Muon and Neutral Background at SND@LHC

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Introduction

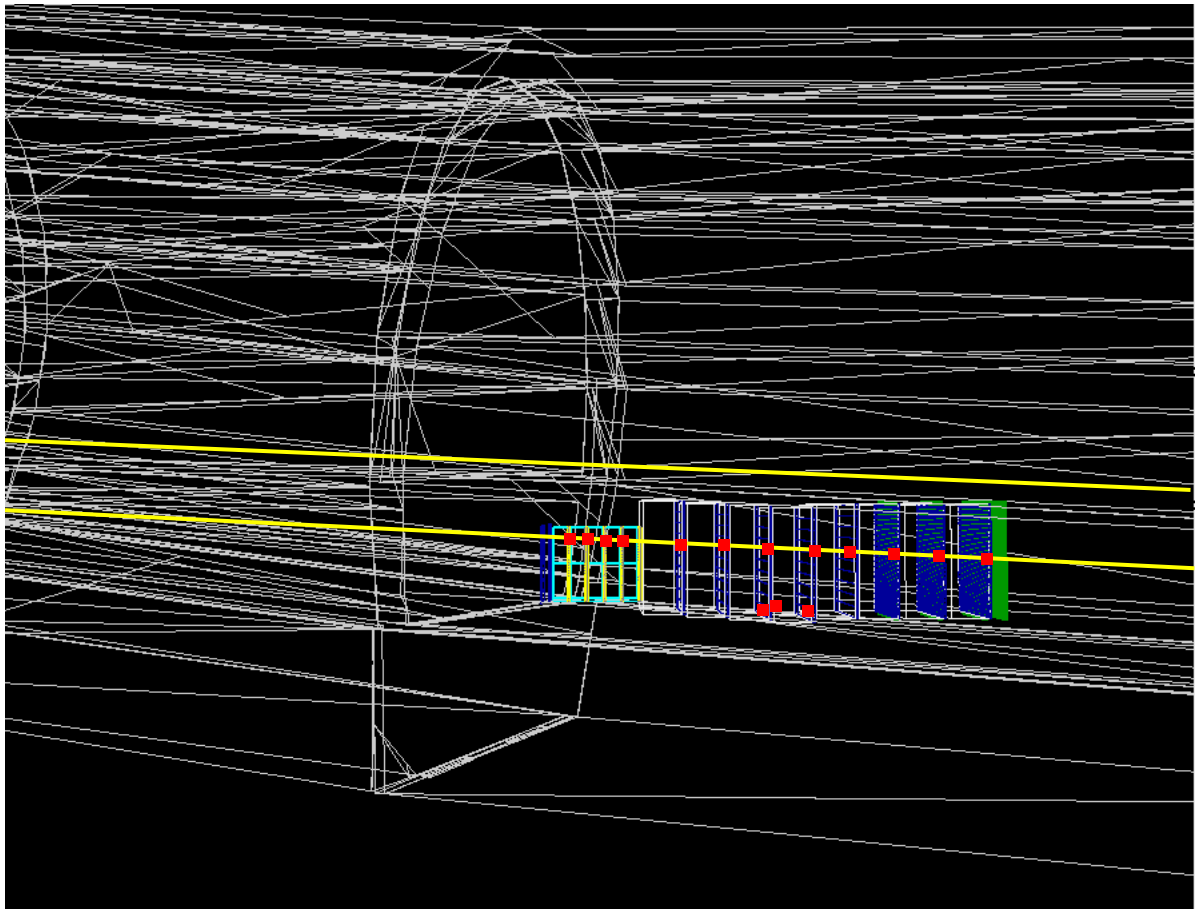
The majority of backgrounds at SND@LHC originates from **muons**:

- Muons passing through the detector.
- Muons making deep inelastic scattering (DIS) in the concrete or rock close to the detector or even in the detector.

In particular, the last ones can be source of **neutral** particles such as neutrons, K_L and K_S which are not detected by Veto and thus mimic neutrino interactions.

Muon Background Simulation

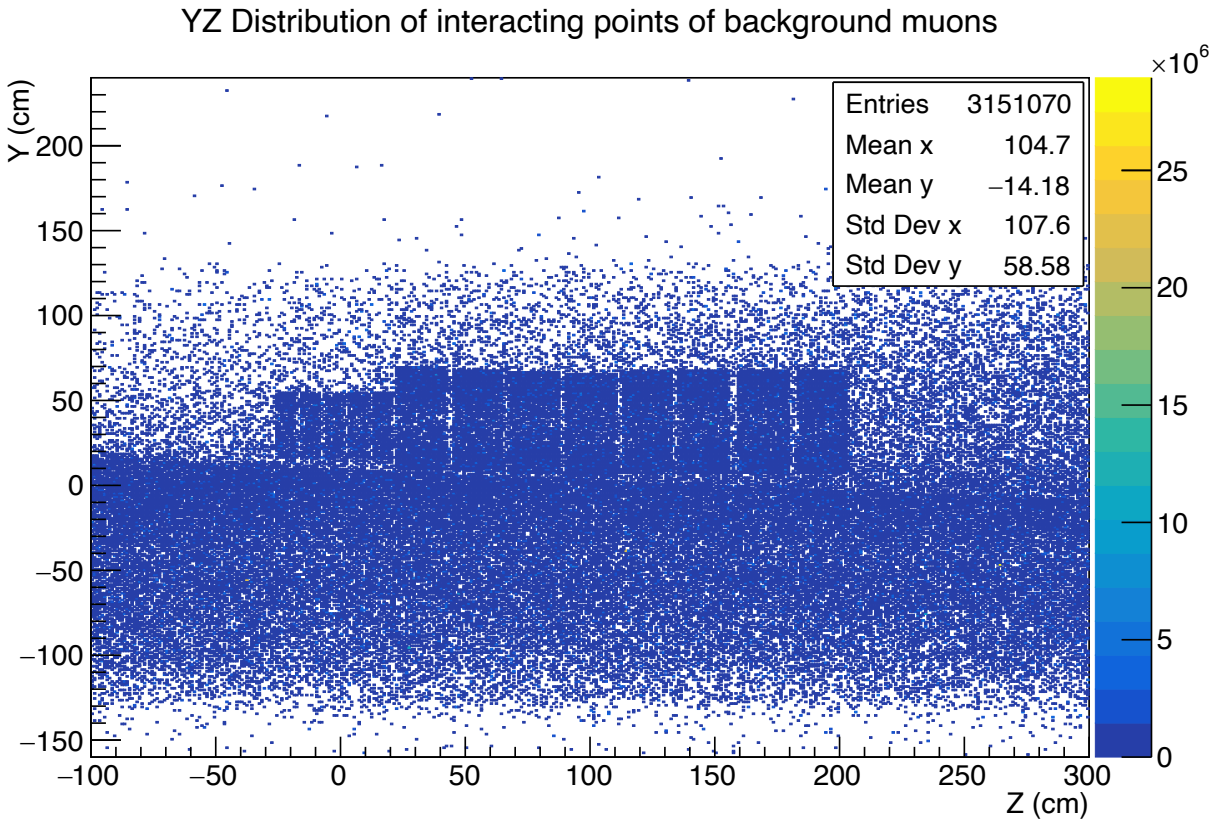
Simulations of background muons provide information on particles produced by DIS of muons and their hits in electronic detectors.

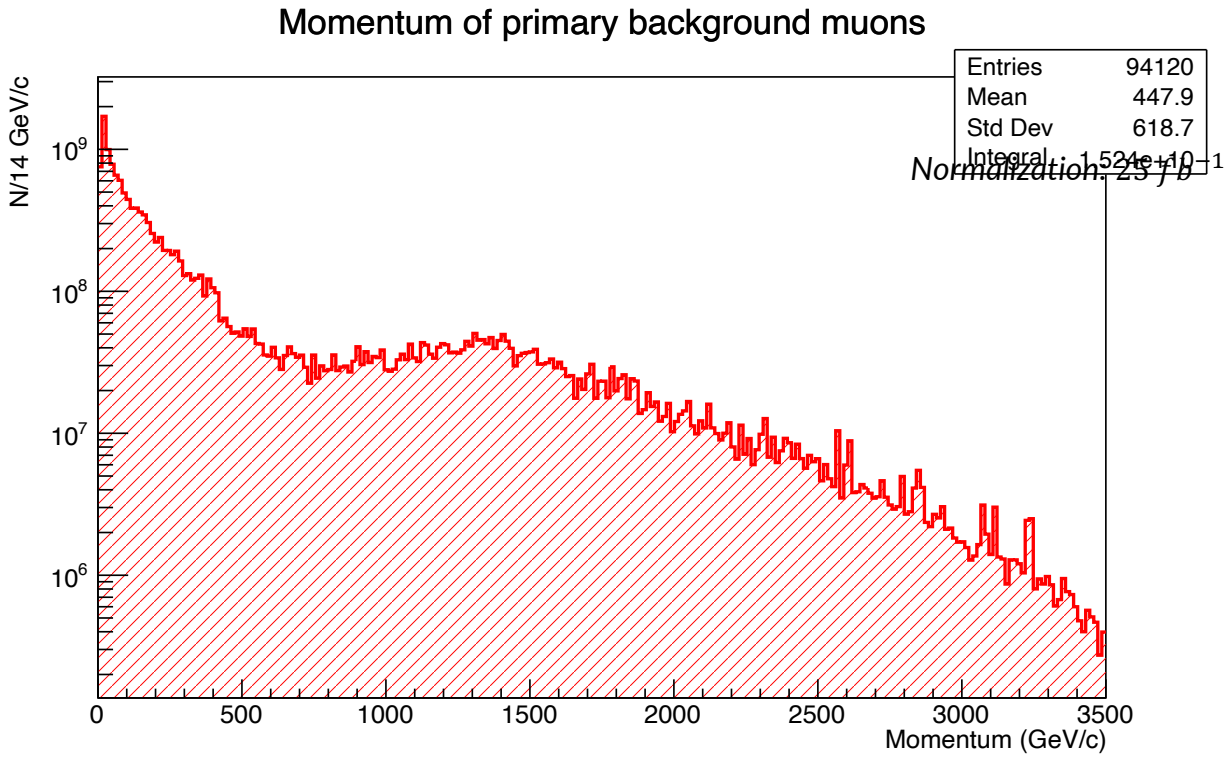


Goals:

- Characterization of **muons** from IP and K , π decays.
- Characterization of muon-induced **neutral background**.

Background muons





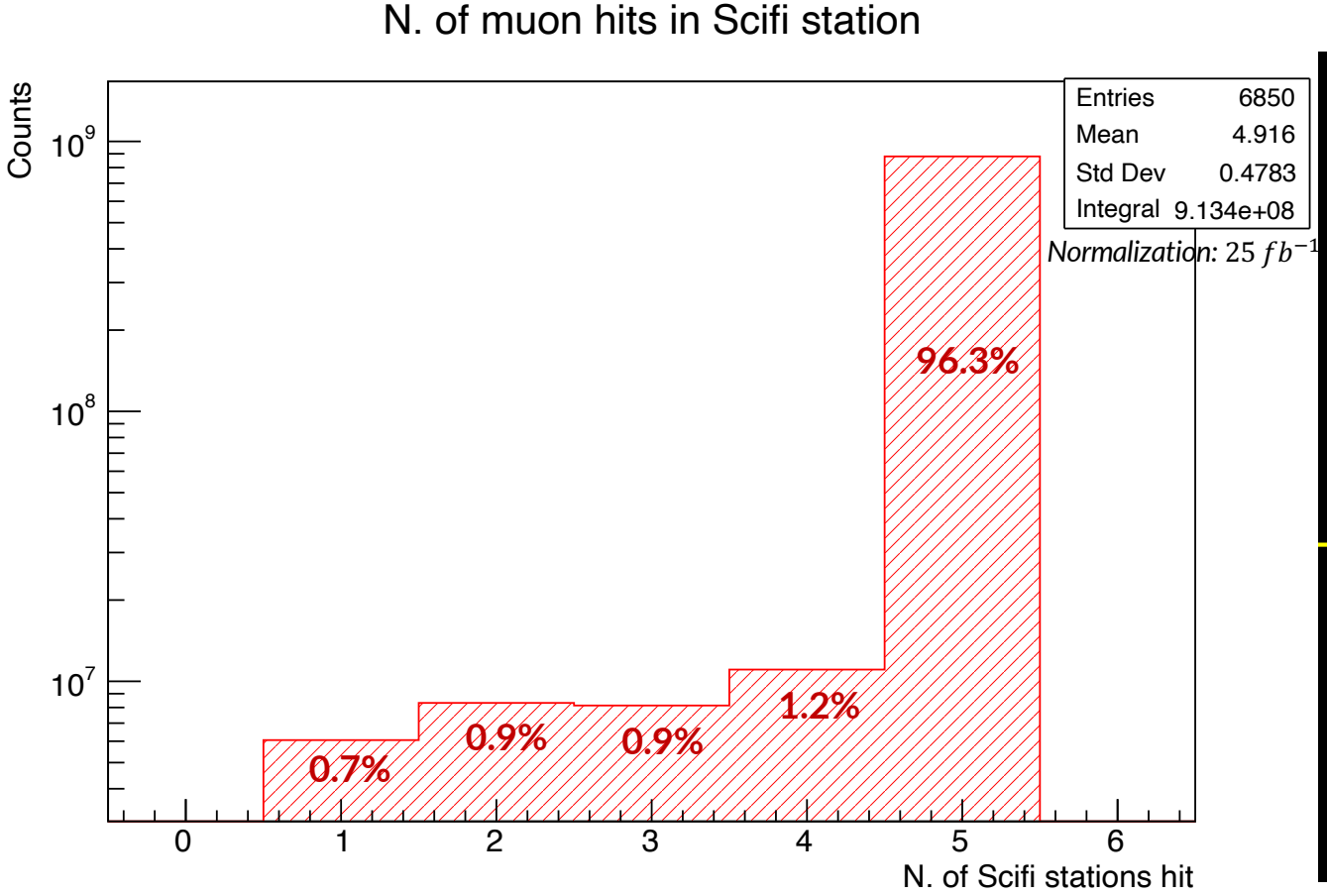
Background muons simulated with FLUKA in the upward crossing angle and propagated in the TI18 Cavern and SND Detector with GEANT4.

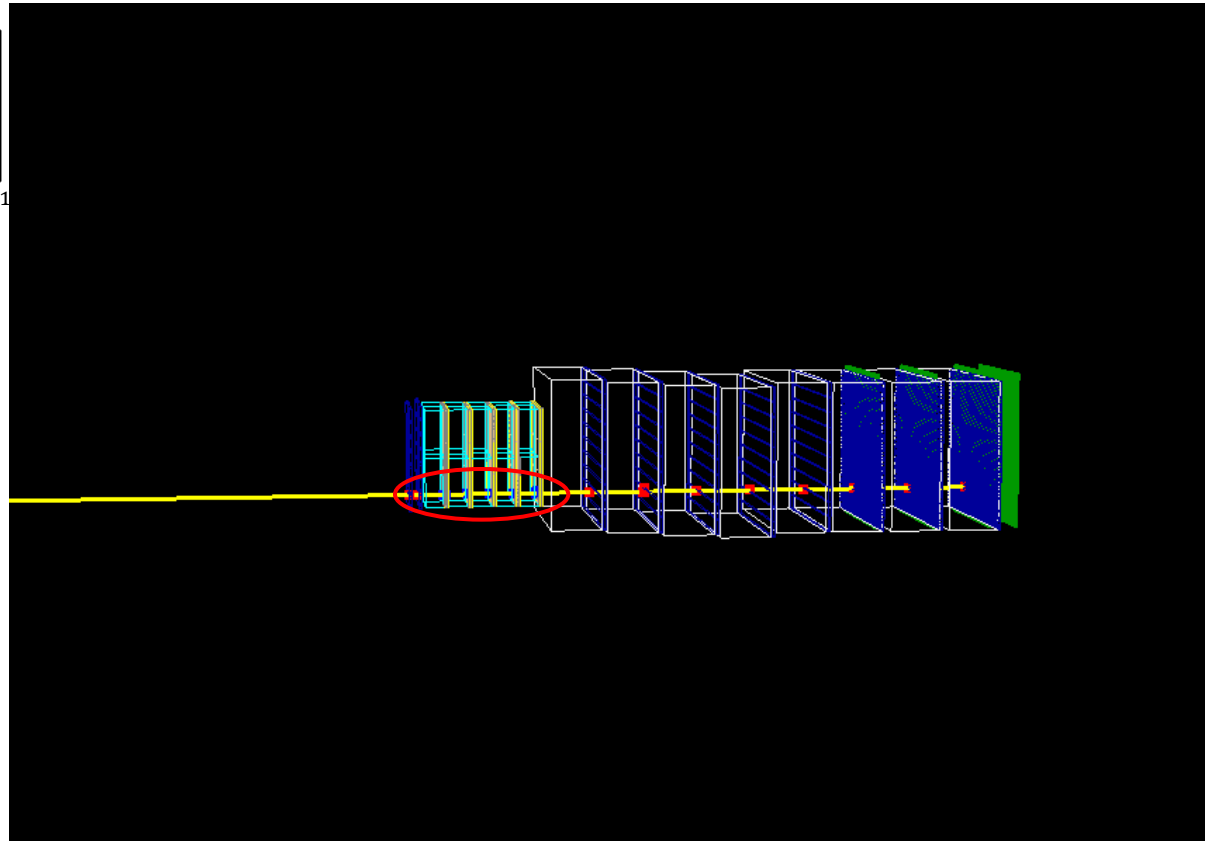
Histograms shown are normalized to $25\ fb^{-1}$ which corresponds to a single RUN (1/6 of the full exposure).

Here muons which leave at least **one hit** in Scifi or MuFilter are considered.

Background muons – *in Scifi*

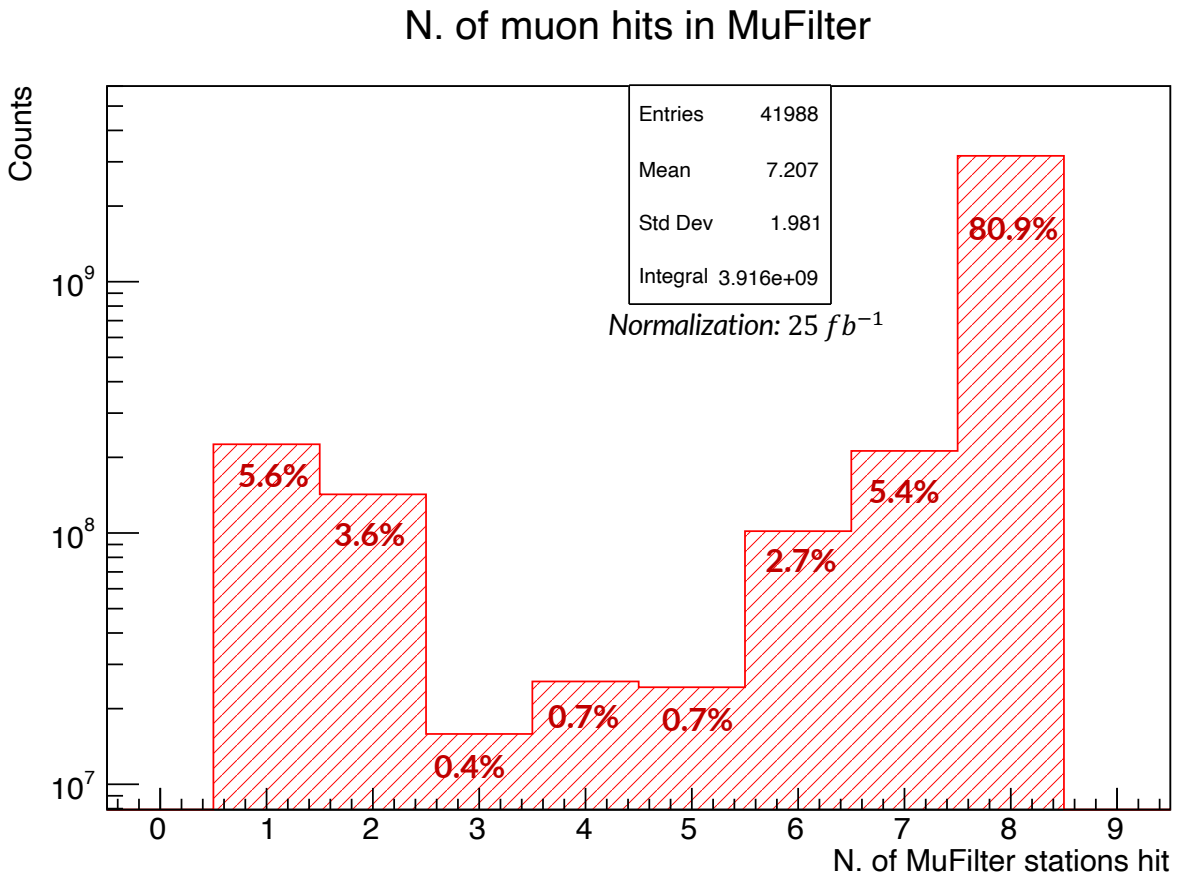
The large majority of muons hitting the Scifi passes through the whole detector.

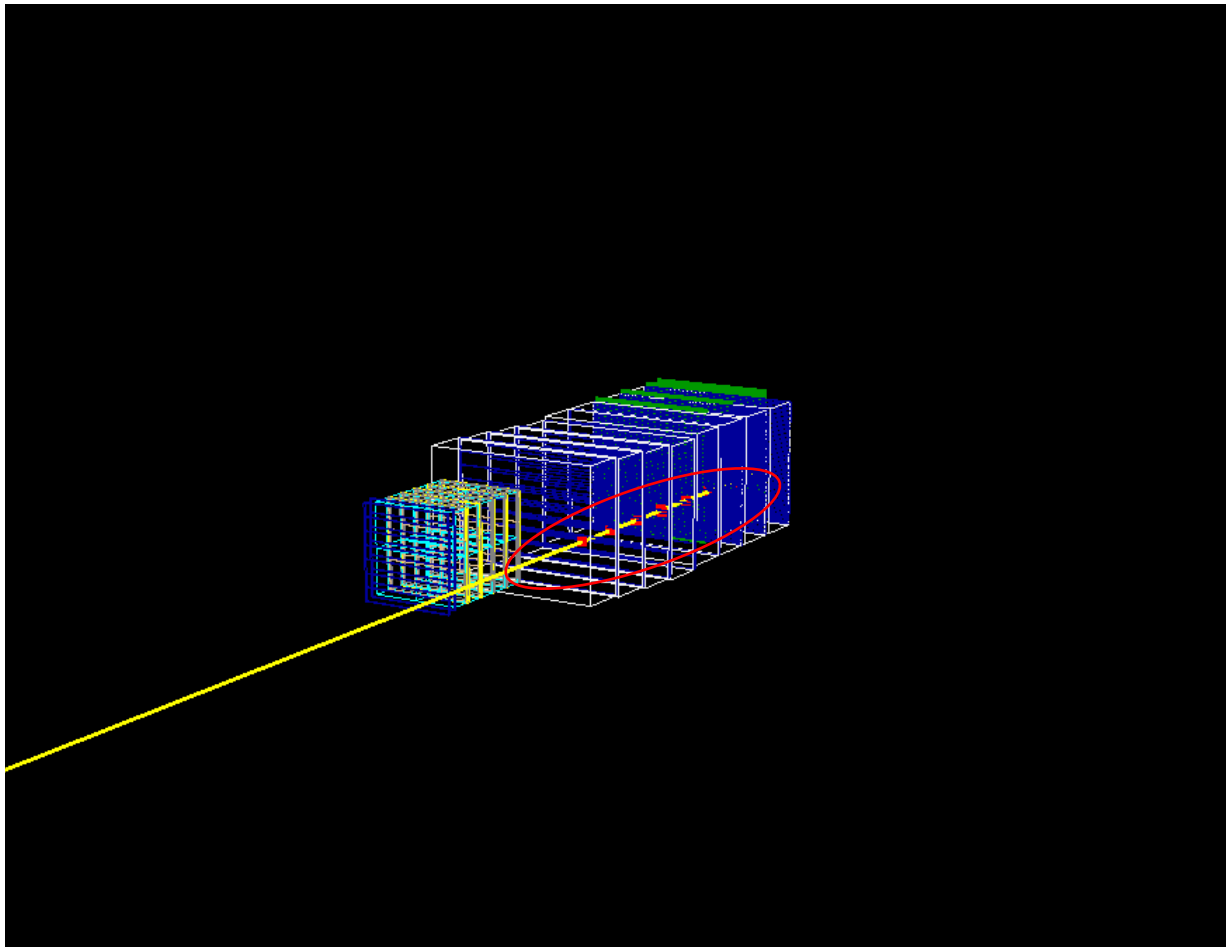




Background muons – *in MuFilter*

A similar scenario is observed for muons hitting the MuFilter



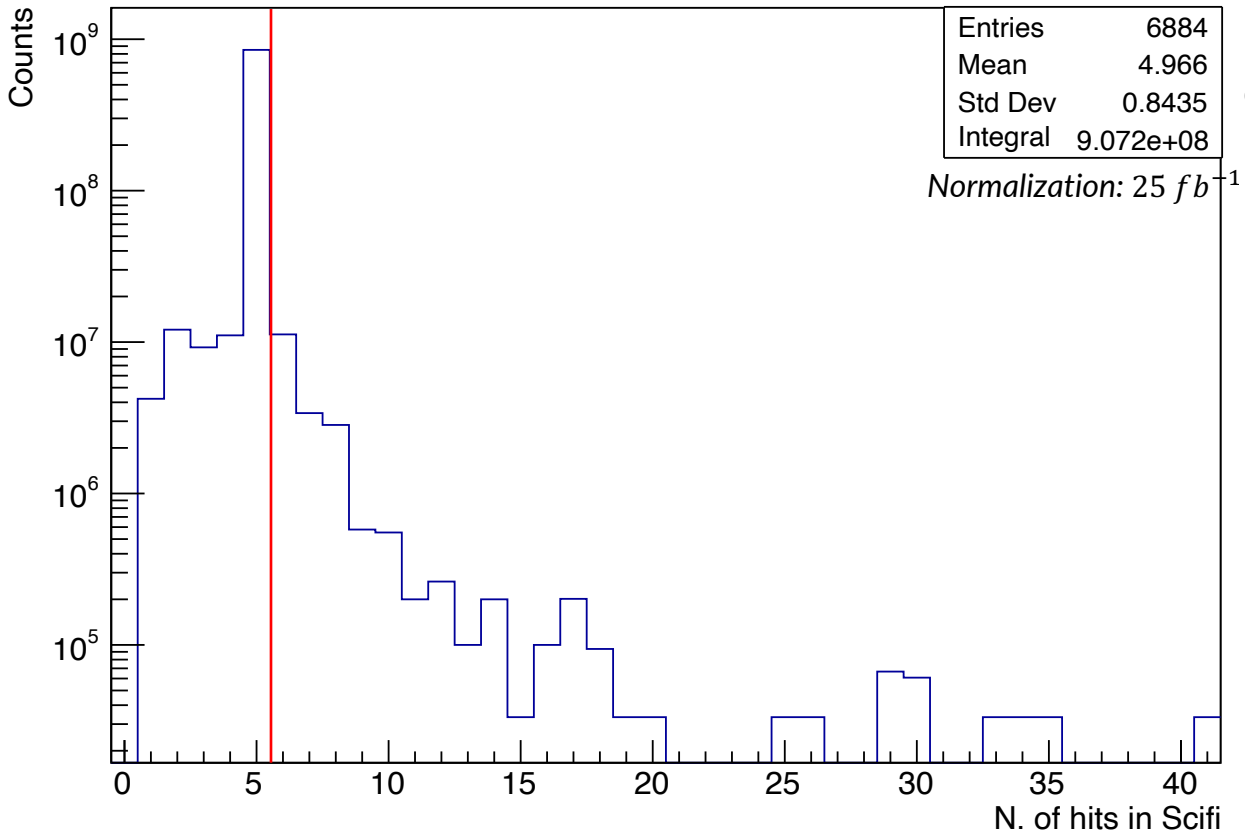


Hits on the last vertical only plane are neglected

Particle hits produced – *in SND Detectors*

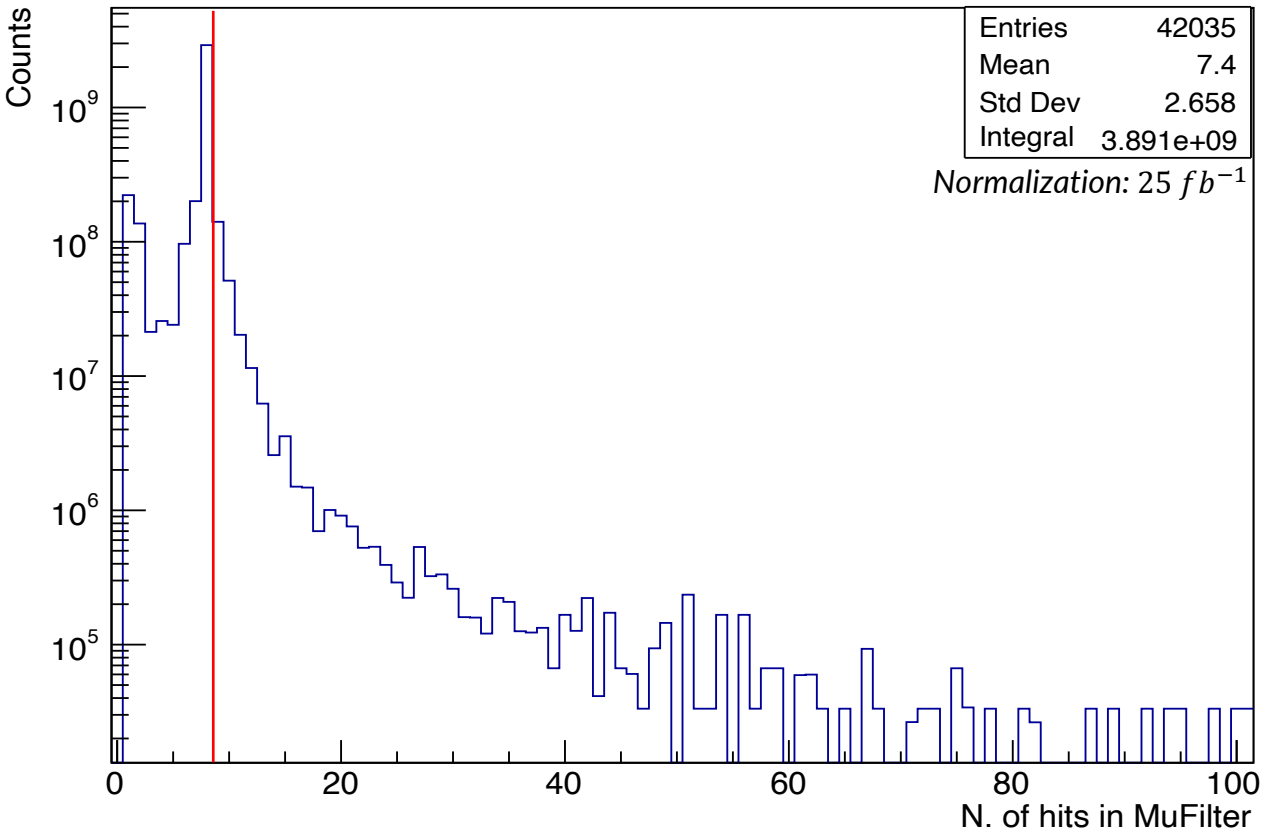
Fraction of muons with number of hits > 5 : 2 %

N. of particle hits in Scifi with energy > 1 GeV

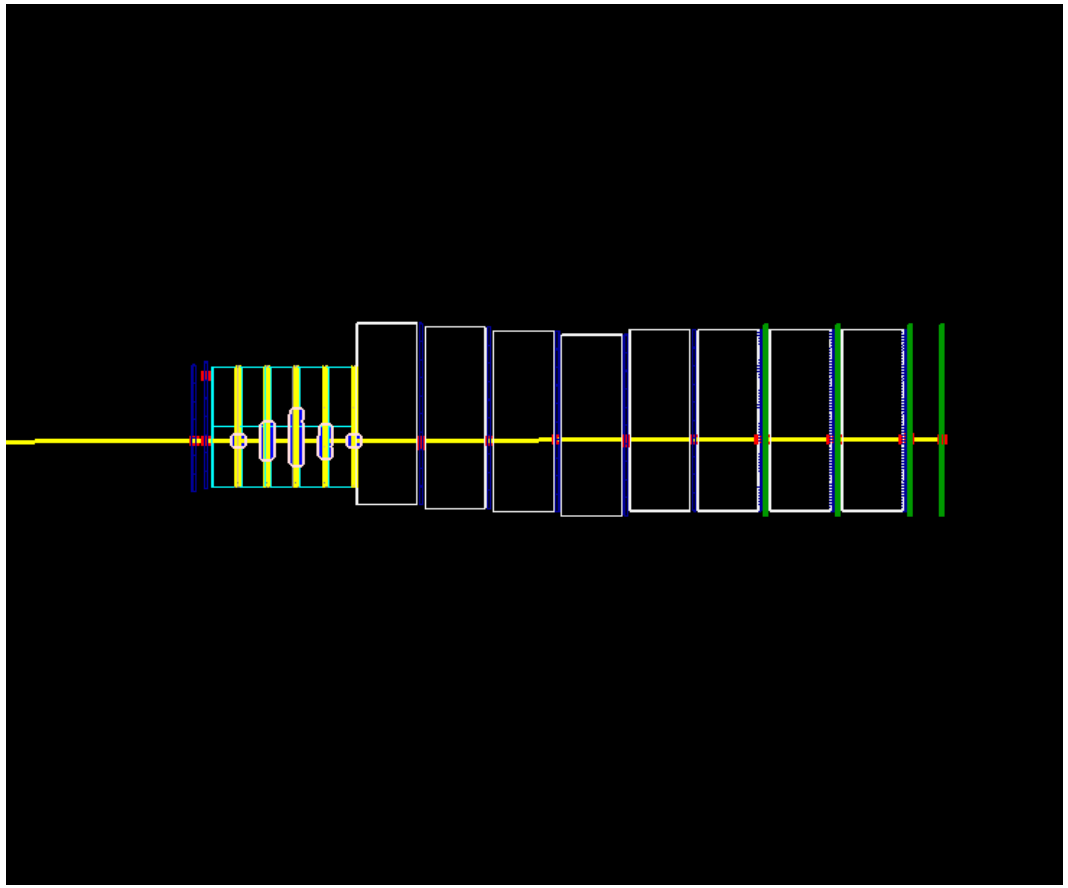


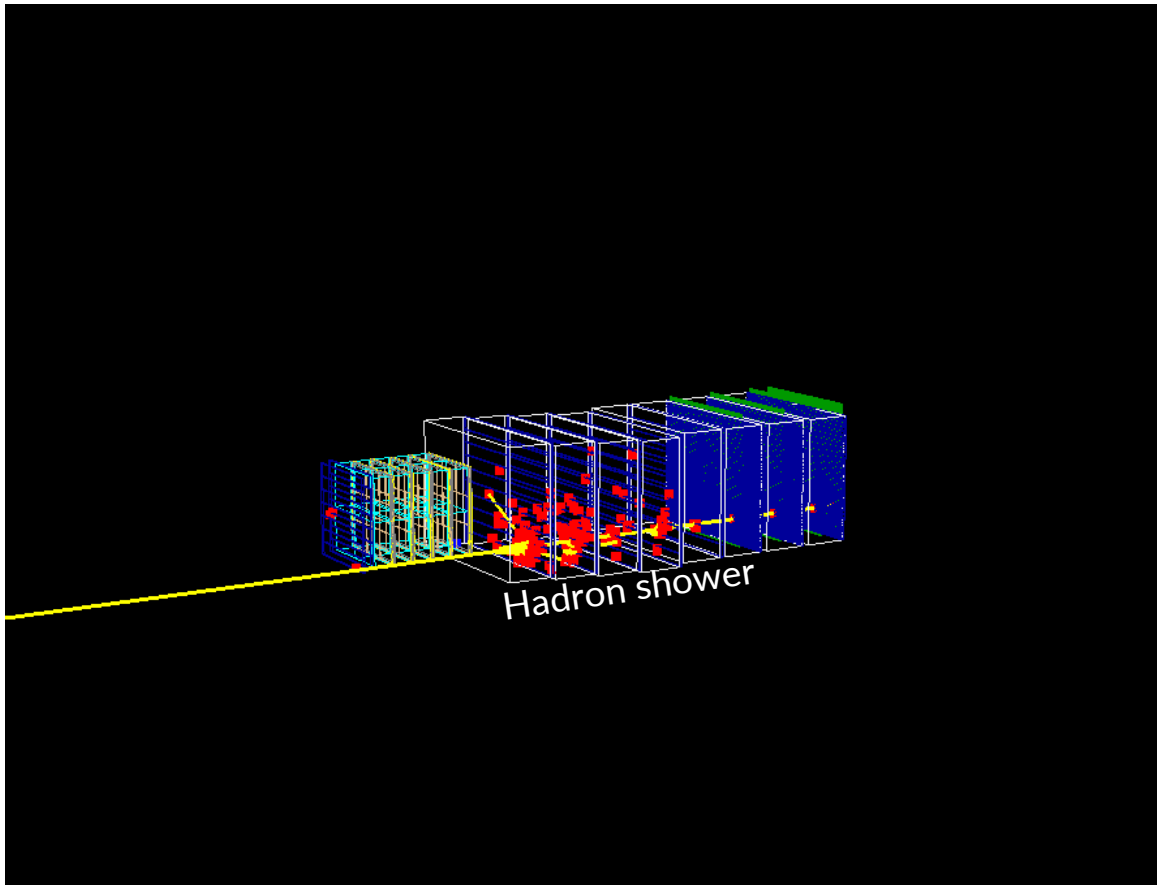
Fraction of muons with number of hits > 8 : 6.4 %

N. of particle hits in MuFilter with energy > 1 GeV



Particle hits produced – *in Scifi & MuFilter*





High occupancy events are due to electromagnetic showers as well as hadron showers occurring in passive materials

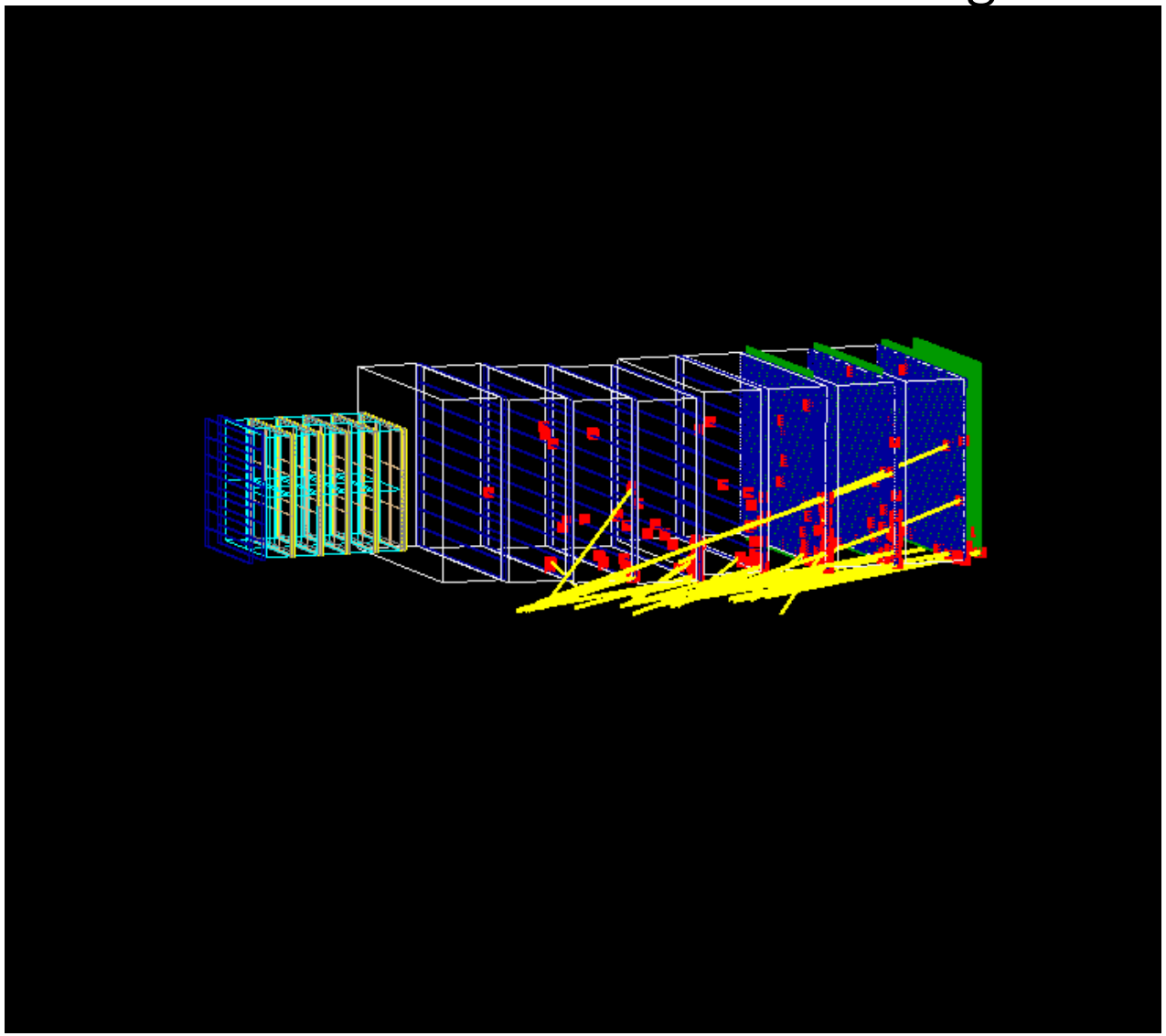
Neutron background

1/10 statistic is being used

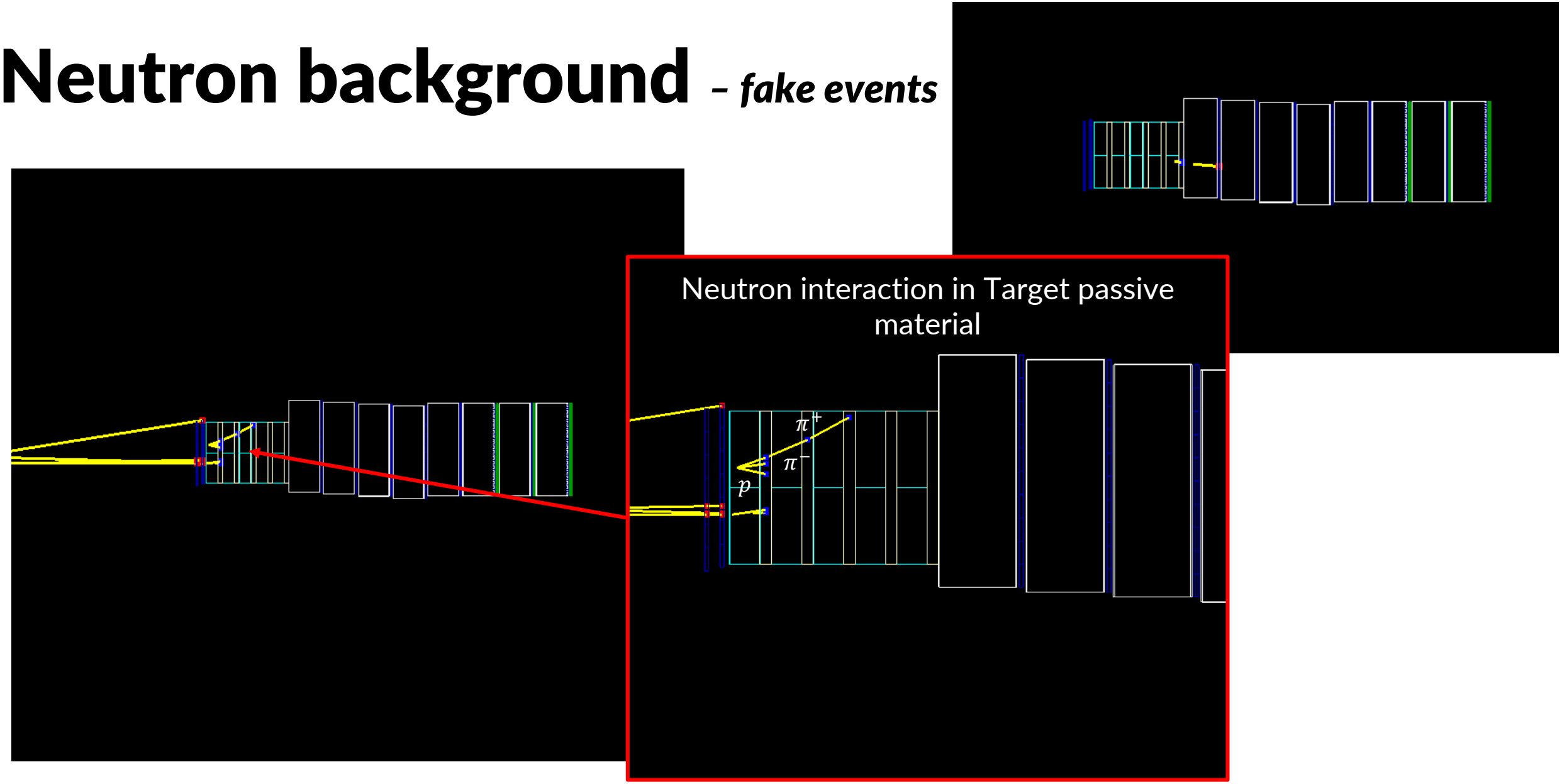
Neutrons, in particular, can mimic neutrino signal interaction in the detector, especially when the **muon is not detected**.

Thus, a proper characterization for background rejection is needed.

For this purpose, a dedicated simulation has been studied:
Only muon DIS on protons and neutrons are simulated in order to enhance the neutron production.



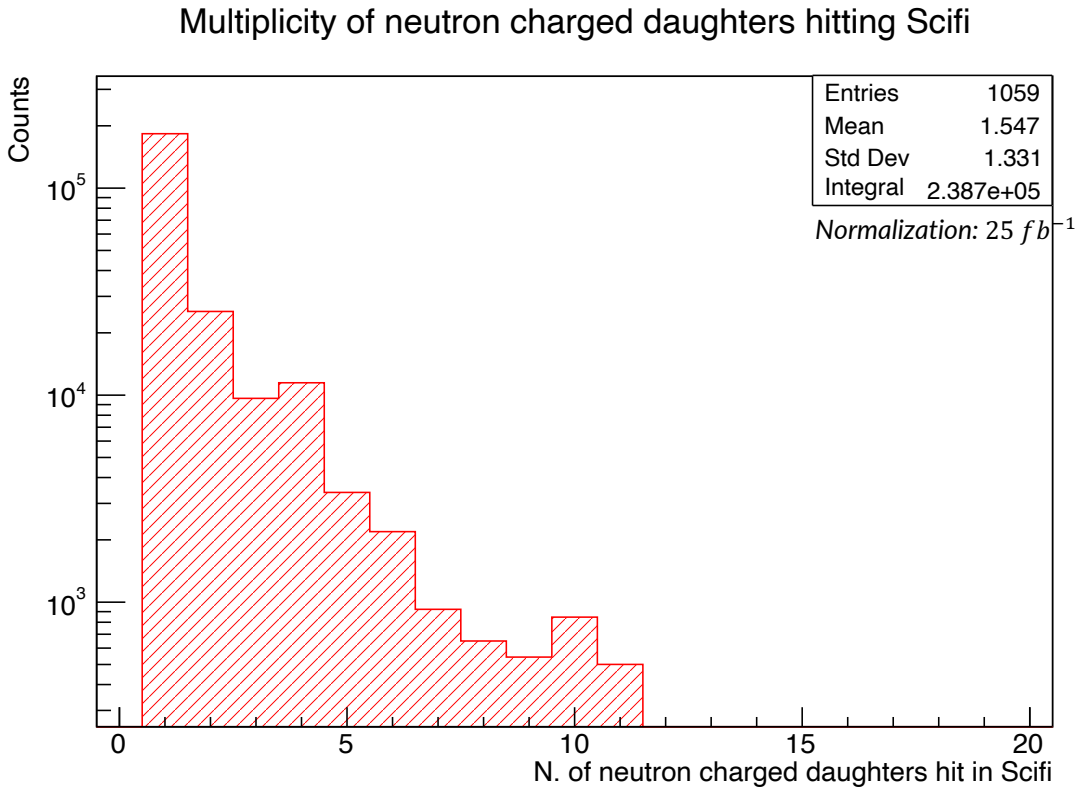
Neutron background – *fake events*

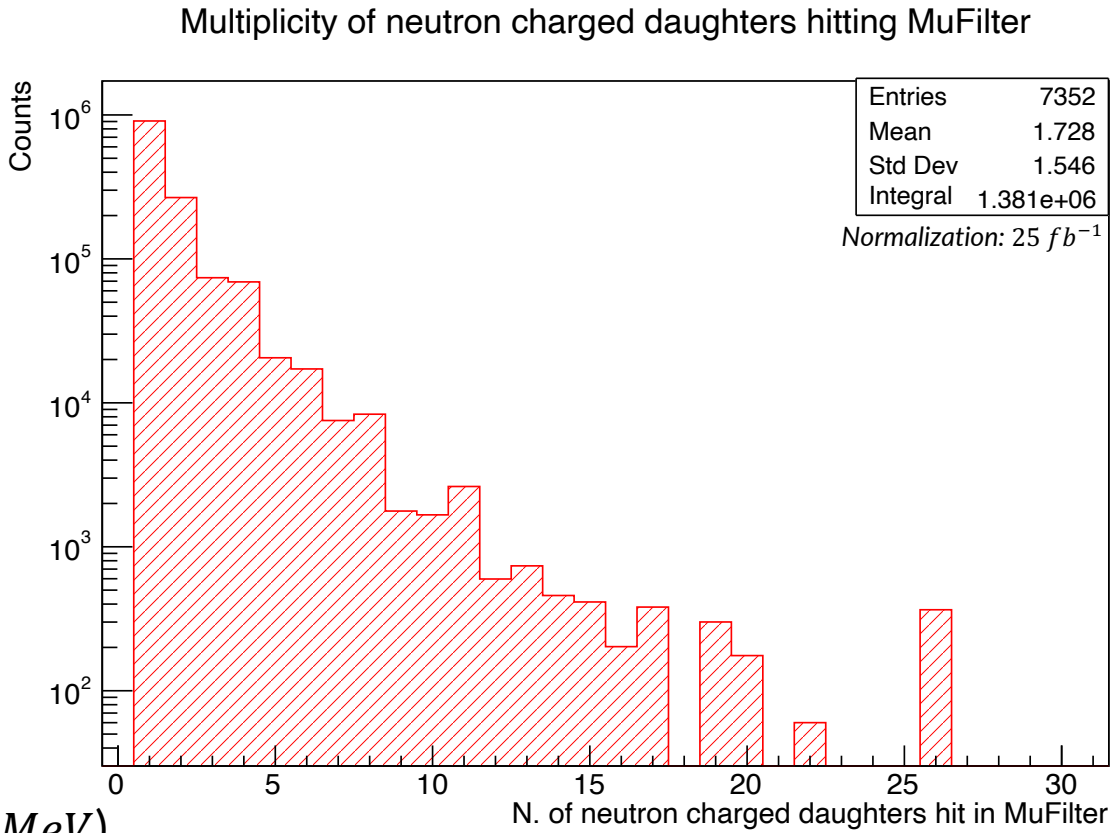


Neutron background – *Charged daughters*

Neutron charged daughters will produce signal in detectors.

Hits of charged particles particles produced by neutrons will be recorded by electronic detectors.





$(E > 100\ MeV)$

Conclusions

- **Muon background**

  - Most of muon events are characterized by passing through the whole detectors.
  - High multiplicity events are observed → E.M. and Hadronic showers

- **Neutron background**

  - Neutrons can mimic neutrino signal bypassing Veto:
  - High multiplicity events in detectors observed → H. Showers from N

Next Steps

- Run over the full statistics
- Deeper characterization of neutral background
- Neutral background rejection criteria

Thank you for your attention!