First Studies With SND@LHC

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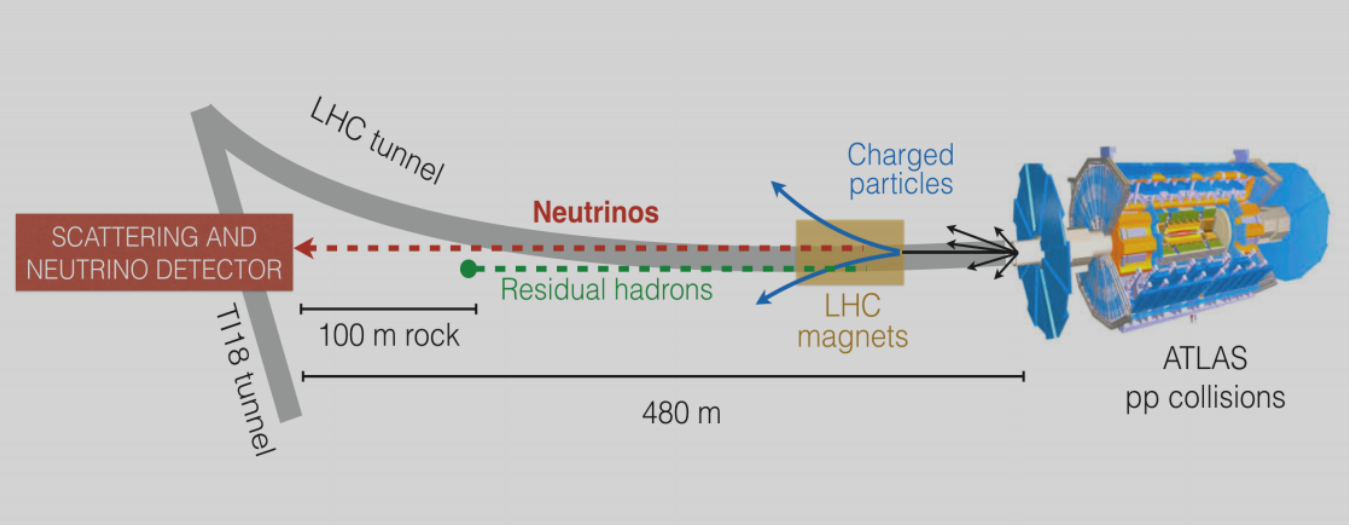
LABORATÓRIO DE INSTRUMENTAÇÃO
E FÍSICA EXPERIMENTAL DE PARTÍCULAS

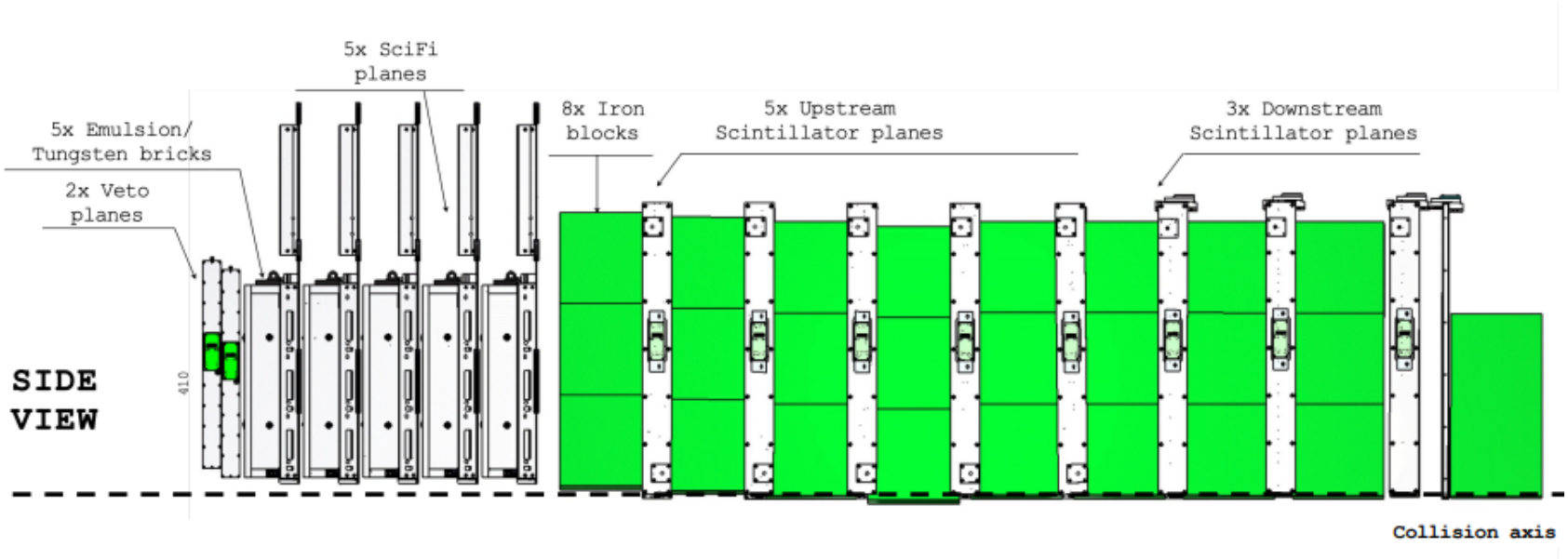
SND@LHC Setup



Detects neutrinos at LHC!

- Located 480m from ATLAS
- Shielded by 100m of rock
- High energy neutrinos
- Large flux

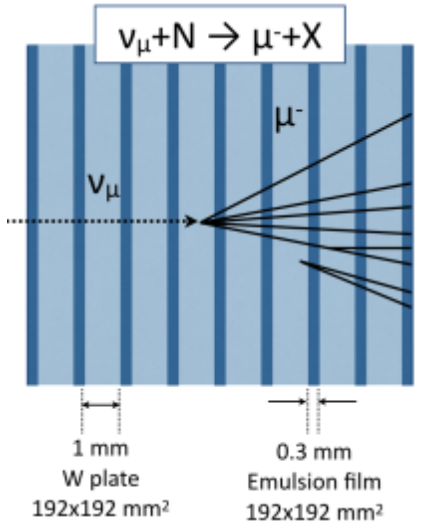
The Detector

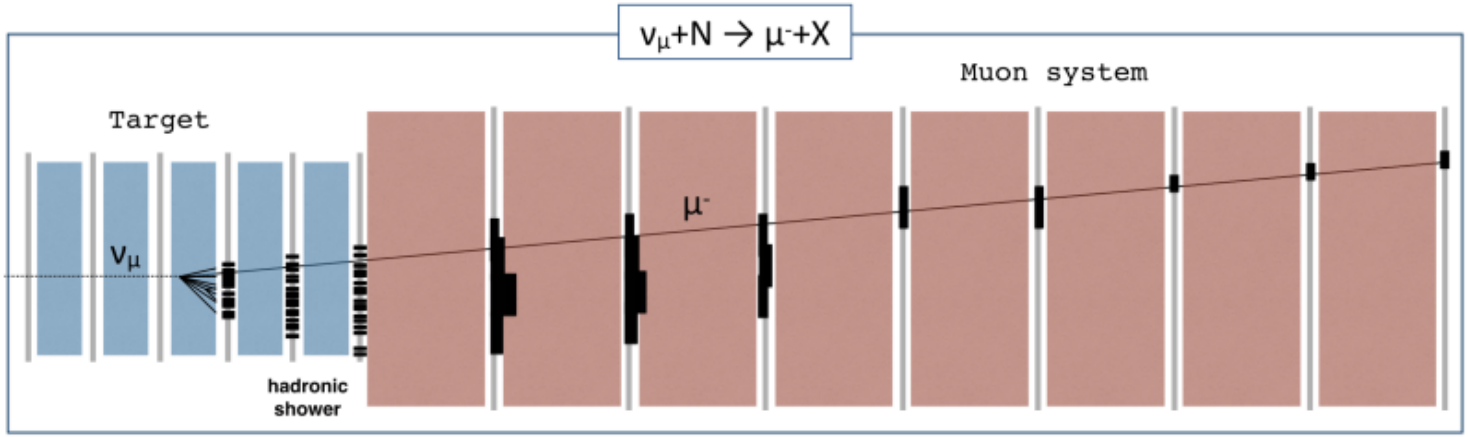


- Veto System
  - Silicon Photomultipliers
  - Scintillating Bars
- Emulsion Target
  - Emulsion Bricks
  - Scintillating Fiber Trackers
- Muon System / Hadronic Calorimeter
  - Scintillating Detector Planes
  - Iron Blocks

Neutrinos? Where?

- Almost never interact
- Transfer energy to materials $\rightarrow e, \mu, \tau$
- Electrons create particle showers
- Muons are very penetrating

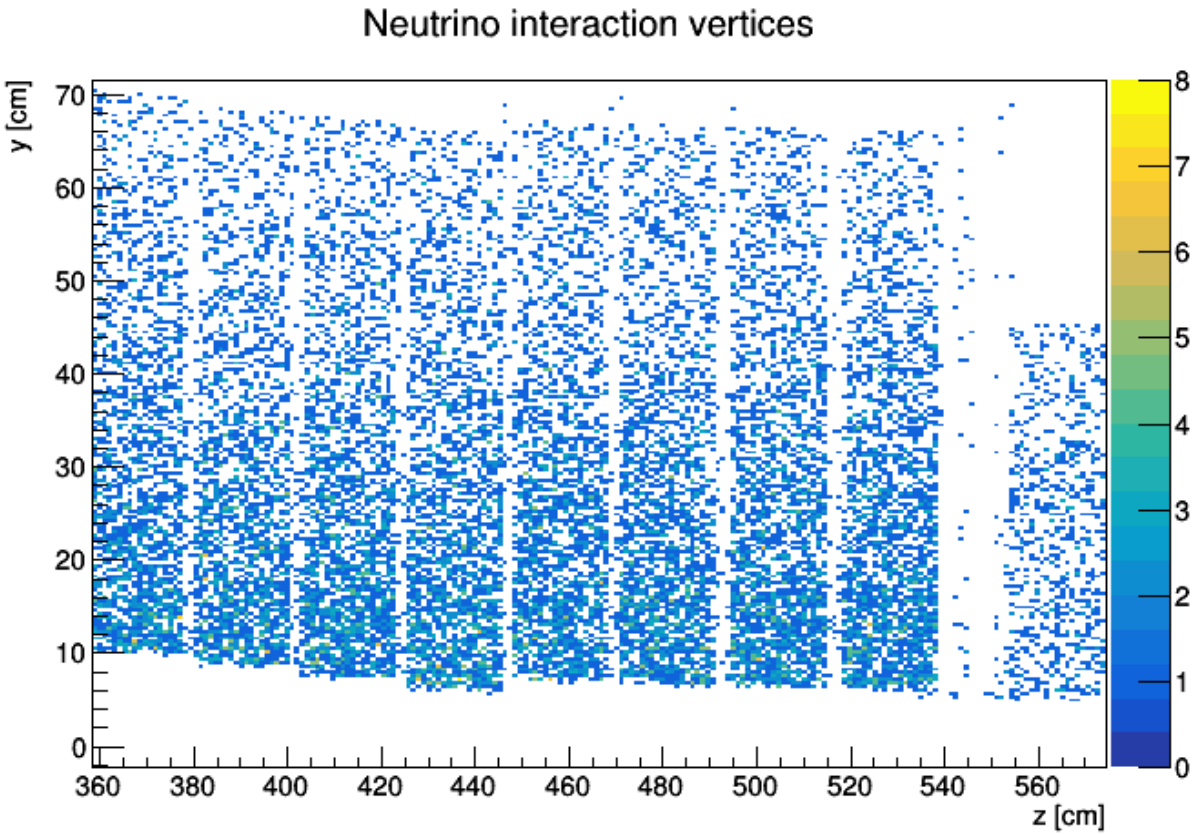




Objectives

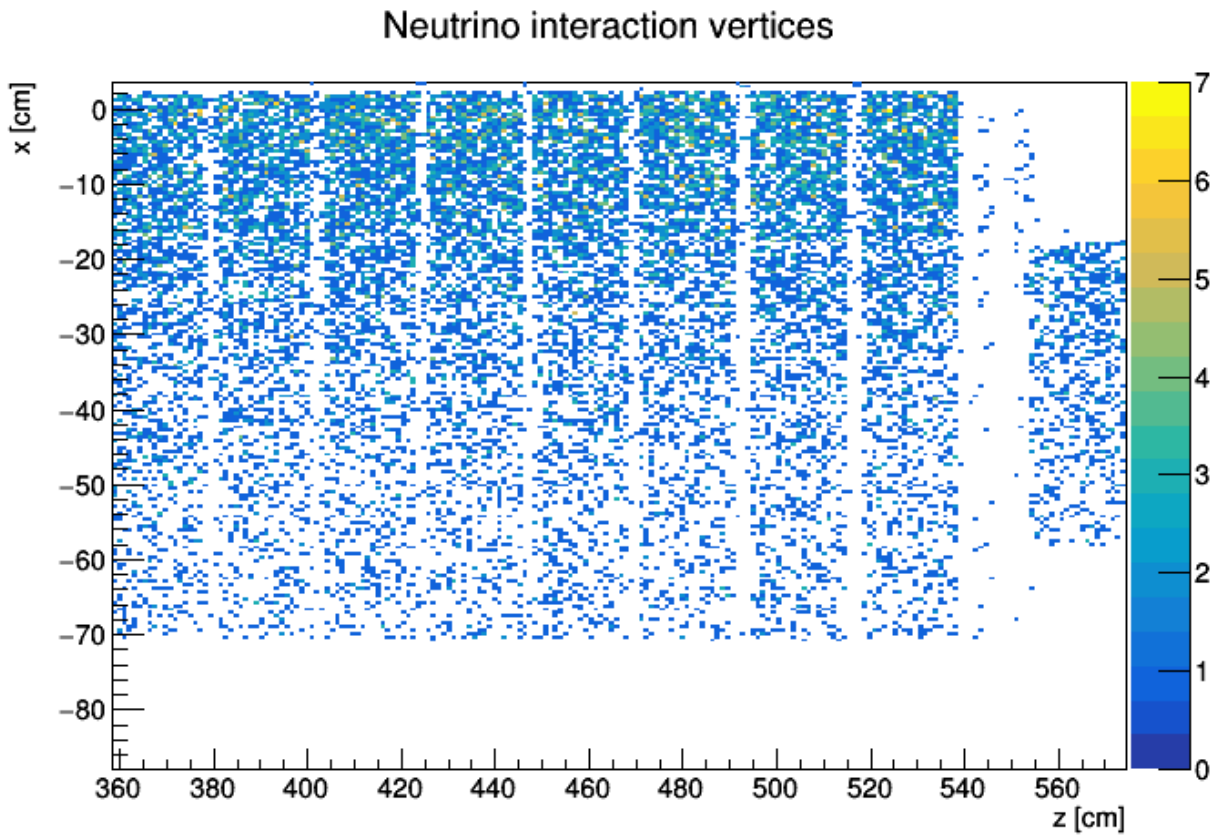
- Simulate neutrinos interacting within the first 4 Upstream Fe blocks;
- Calculate efficiency for detecting and identifying muon neutrinos.
- Implement the upcoming geometry for the next test beam
- Analyze the particle shower as a result of the beam and its energy with three different configurations

Neutrino Interaction Vertices (ZY)



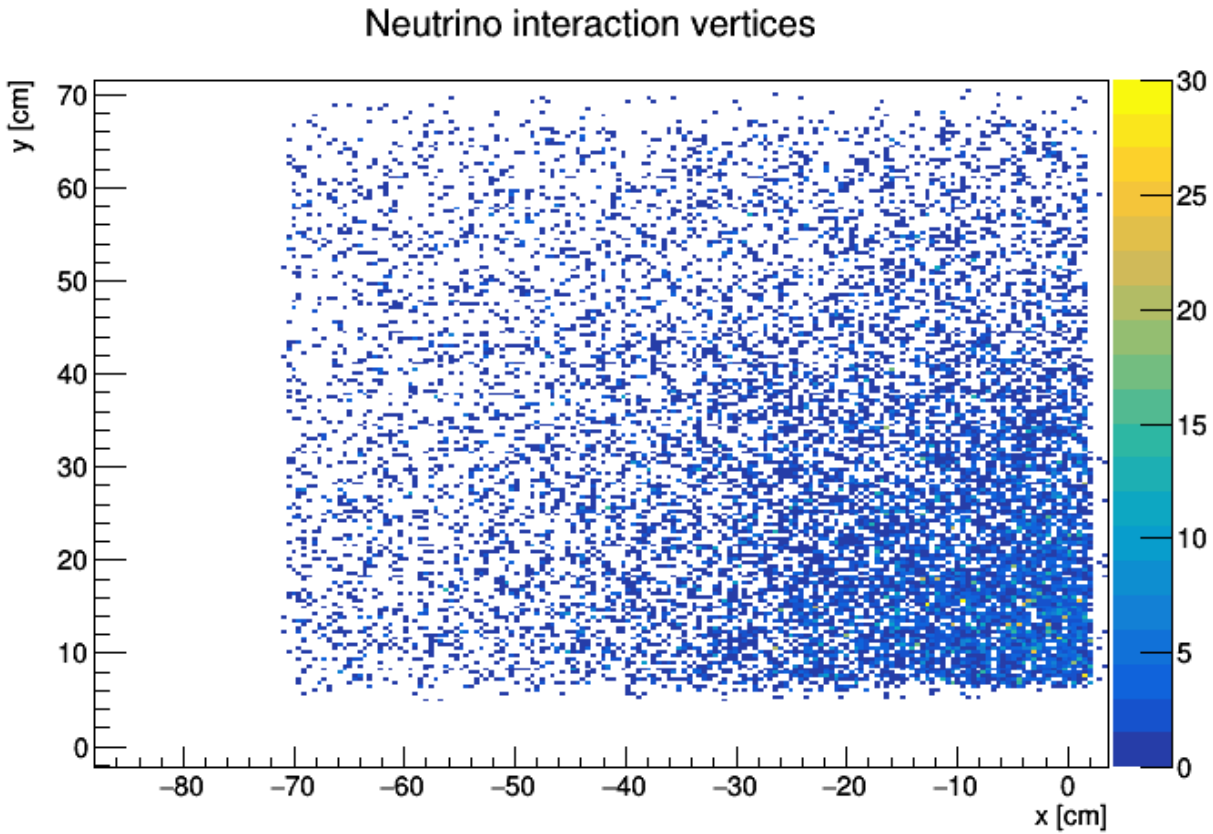
- Visible tilt of detector;
- Most interaction vertices on Fe bars (Indirect detection).

Neutrino Interaction Vertices (ZX)



- Most interaction vertices on Fe bars (less interactions on Scintillator Plates).

Neutrino Interaction Vertices (XY)



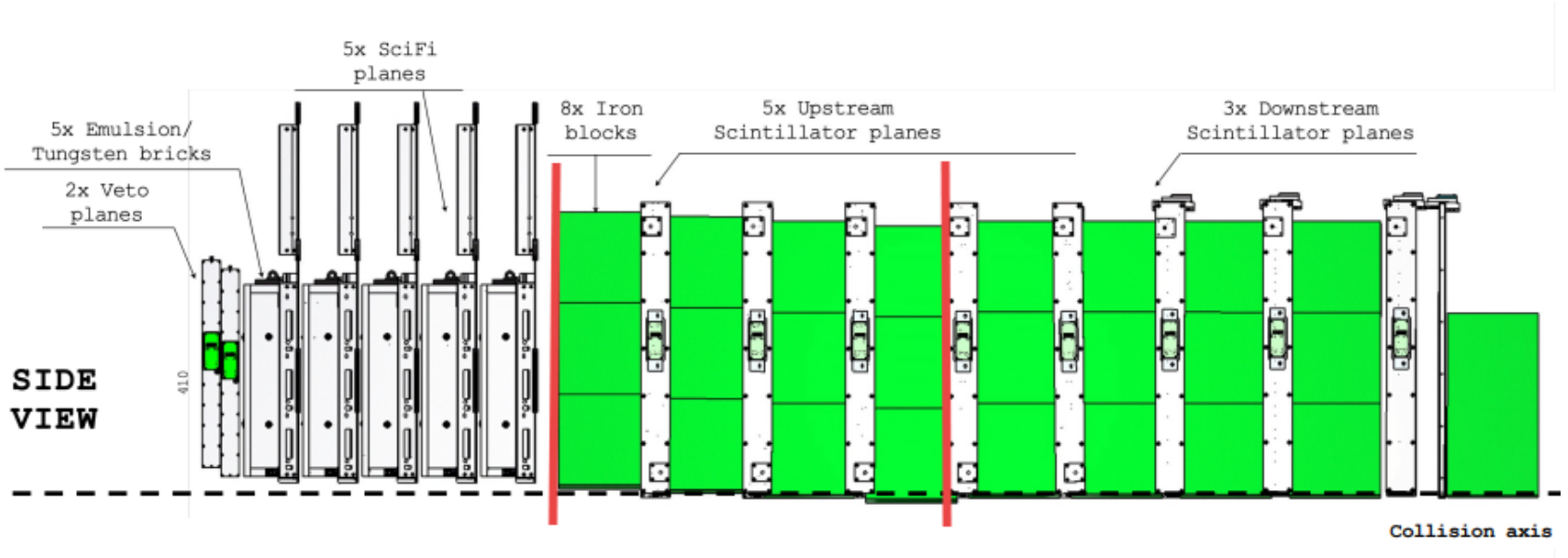
- More interaction close to (x,y)=(0,0).

How do we simulate? (Simplified)

1. Generate geometry file;
2. Use FLUKA flux files already available (Generated with Monte Carlo techniques);
3. Generate neutrino events using Genie;
4. Simulate events with Genie and Geant4;
5. Digitalize data.

18000 events were generated with these techniques.

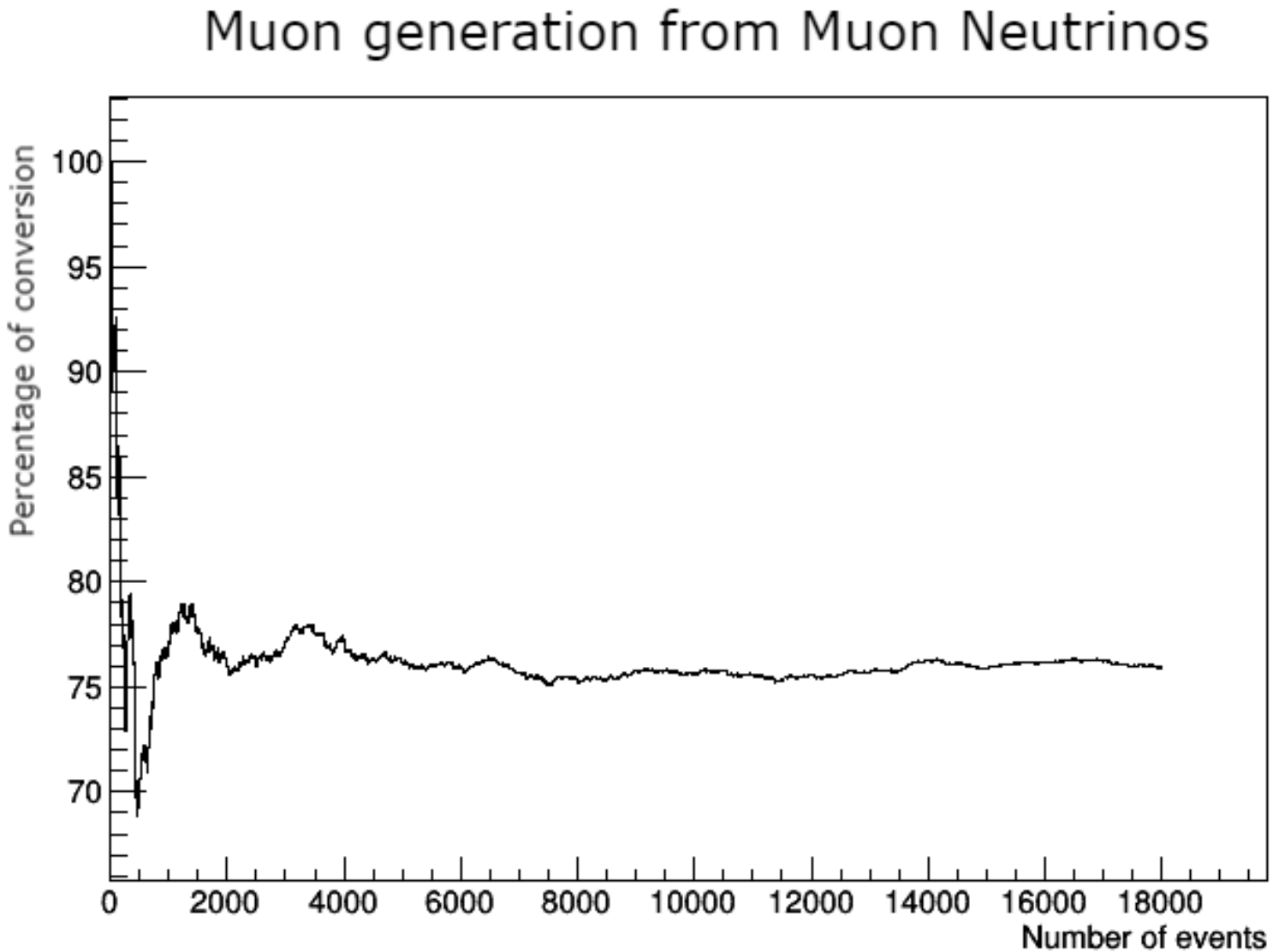
Part of Detector Used for First Interactions



Detector Efficiencies for Muon Neutrinos and Muon Anti-Neutrinos

- Hits in first 4 Iron Blocks in relation to all hits in all Muon System: 57.9%
- Next efficiencies calculated only for hits in the area mentioned above. Events with:
  - Muons Generated: 75.1%
  - Muons Detected: 19.2%
  - Muons Generated when they're detected: 92.5%

Muon Generation From Muon Neutrinos

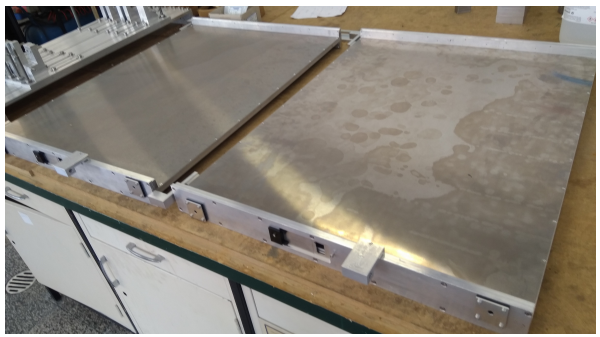


New Testbeam

- Simulate before the beam
- Similar setup to the original beam

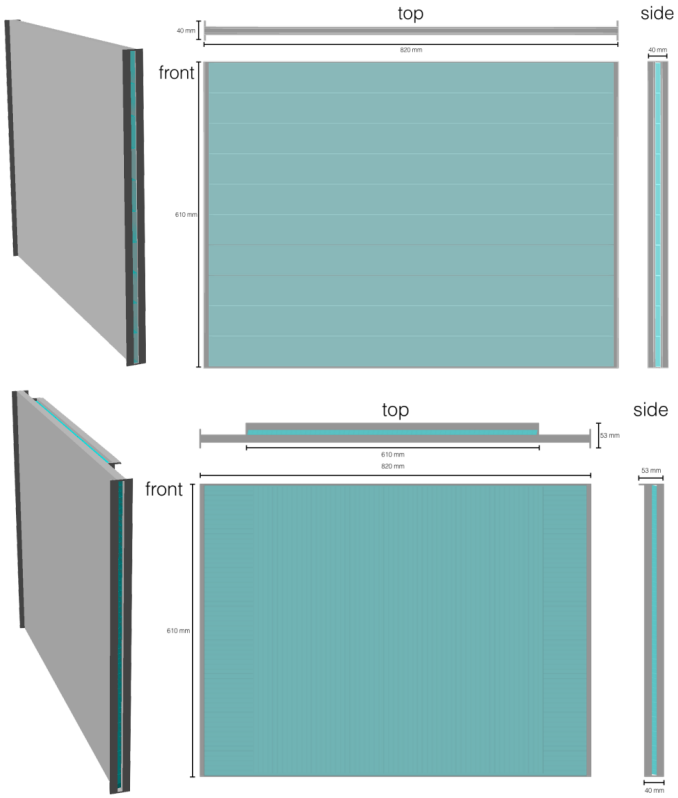
- No Veto Detector
- Emulsion Target $\rightarrow$ Iron Block

- Problem! We will only have 3 spare planes: 2 Upstream and 1 Downstream (in the making right now at LIP)



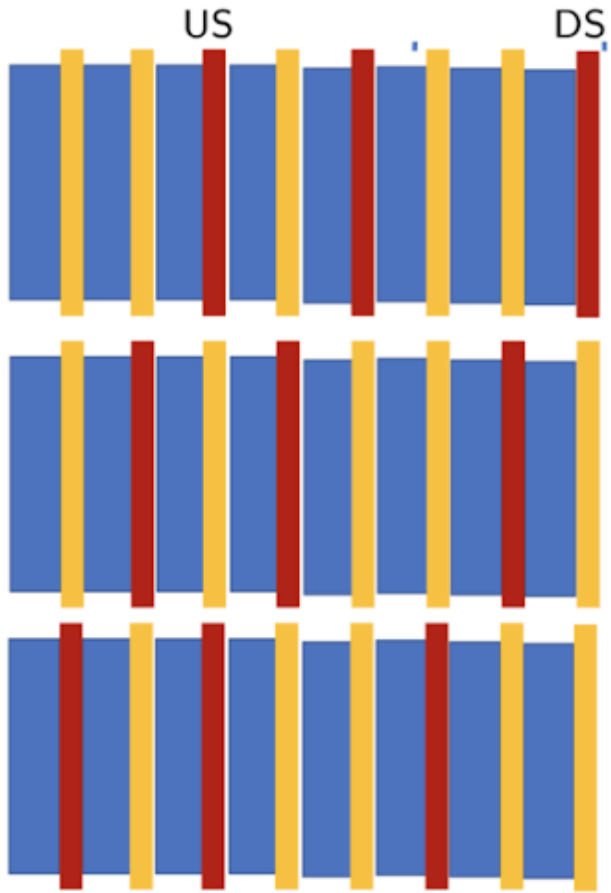
New Geometry

- Remove Veto detector
- Remove Emulsion target
- Create new iron target with *SciFi* planes to trigger events
- Muon System with 2 Upstream and 1 Downstream planes



Geometry Configurations

- Same structure everytime
- Covers the entire detector
- Collects full and comparable data
- Made with Geant4



Conclusion

- Learned about SND@LHC
- Simulated (a lot) of events
- Calculated some efficiencies
- Implemented new geometry
- Getting ready for the next test run!

- Links
  - SND@LHC Website
  - Software Repo
  - Paper Website
  - Technical Proposal