Measurement of Collider Neutrinos with the SND@LHC Experiment

7th IDPASC/LIP Students Workshop

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Scattering and Neutrino Detector

Simple but unorthodox system that detects **neutrinos generated at ATLAS**.

Detect neutrinos through scattering with an emulsion target.

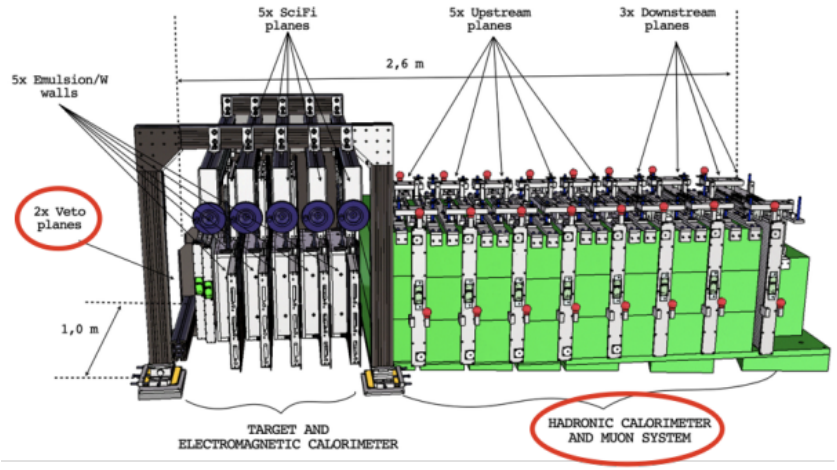
Divided in 3 parts :

- Veto System (Scintillating Bars)
- Emulsion Target
  - Emulsion Bricks
  - Scintillating Fiber Trackers
- Muon System / Hadronic Calorimeter (Scintillating Bars)

Located $\approx$ 480 m away from ATLAS IP

Shielded by $\approx$ 100 m of rock

Angular acceptance : $7.2 < \eta < 8.4$



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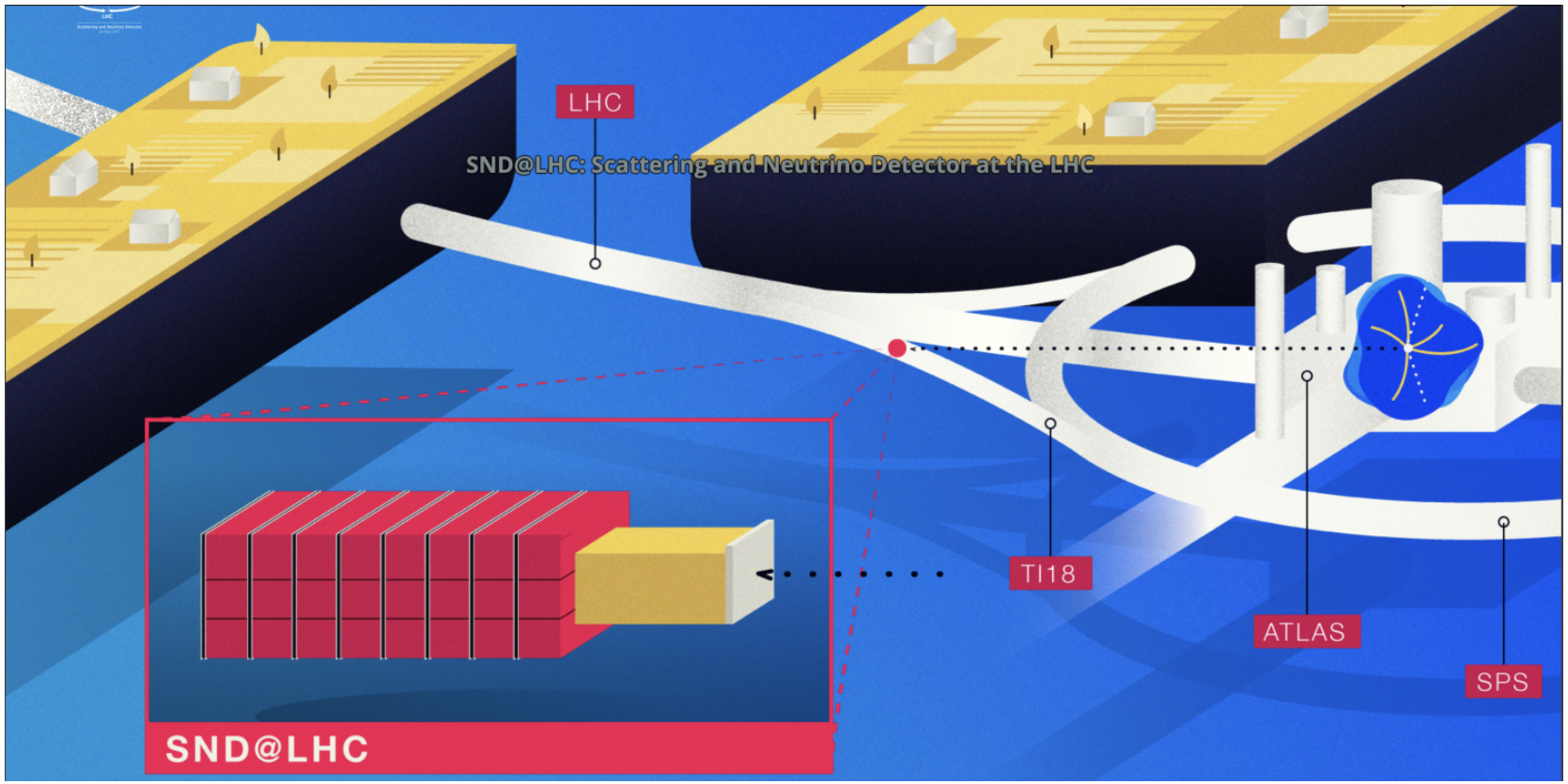

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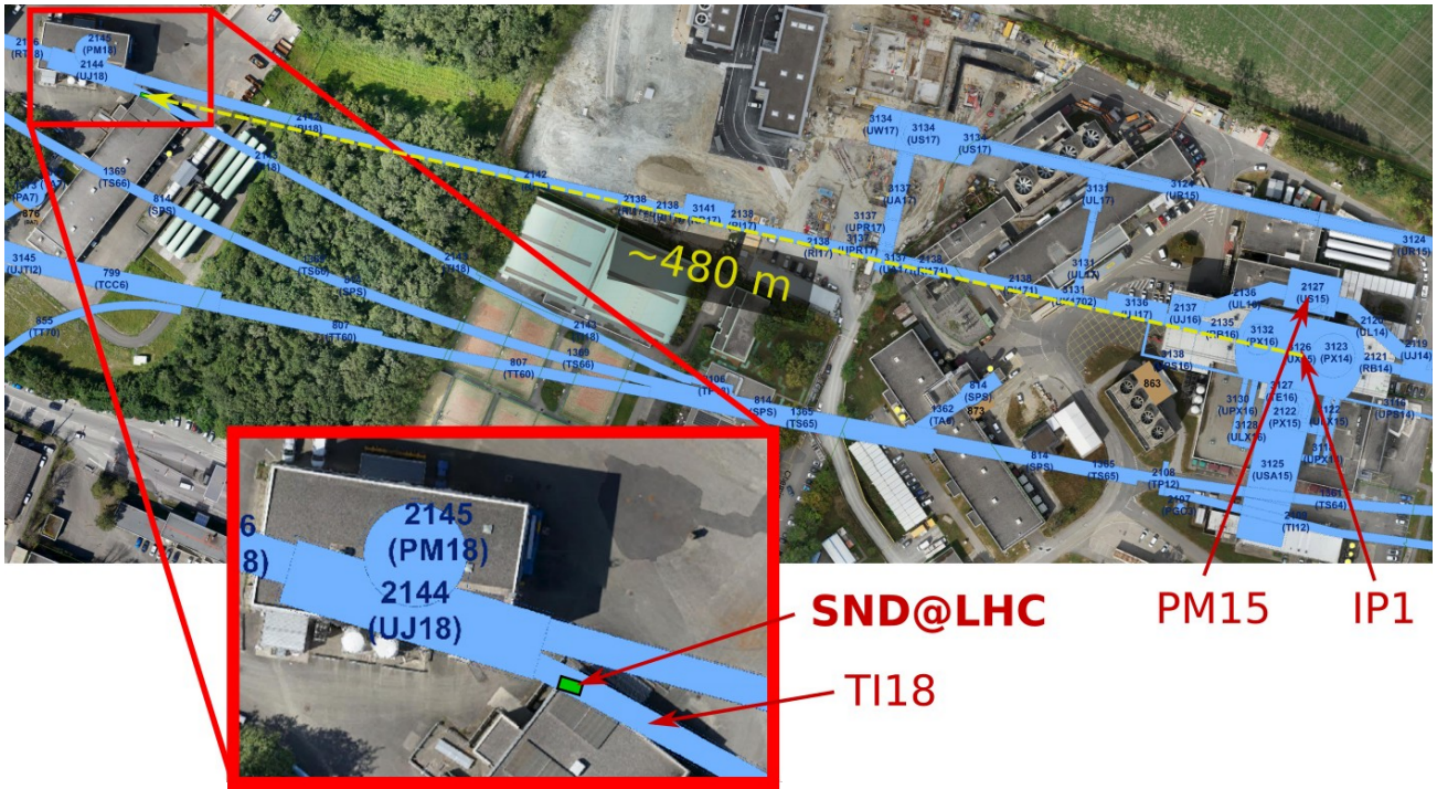
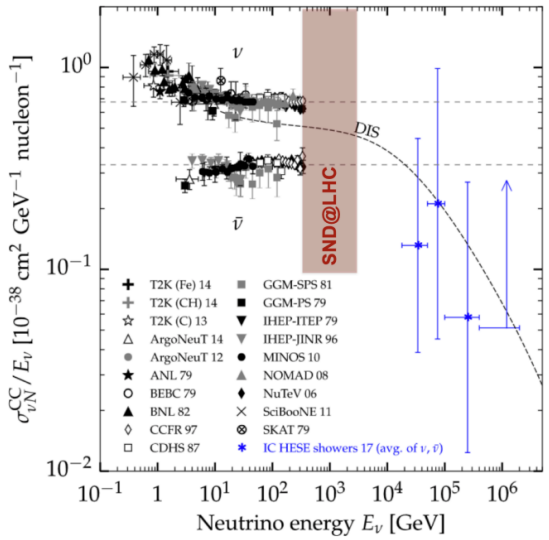
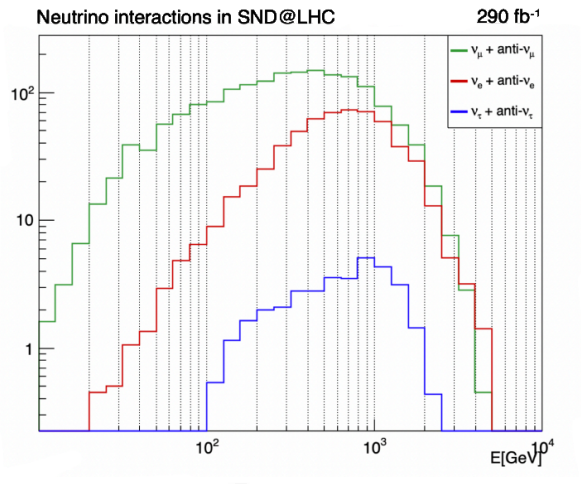


Objectives

Why build the SND ?

- Unprecedented **observation of Collider Neutrinos**
- Unexplored energy range
- Lepton Flavour Universality Test
- Measurement of charm production through pp $\rightarrow \nu X$
- Complementary to FASERν
- Proof of concept for next generation experiments



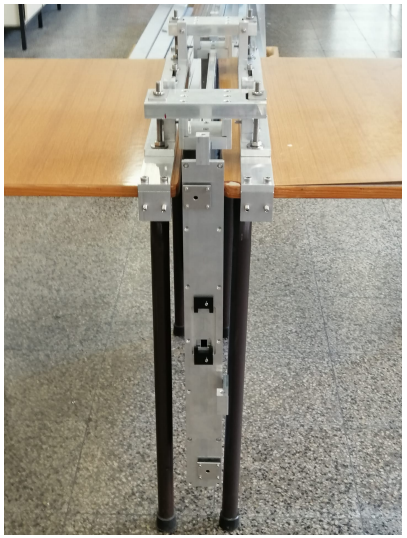


Building the Muon System

Detector was **assembled from July - October 2021**

Frames for the Muon System were produced at LIP (Coimbra)

Participated in the assembly of the Muon System trackers



Building the Muon System

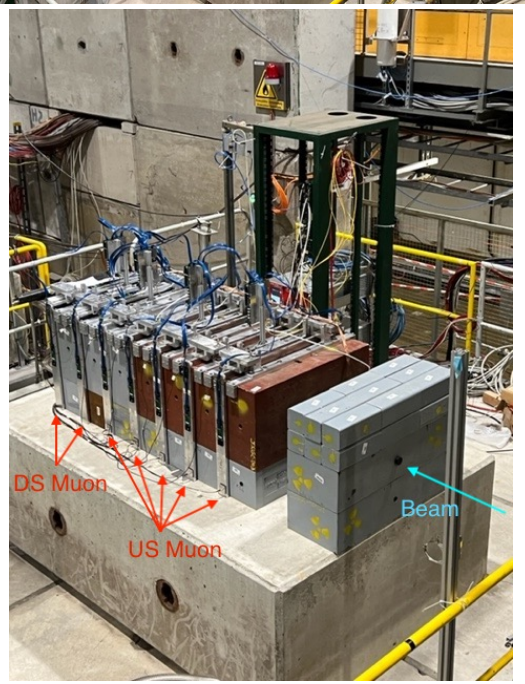




Test Beams

2 Test Beams at H8 (SPS) prior to TI 18 installation (only Muon System) :

- 1st Test Beam
  - Start : 1st September
  - Finish : 5th September
  - 1st time seeing data at all
- 2nd Test Beam
  - Start : 29th September
  - Finish : 6th October
  - 4 Pion beams with different energies
  - Varied beam luminosity
  - Different front-end electronic configurations
  - Most data for commissioning

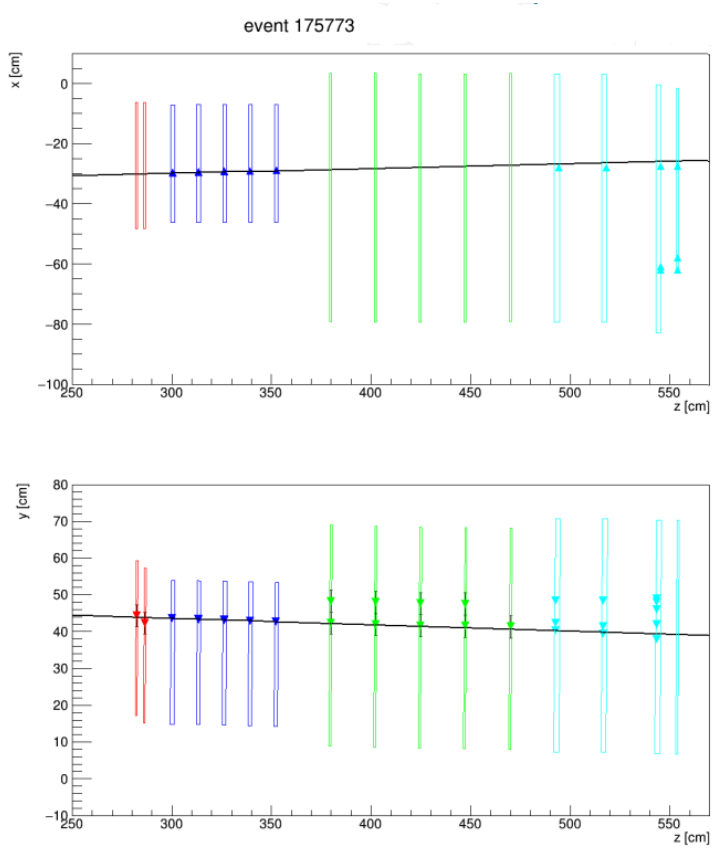


Current Status

- Detector setup at TI 18 fully functioning
- Can see particles hitting the detector (cosmic rays and stray muons)
- Neutrinos are much rarer and need specialized analysis !
- Scrubbing lights up the whole detector (everything is working !)

Commissioning still ongoing :

- Interplane position alignments
- Intraplane position alignments
- **Timing calibrations**
- Energy calibration



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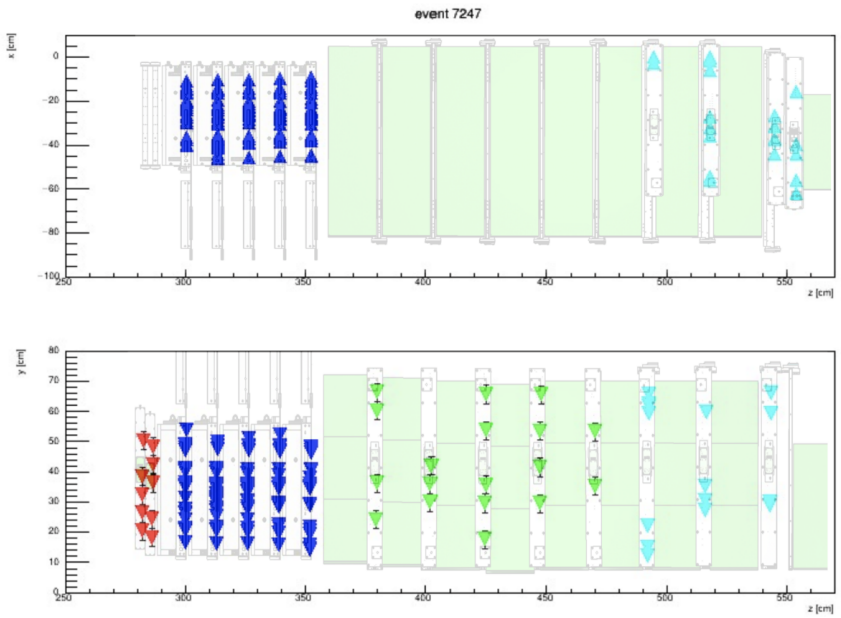
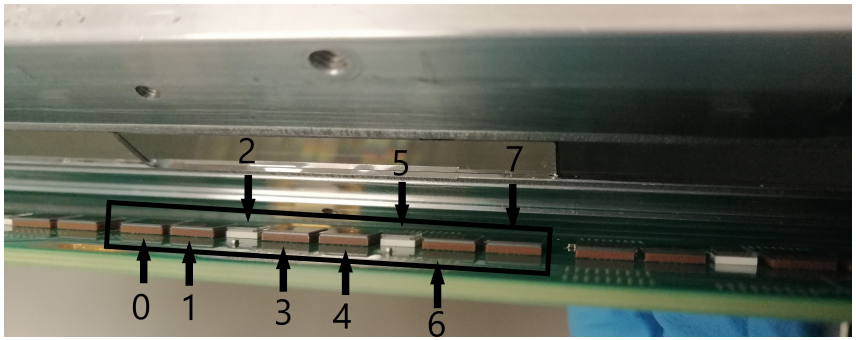


Timing Calibration

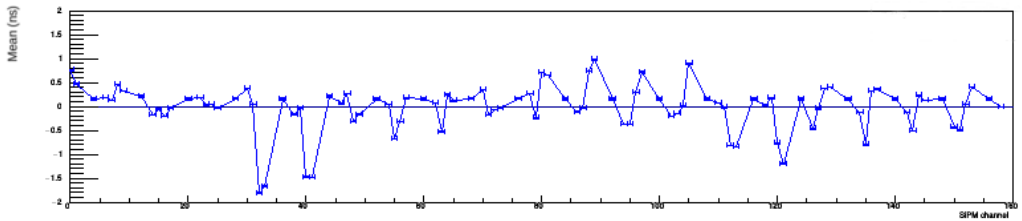
Goals :

- Find if discrepancies came from the time difference distributions (possible bad channels)
- Establish constant map to correct timing
- Do all this in an easily repeatable and automated process that can be applied both retroactively and to new data



Process

- Fit all channels
- Find the mean
- Define and refine criteria for bad fits
- Get good description of differences
- Proceed to correct channels



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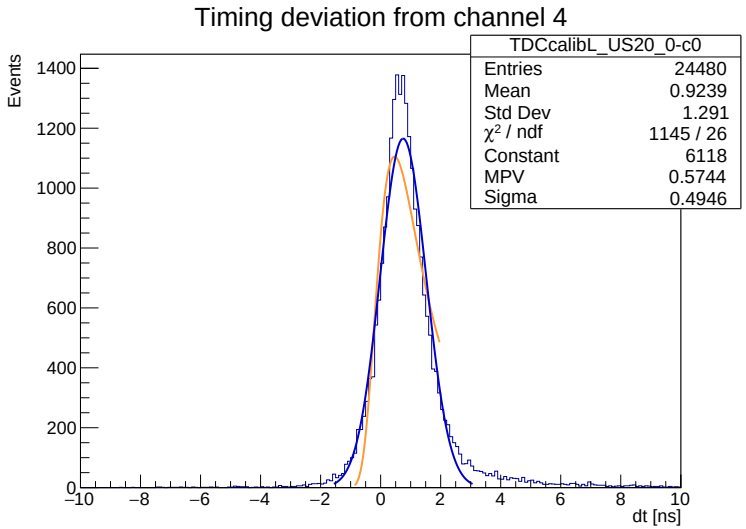

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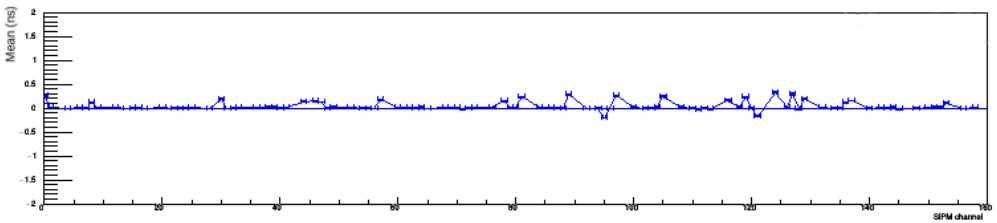

Final Remarks and Future Work

To sum it all up :

- SND@LHC has been built on a very short schedule, and is still being commissioned
- However, it is already taking data
- LIP has been heavily involved in the newest LHC experiment
- The contributions made by the group are very important

What's next ?

- Fine tune the method
- Convolute it with other time corrections
- Apply it to the incoming Run 3 data
- Publish the results
- Move on to the next thing !