



# Neutrino detection at the SND@LHC experiment

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Scattering and Neutrino Detector  
at the LHC

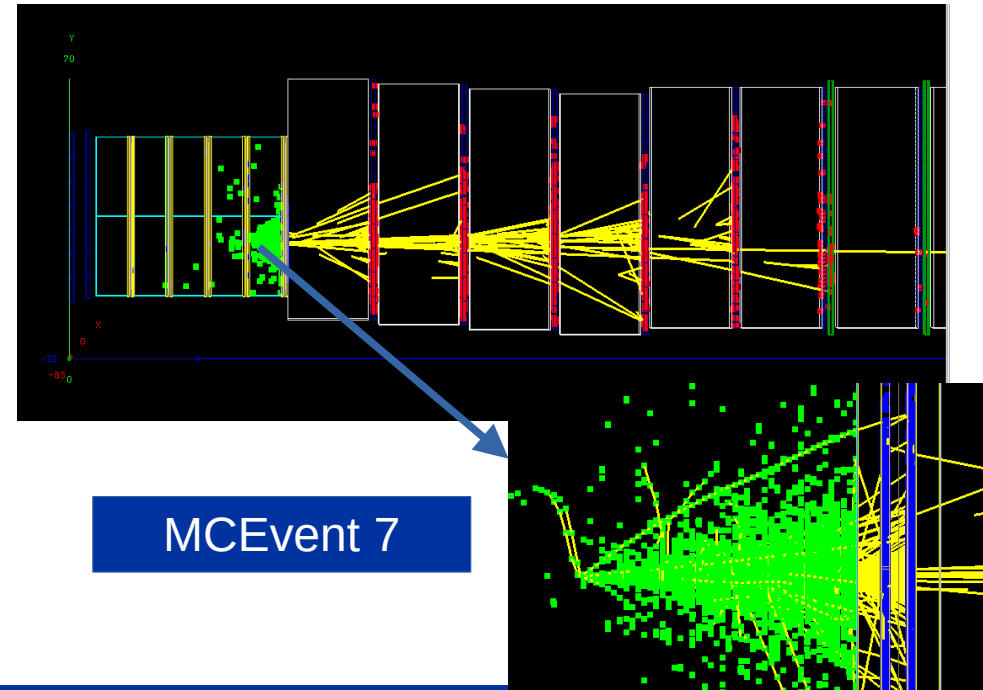
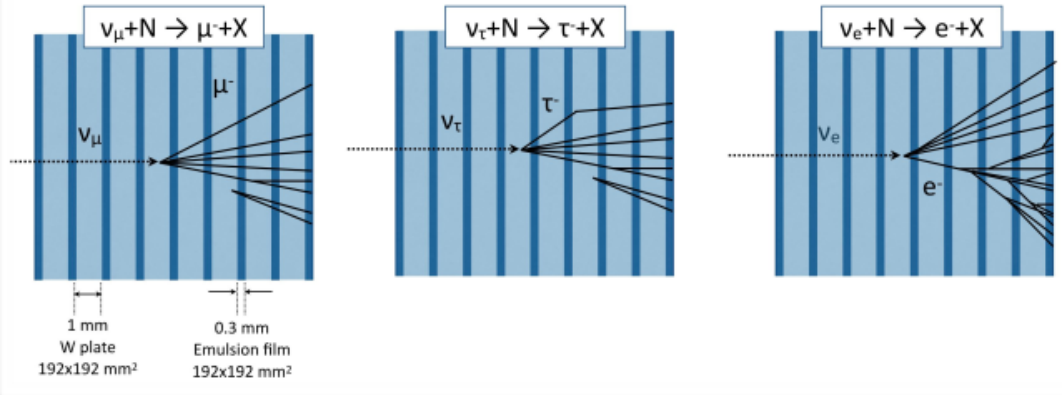


# Introduction

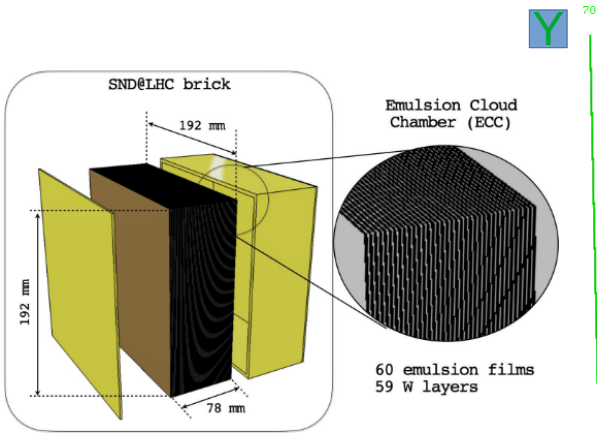
## Reconstruction of neutrino interactions in the Scattering and Neutrino Detector at LHC (SND@LHC) target

High spatial resolution provided with nuclear emulsions:

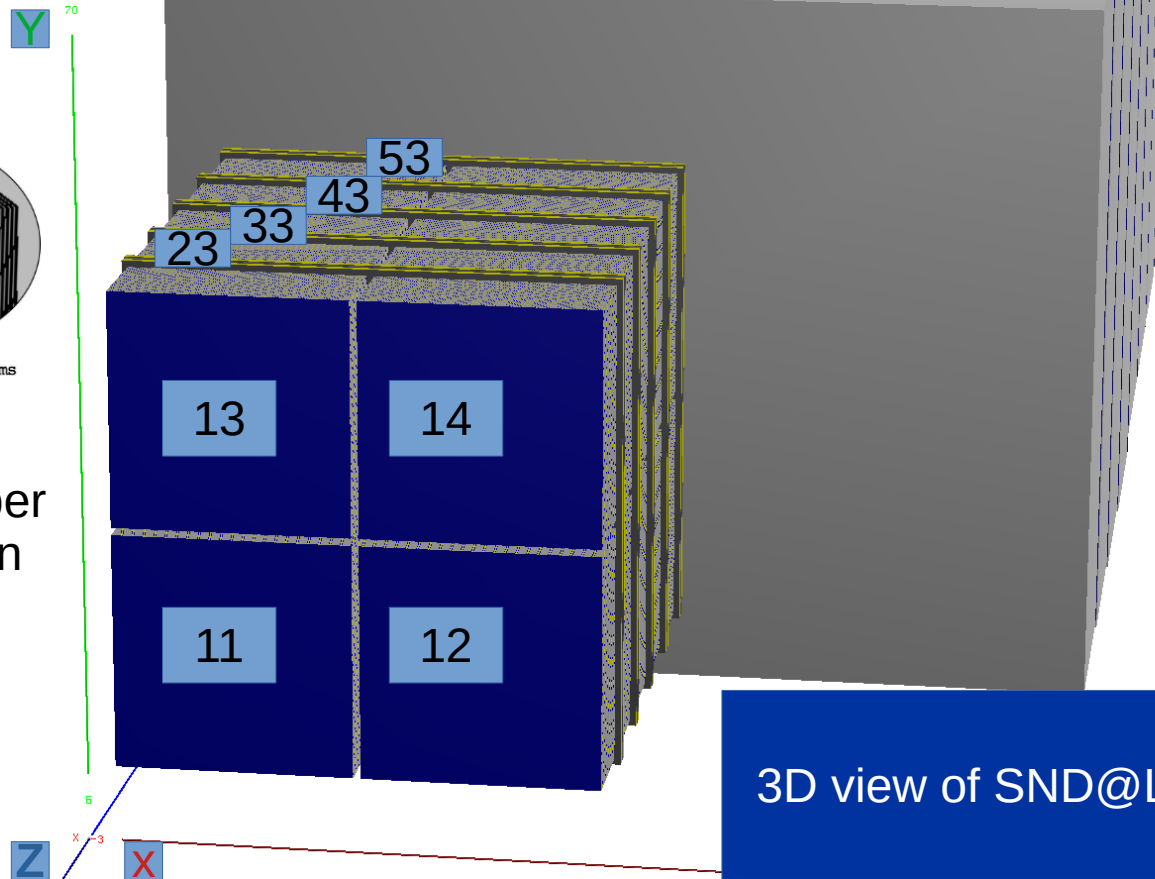
- Tracking particles in emulsion films;
- Locate neutrino vertex;



# Geometry of Emulsion targets



Emulsion Cloud Chamber (ECC): nuclear emulsion films interleaved by passive tungsten plates



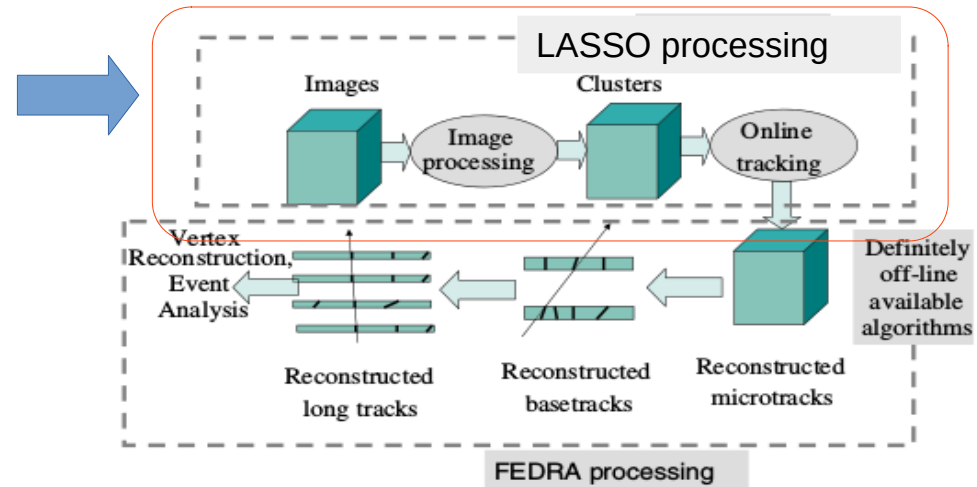
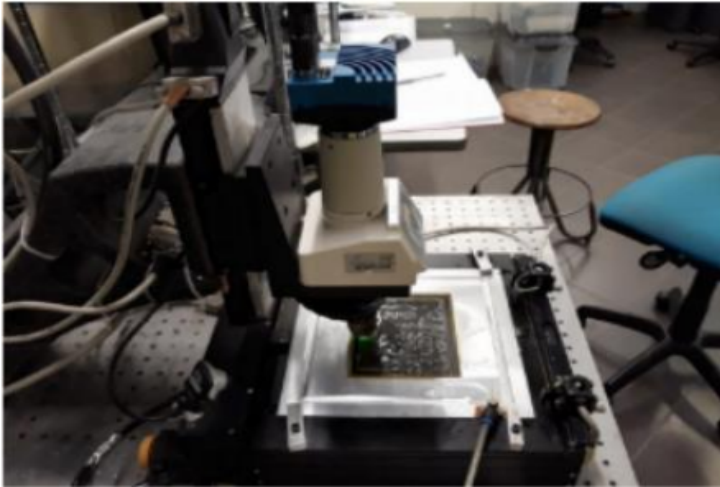
3D view of SND@LHC target

# Data reconstruction in nuclear emulsion films

One emulsion film: two emulsion layers separated by a plastic base

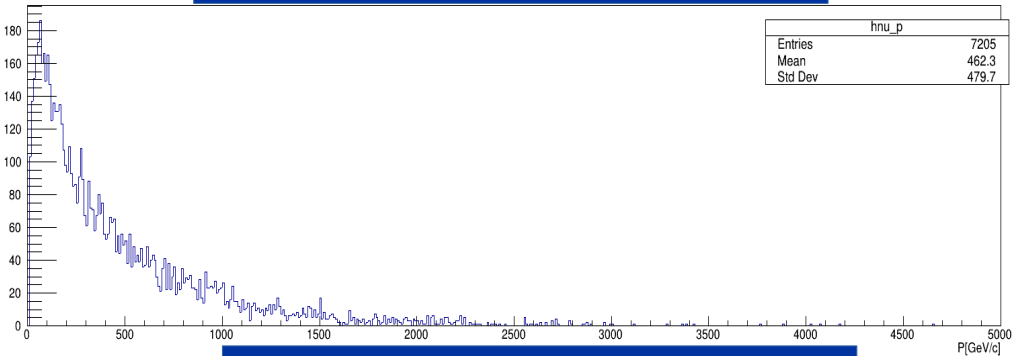
Micro-track: particle trajectory in each emulsion layer, processed from images obtained with automated optical microscopes

Base-track: particle trajectory in the film, connecting the two micro-tracks

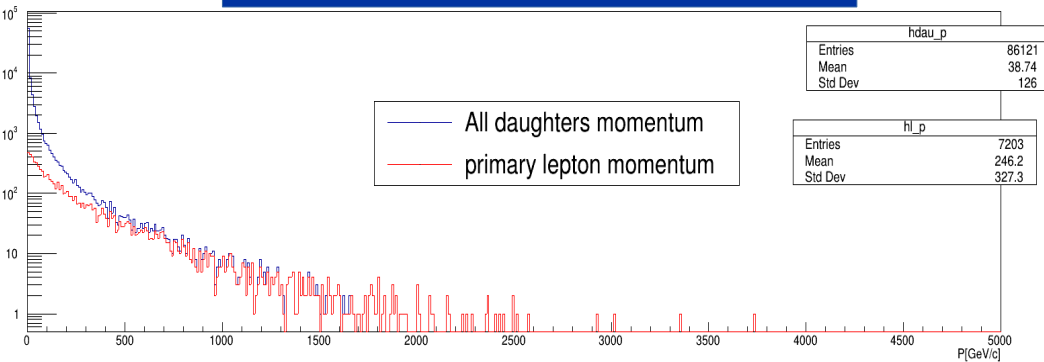


# Neutrino simulation

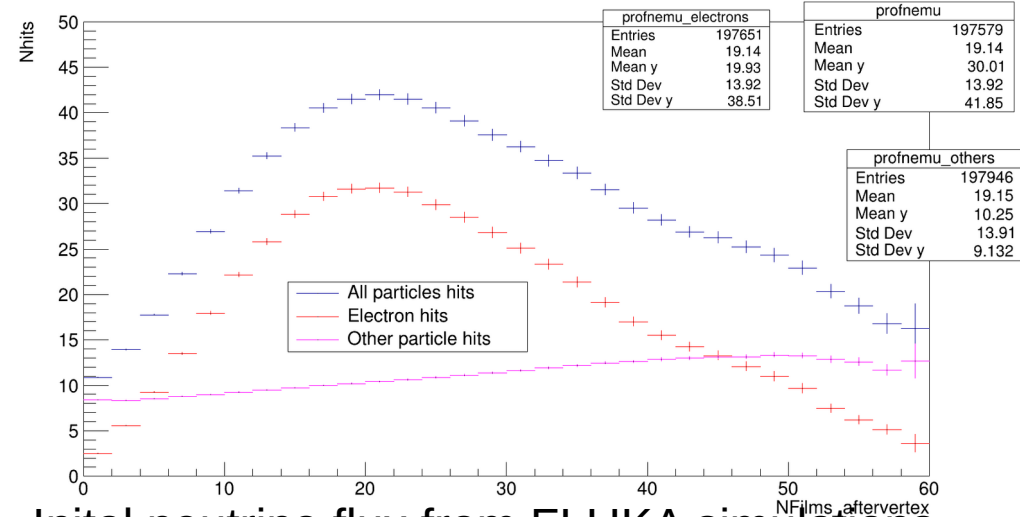
## Neutrino momentum



## All daughters momentum



## Hits in muon neutrino simulation



Initial neutrino flux from FLUKA simulations

Neutrino interactions simulated in GENIE and propagated in GEANT4

Here, comparing momentum of neutrino and particles produced in its interaction

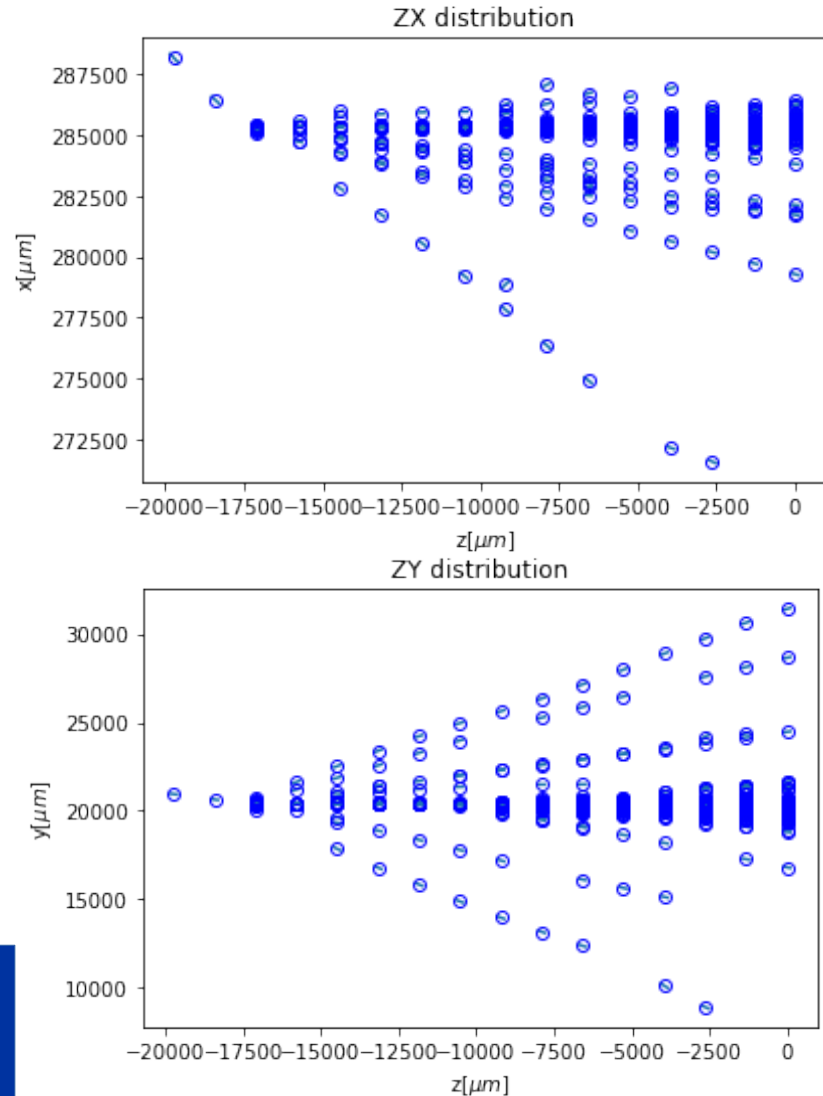
# From simulation to reconstruction

Hits from simulation converted into base-tracks.

Applied the following parameters:

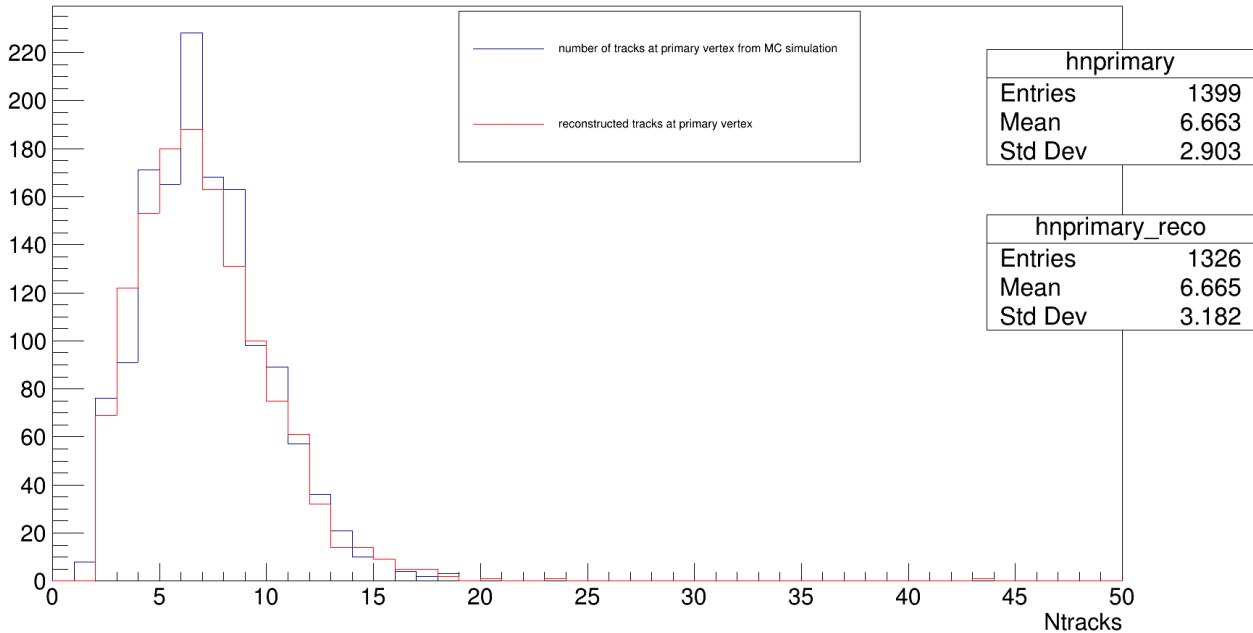
- \* Assumed efficiency for single base-track: 90%
- \* Angular smearing: 3 mrad
- \* Minimum momentum: 100 MeV/c
- \* Maximum angle: 1 rad

Display of MCEvent 38 in a brick  
with all base-tracks provided  
for reconstruction

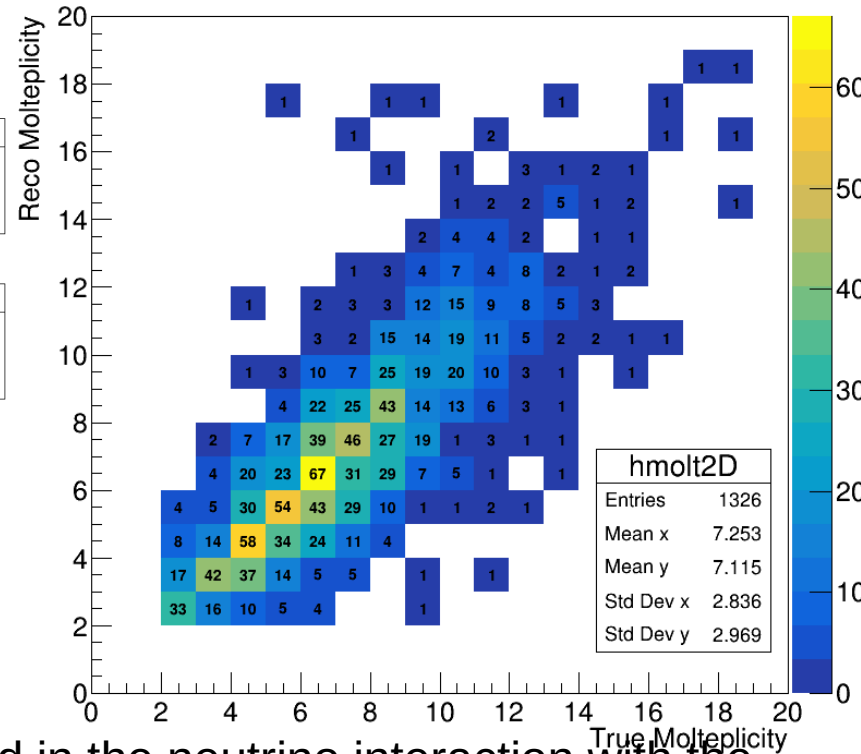


# Multiplicity of reconstructed vertices

number of tracks at primary vertex from MC simulation



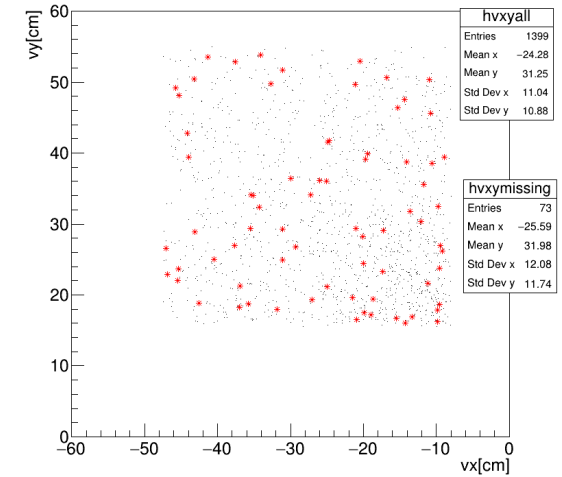
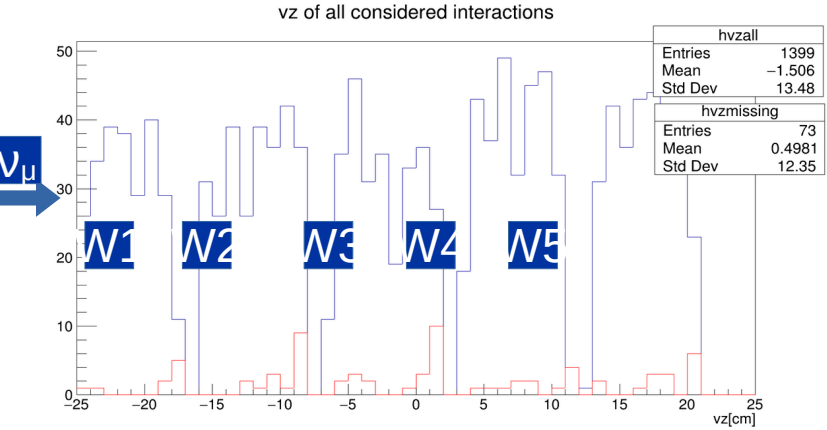
reco molt vs true molt



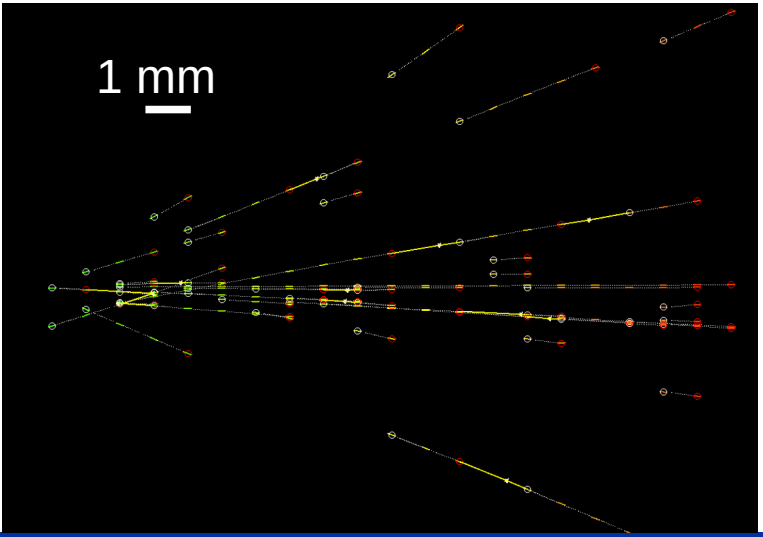
- Comparing number of tracks directly produced in the neutrino interaction with the multiplicity of the reconstructed neutrino vertex

# Reconstruction efficiency

- Among the simulated neutrino events in the target, ~5% have not reconstructed vertex
- Found reasons for no reconstruction:
  - Geometrical containment;
  - Low multiplicity;



Blue: all events  
Red: not reconstructed vertices



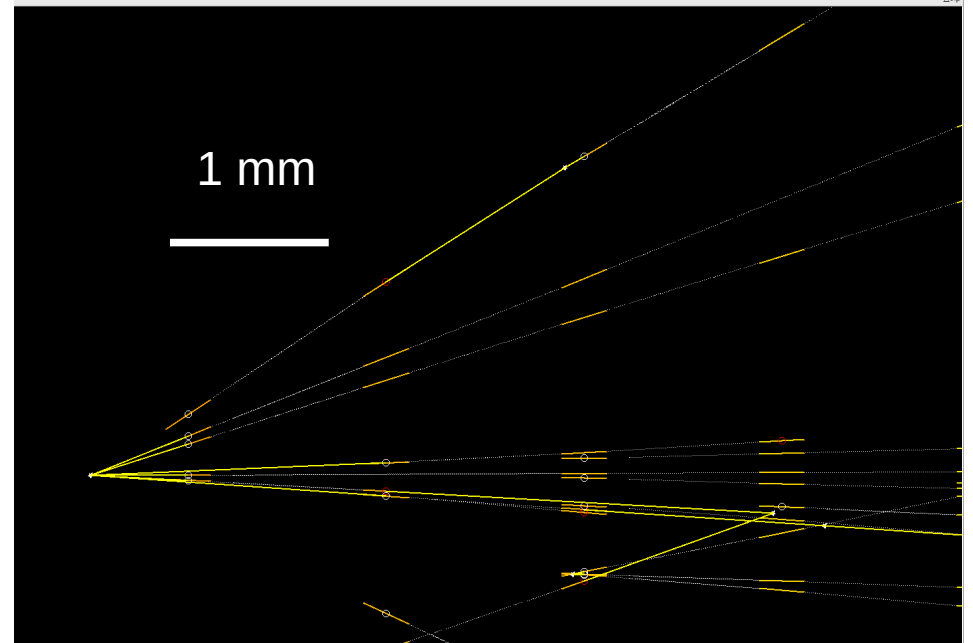


# Conclusions

## Track and vertex reconstruction tested on Monte Carlo simulation of neutrino events in SND@LHC

### Next tasks:

- Add background simulation to emulsion target
- Implement signal vs background identification



# Thank you for your attention



SND@LHC installed in TI18

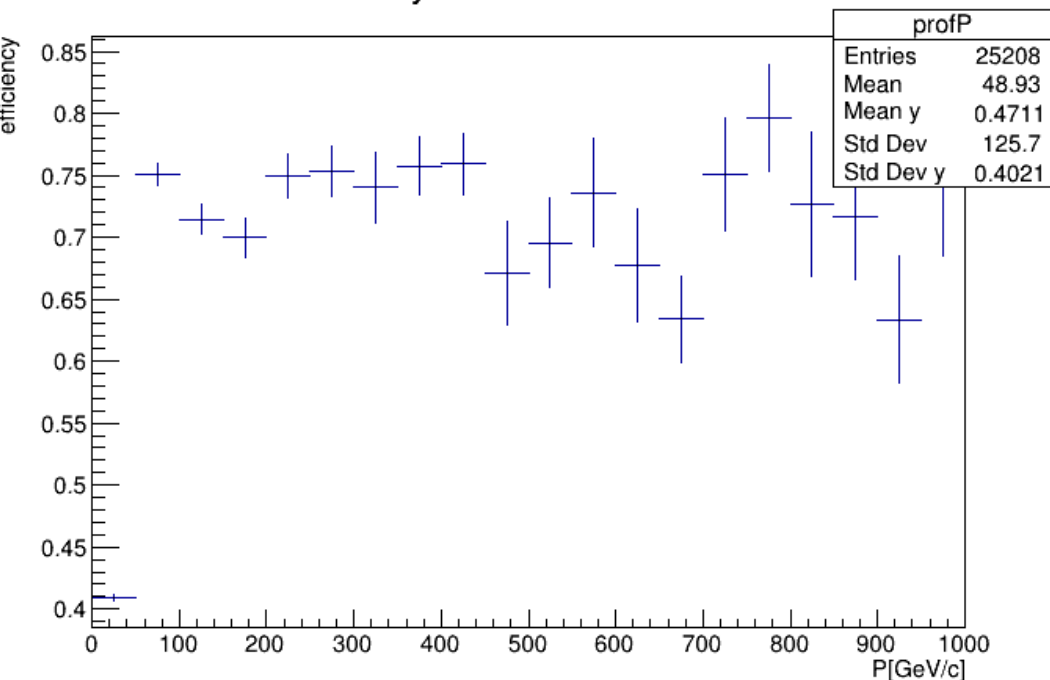
[home.cern](http://home.cern)

The cake was not a lie

# Track reconstruction

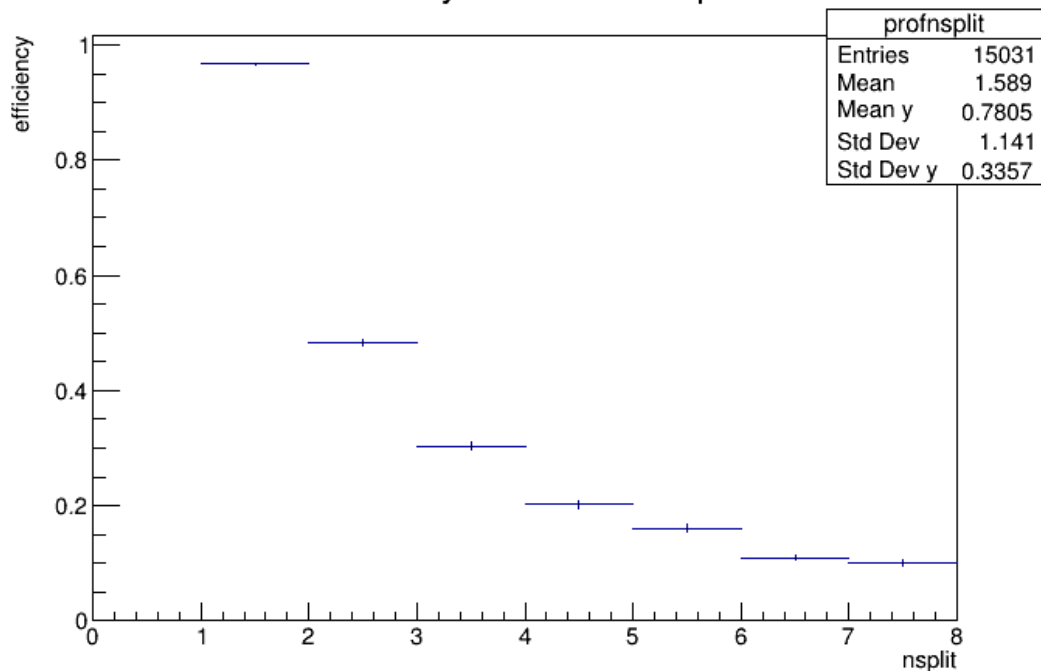
## Tracking performed with Kalman Filter in the whole area

Efficiency for different momenta



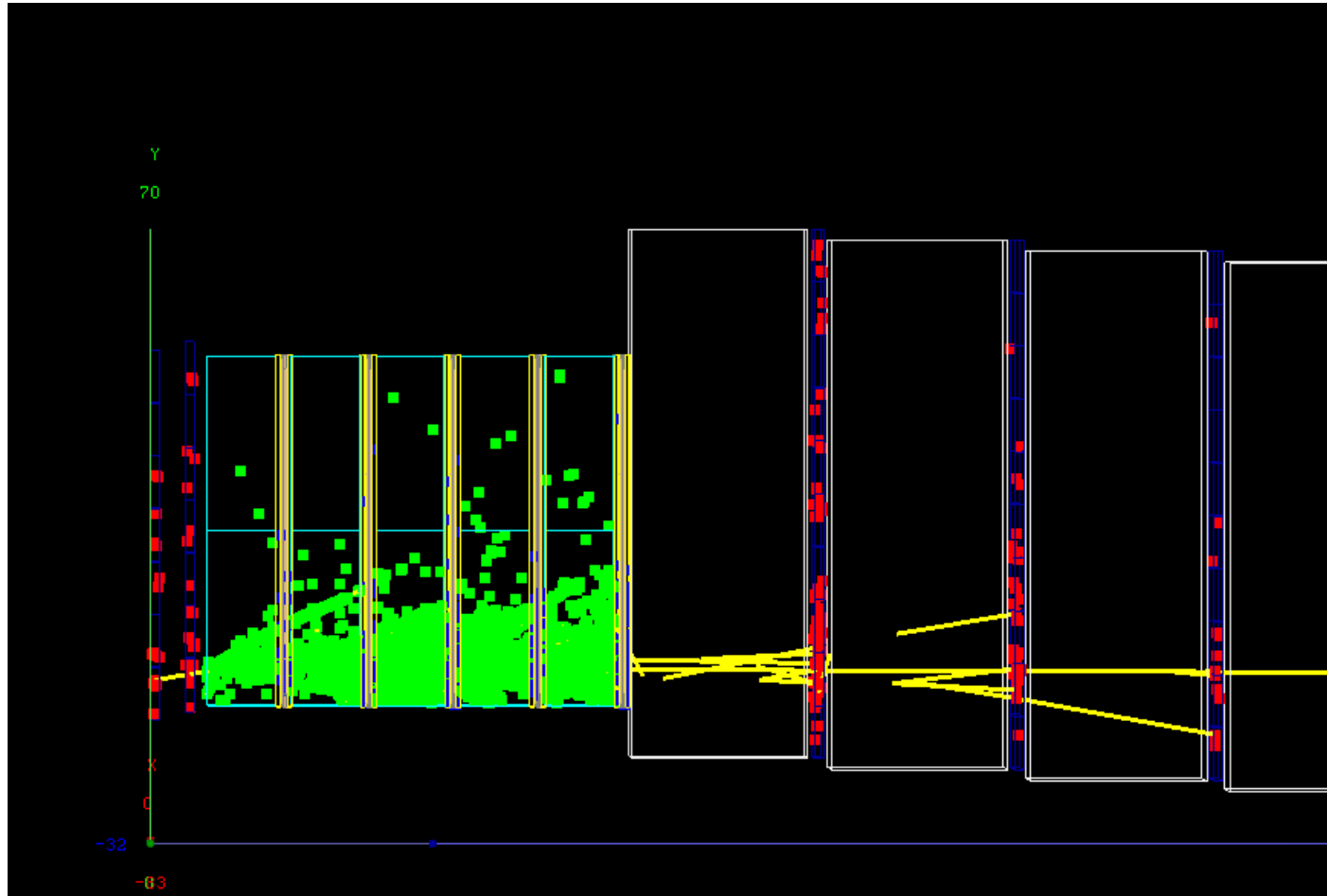
Efficiency evaluated as  $n_{\text{segreco}}/n_{\text{segtrue}}$   
At low momentum, many tracks splitted

Efficiency for different nsplit



$n_{\text{split}} = n_{\text{tracks reconstructed}}$   
for each true track

# Display of a MCEvent travelling the whole detector



MCEvent 13