# Geant4 Simulation of Neutrons interaction with GEM-foil and gas

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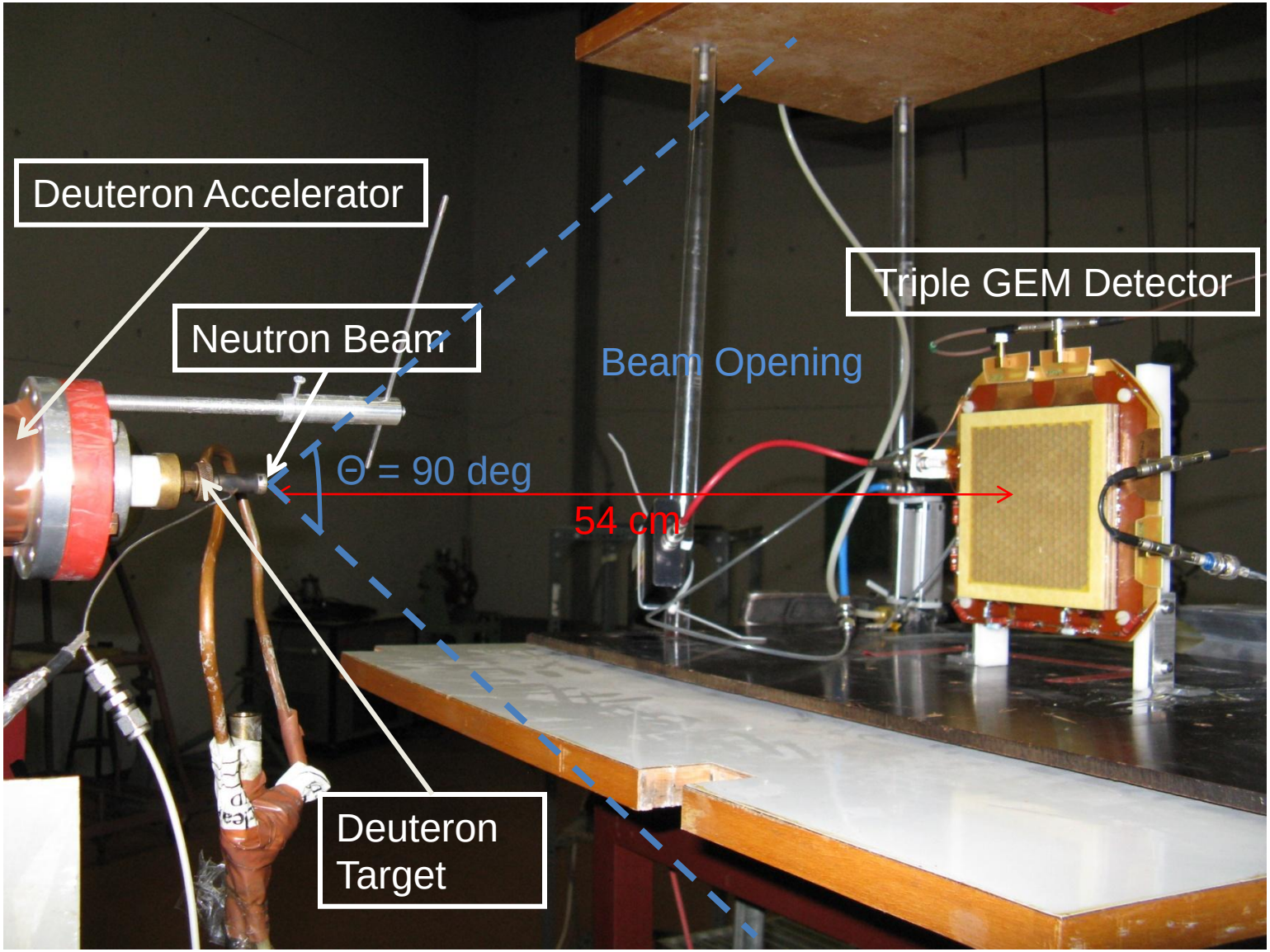
# Outline

- Simulation of 5.5 MeV neutron processes in a GEM detector in order to understand better the measurements performed with a Triple GEM detector in 5.5 MeV neutron beam in Athens
- Short description of the measurements
- Description of Geant4 simulation

# Experimental Setup

- Triple GEM RD51 tracking detector 10 x 10 $cm^2$ active area powered using a resistor divider
- Standard GEM Foils (140 μm pitch, 50 μm hole diameter)
- Gas Mixture: Ar/$CO_2$ 70%/30%
- Full plane readout
- Pulse Height measurements: ORTEC 142 IH preamplifier and ORTEC 450 research amplifier
- Current Measurements (only on the anode): Keithley PicoAmp 6517 (1 pA resolution)
- 5.5 MeV neutrons from 2.8 MeV deuteron beam collision on a deuteron target
- Two different neutron fluxes

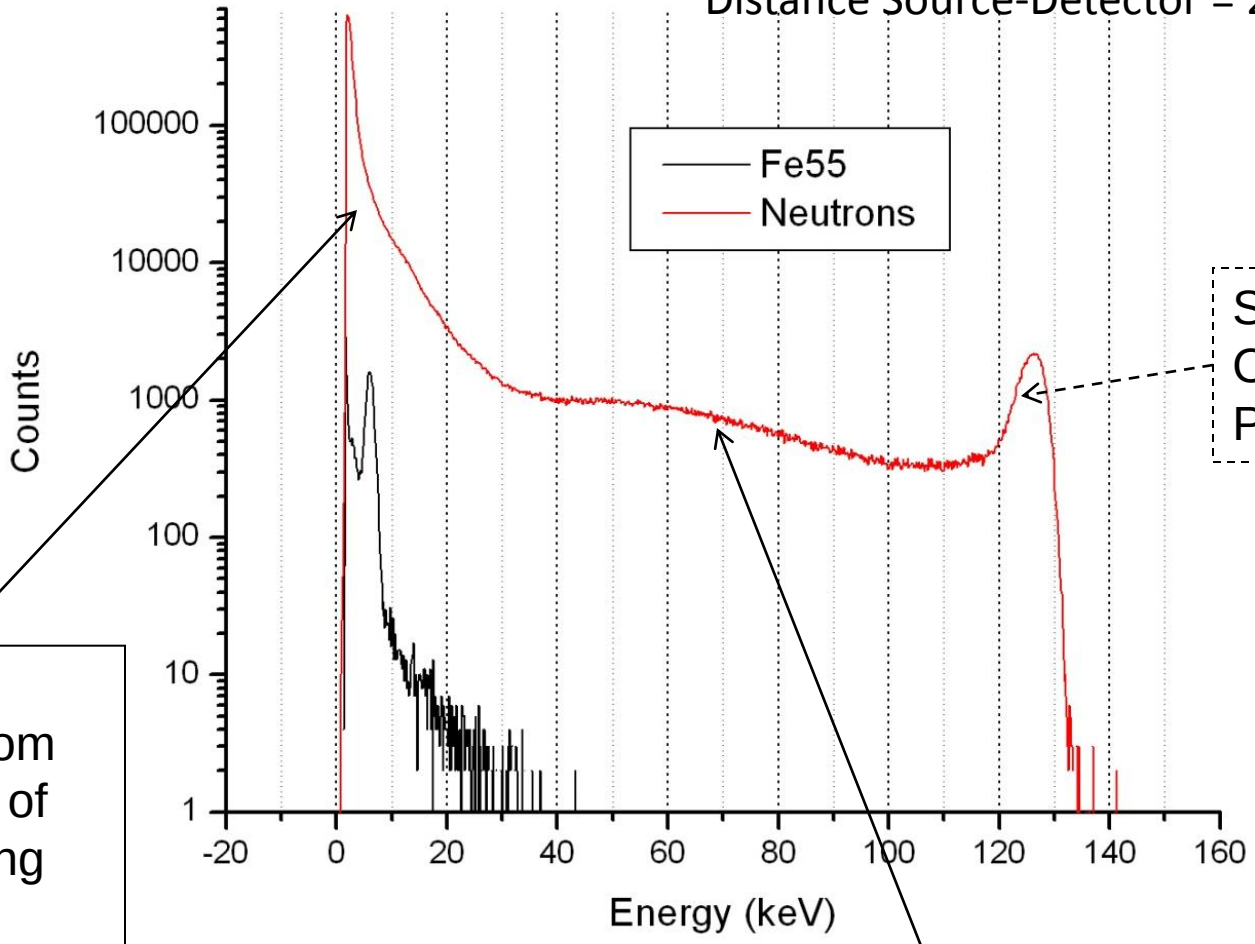
# Picture of the experimental setup



# Neutrons and Iron Spectra

Detector HV = 4200 V
Detector Gain = 5000

Neutrons Flux = $2.2*10^5$ Hz/cm$^2$
Neutrons Energy = 5.5 MeV
Distance Source-Detector = 23 cm



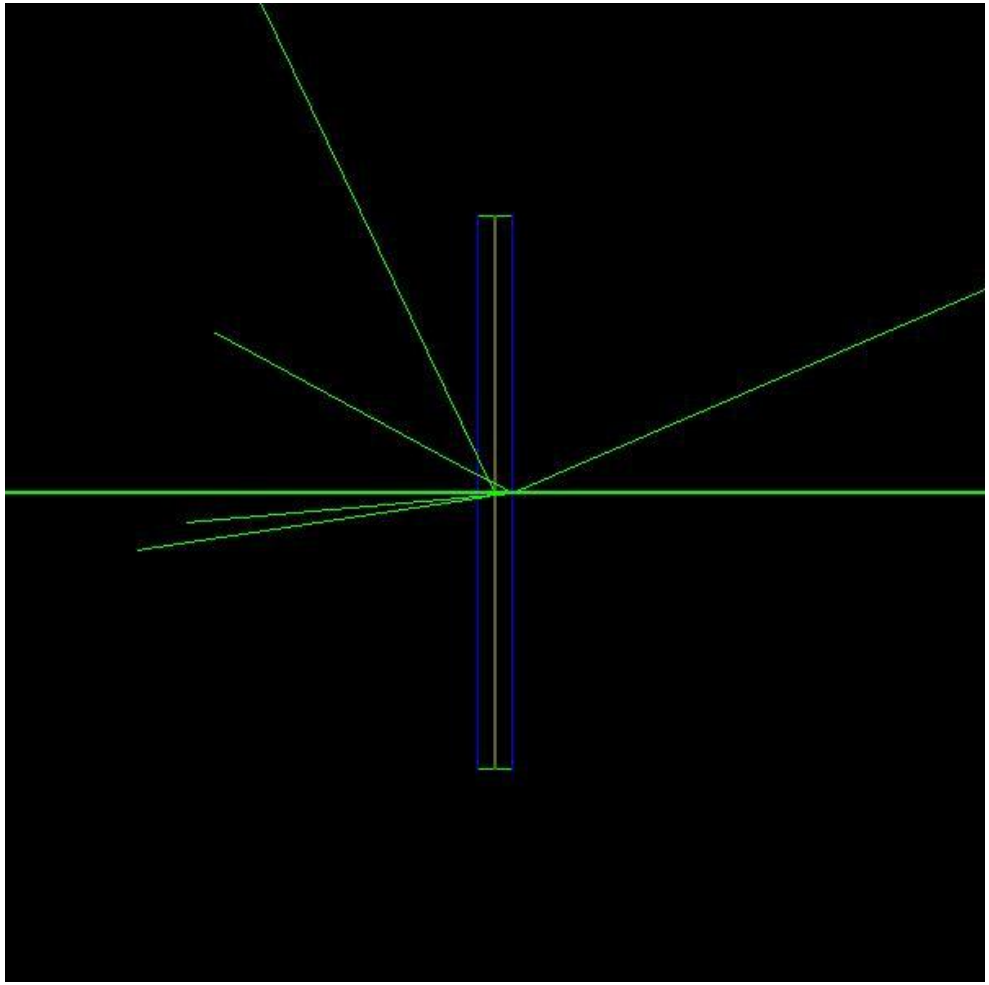

Saturation of ORTEC Preamplifier

Photons coming from activation of surrounding materials

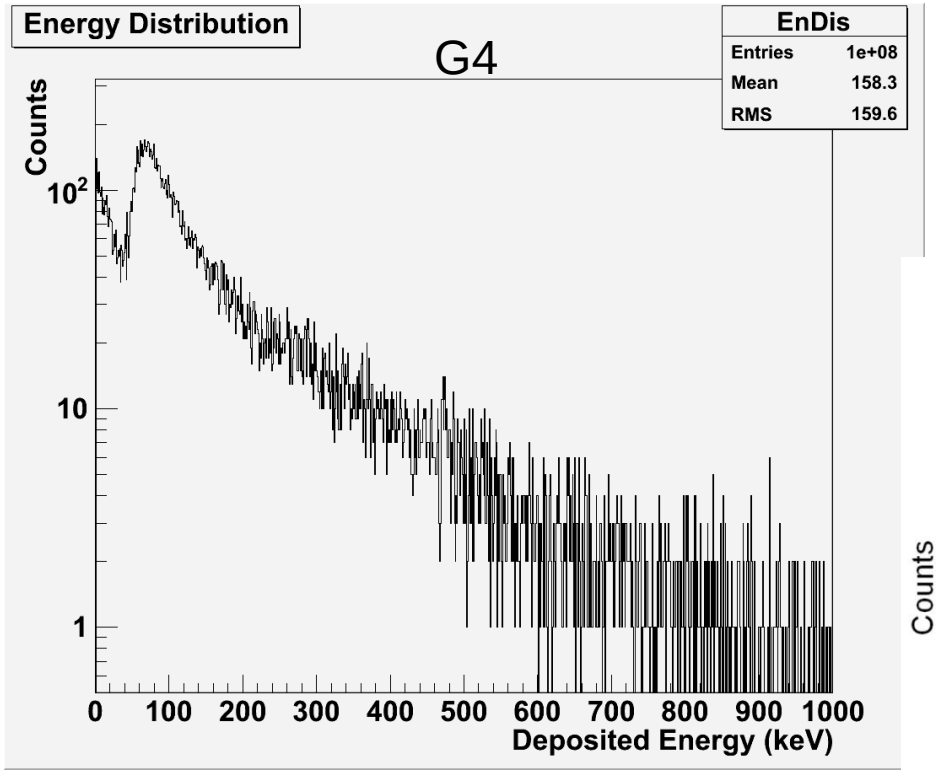
Neutrons conversion

# Simulation parameters

- 5.5 MeV Neutrons
- Gas volume of dimensions 20cm*20cm*12mm
- Gas used Ar/C02 70%/30%
- 50 µm thick Kapton foil copper clad (5 µm) on both sides put in the middle of the gas volume (representing GEM foil w/o holes)
- 5 µm Cu Foil at the two sides of the gas volume, representing Drift and Anode electrode
- Sensitive Detector: Gas Volume
- Physics list QGSP_BERT_HP



# Energy Deposition: First Results & Comparison with measurements

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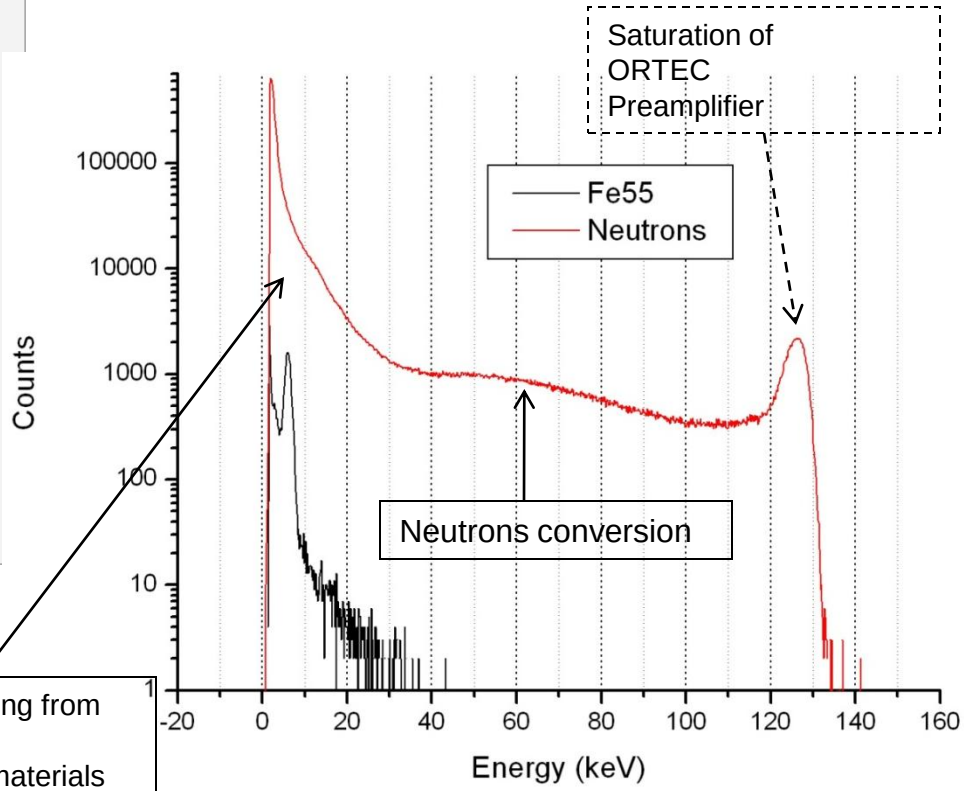
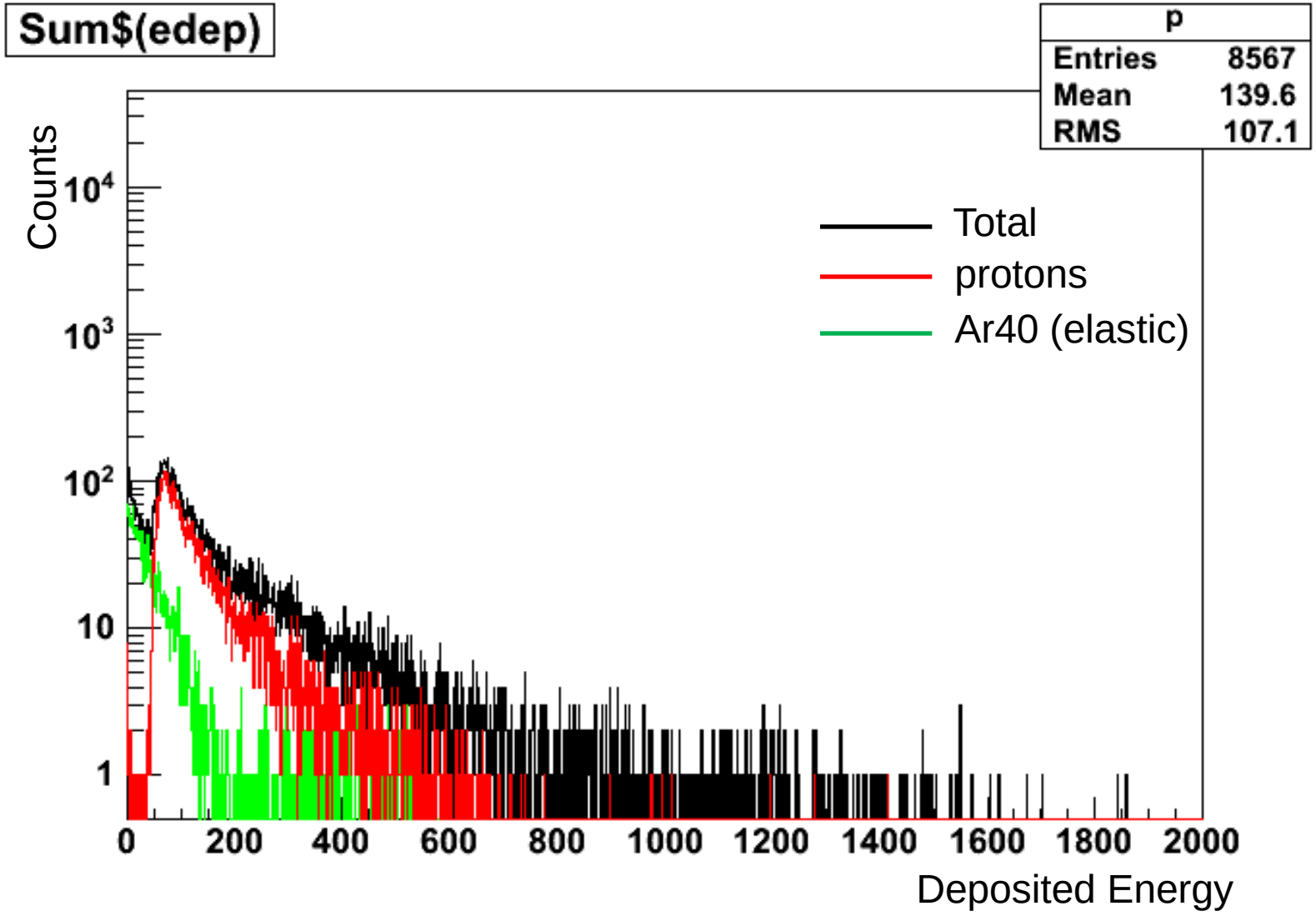



Photons coming from activation of surrounding materials (only??)

Detector HV = 4200 V
Detector Gain = 5000

# Understanding of the physics processes



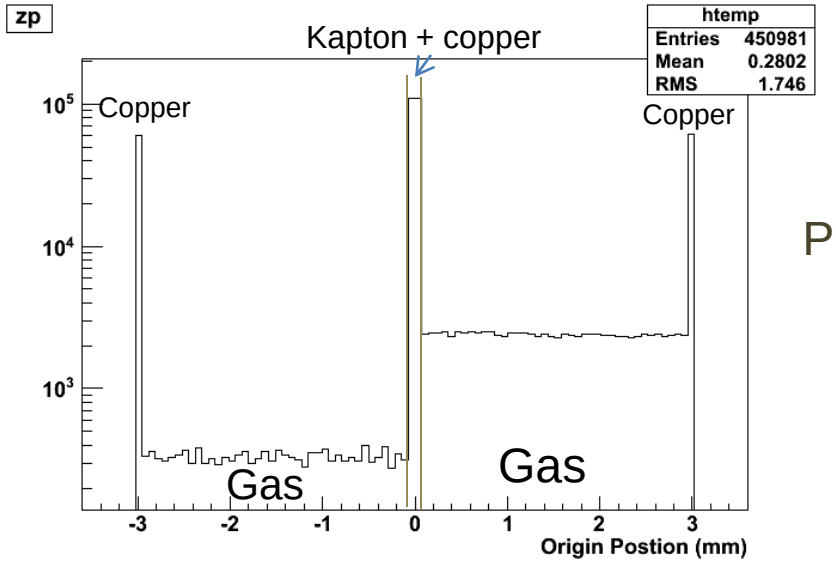
# A list of (some of ) the recognized physics processes coming from primary neutrons

- Ar40
- γ
- n + γ
- p
- C12
- n + Ar40
- O16
- n + C12
- n + Cu63 + γ
- P + γ
- He4 + γ
- p + Ni63
- n + Ar36
- Cu63
- Cu65

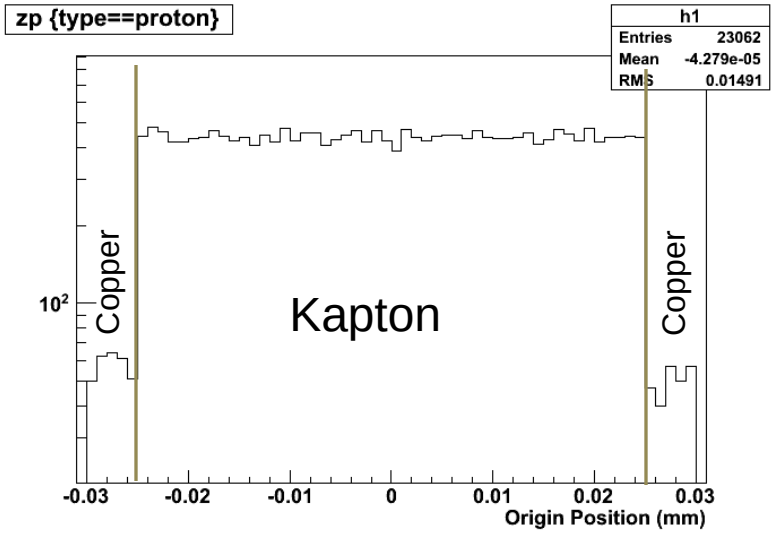
- We want now to understand the places where the conversions come from:
  - We suspect that the protons are created from interaction with solid materials (Copper or Kapton)

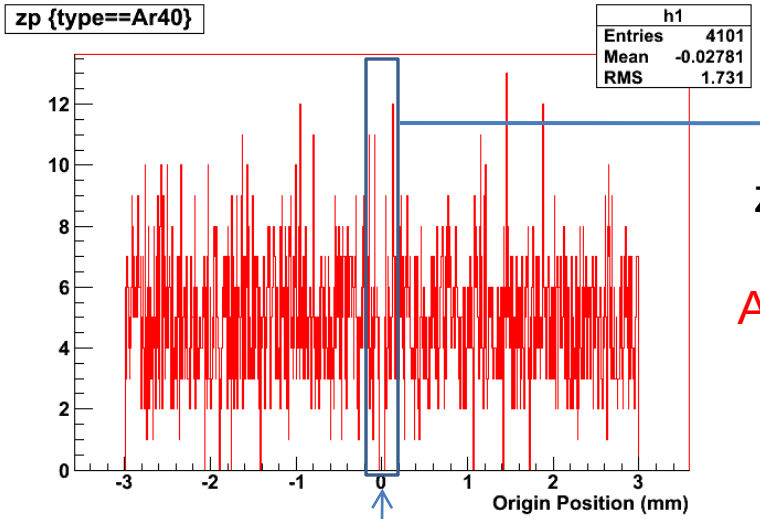
The proton is able to escape, enter the gas and produce ionization

# Origin Positions of particles generated by primary neutrons



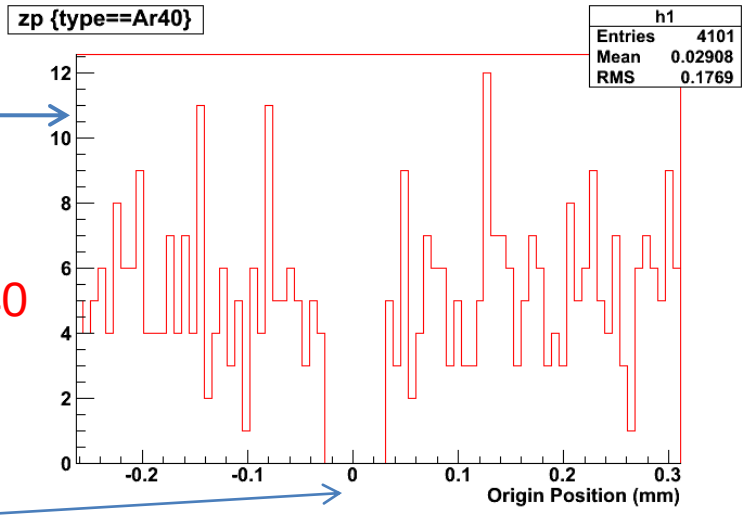

Protons




zoom

Argon40




Kapton
+ copper

# Conclusions

- The physics processes and the shape of the PH spectrum were correctly explained using the simulation
- The different contribution in the spectrum have been recognized
- The simulation gives the possibility to understand the place where the different particles are produced