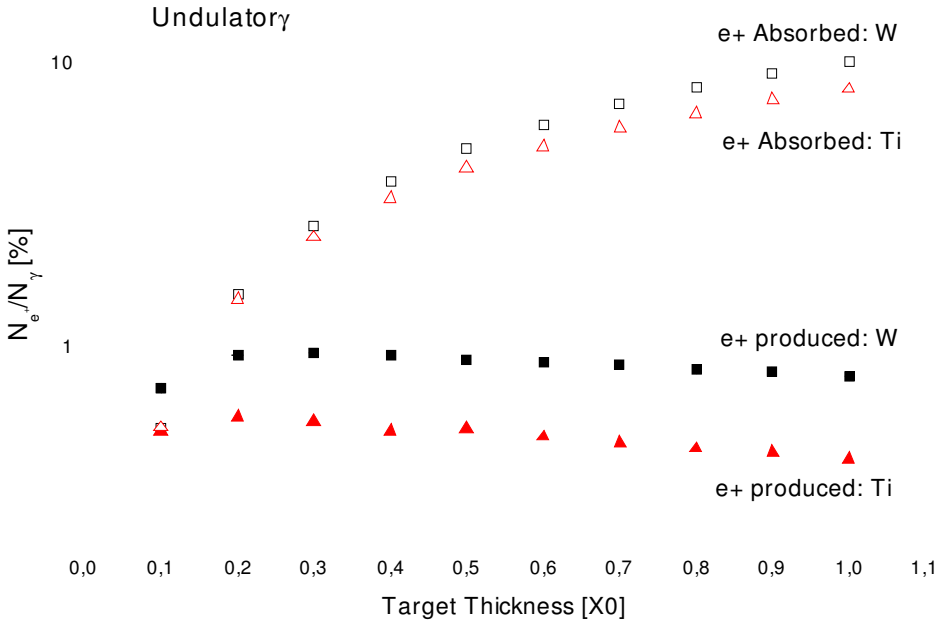
X0 Ti (Titanium) = 36 mm



# e+ Production Efficiency

## E166



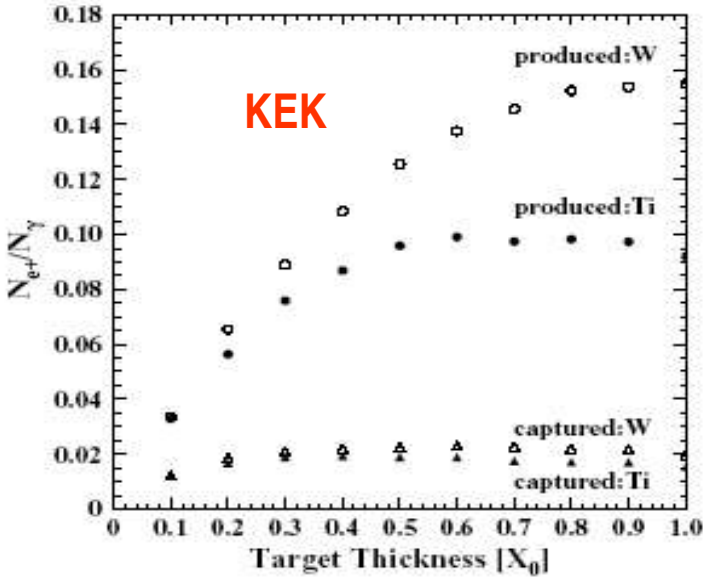
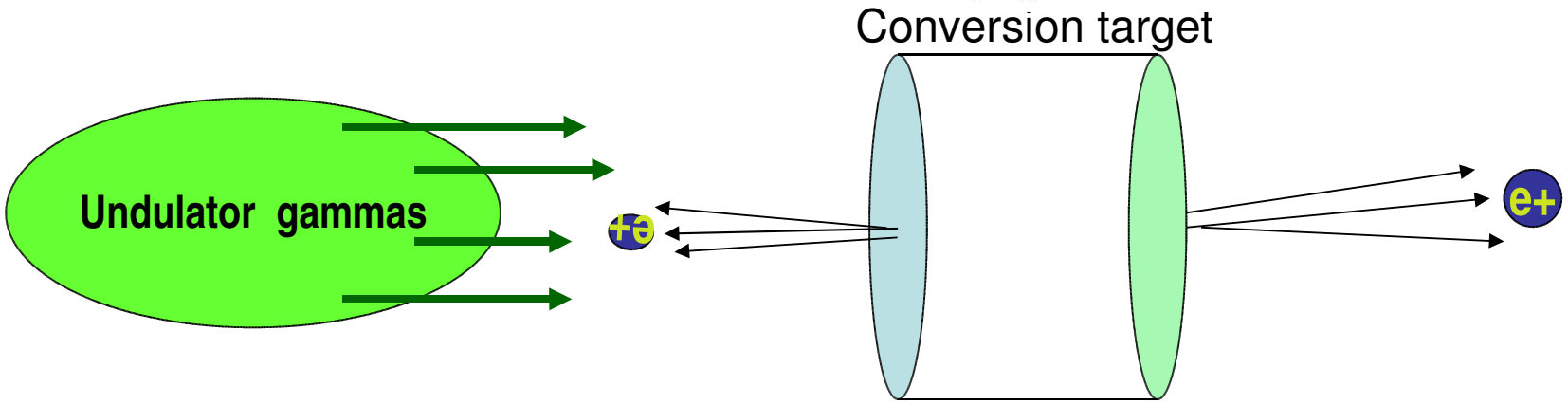
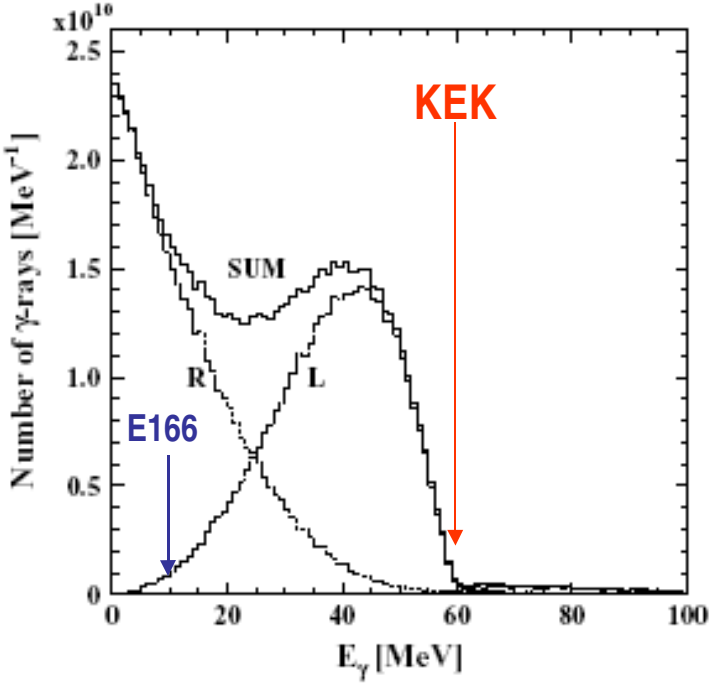




Fig. 16. Positron production rate on tungsten and on titanium as a function of the target thickness in the unit of a radiation length $X_0$.





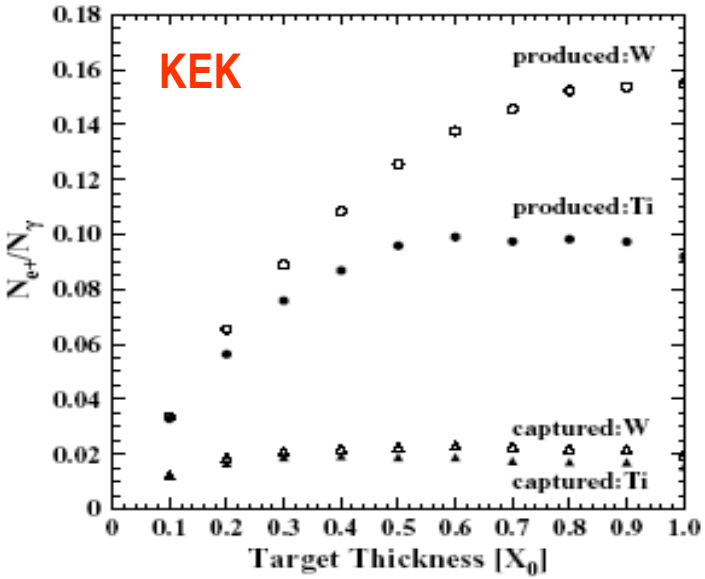
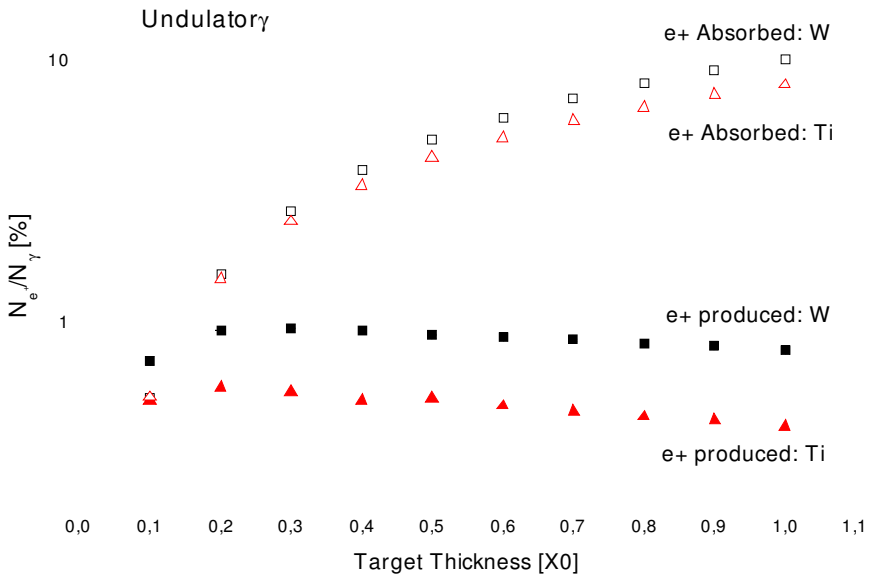
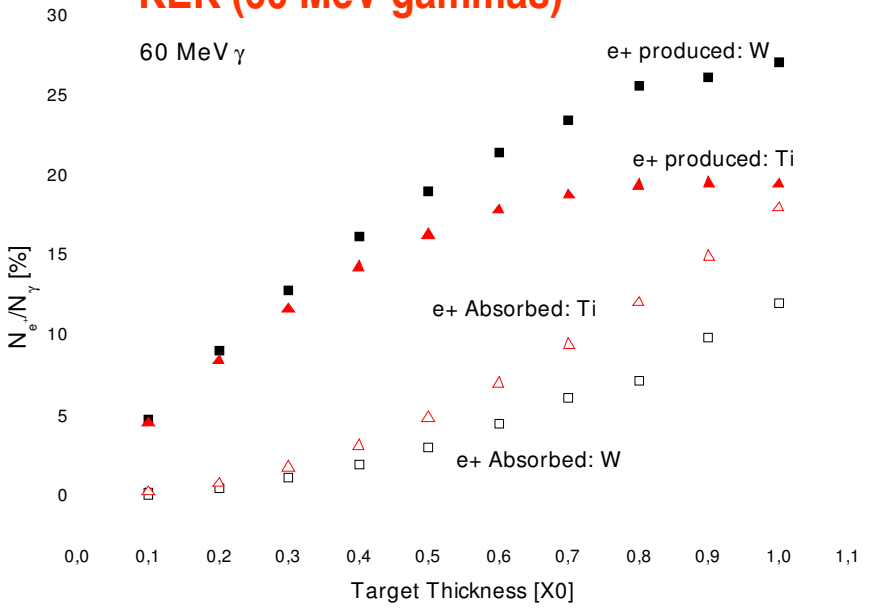




Fig. 16. Positron production rate on tungsten and on titanium as a function of the target thickness in the unit of a radiation length $X_0$.

## E166 (Undulator gammas)




## KEK (60 MeV gammas)



# Outlook for the next 4 weeks