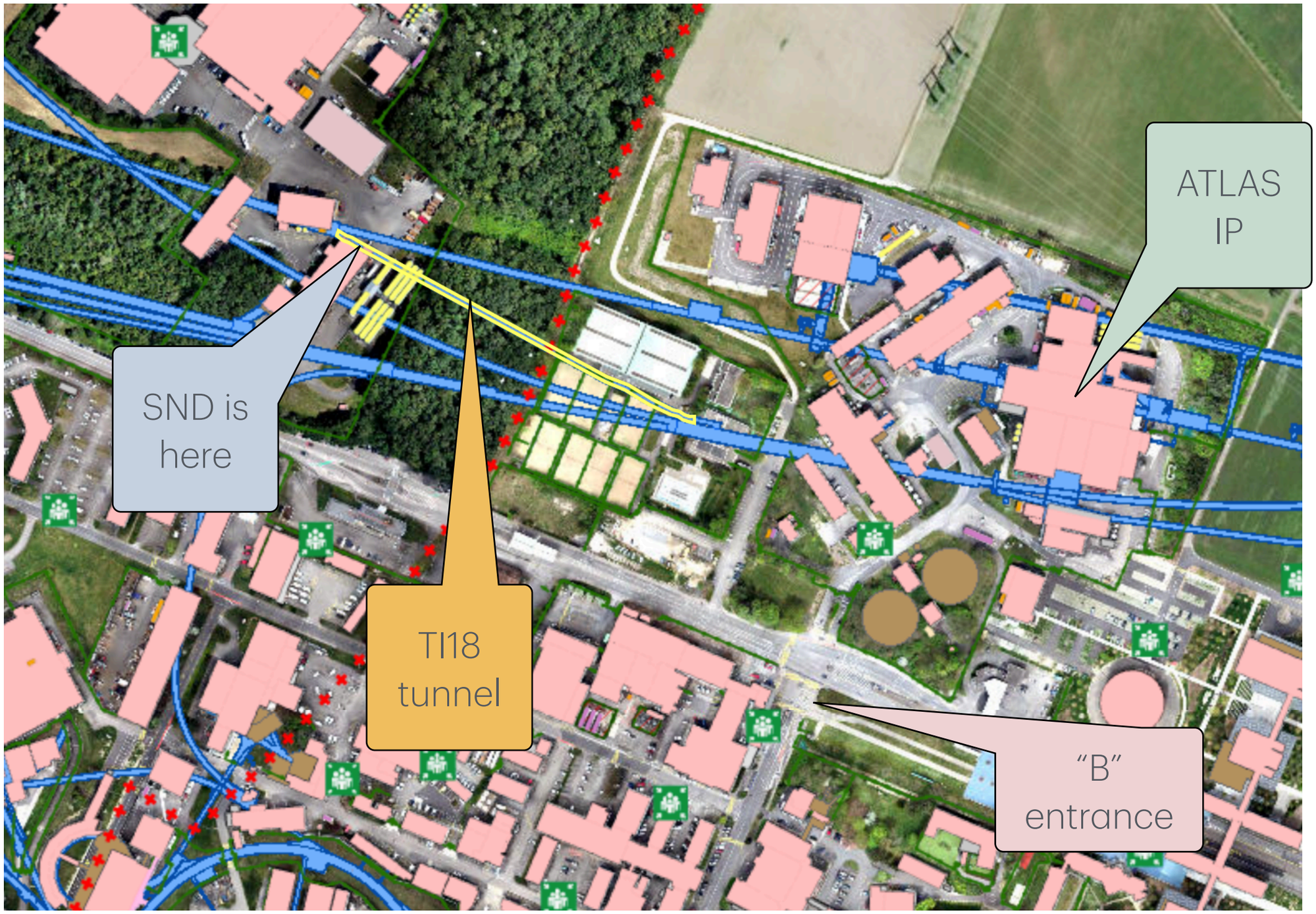
Intro

MiniDT @ SND@LHC meeting
Nov 26th 2024

Luigi Guiducci

Where is SND@LHC

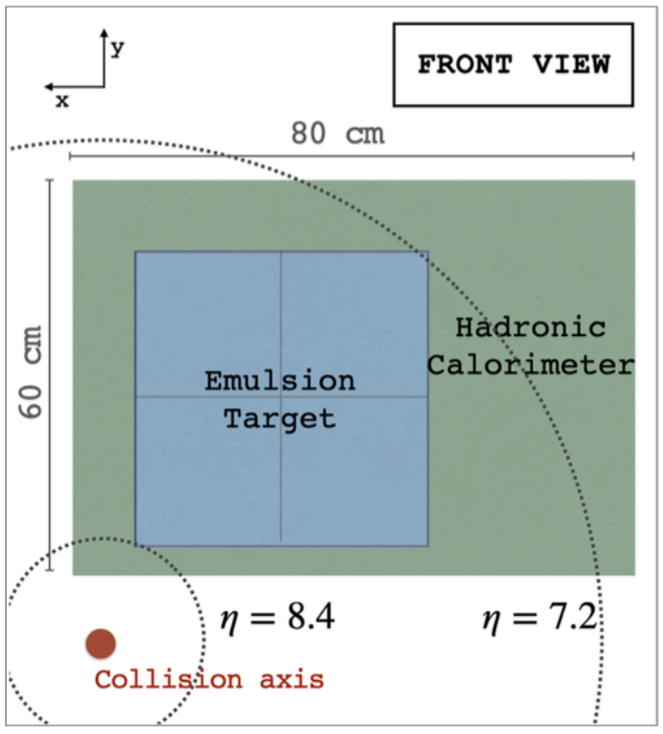


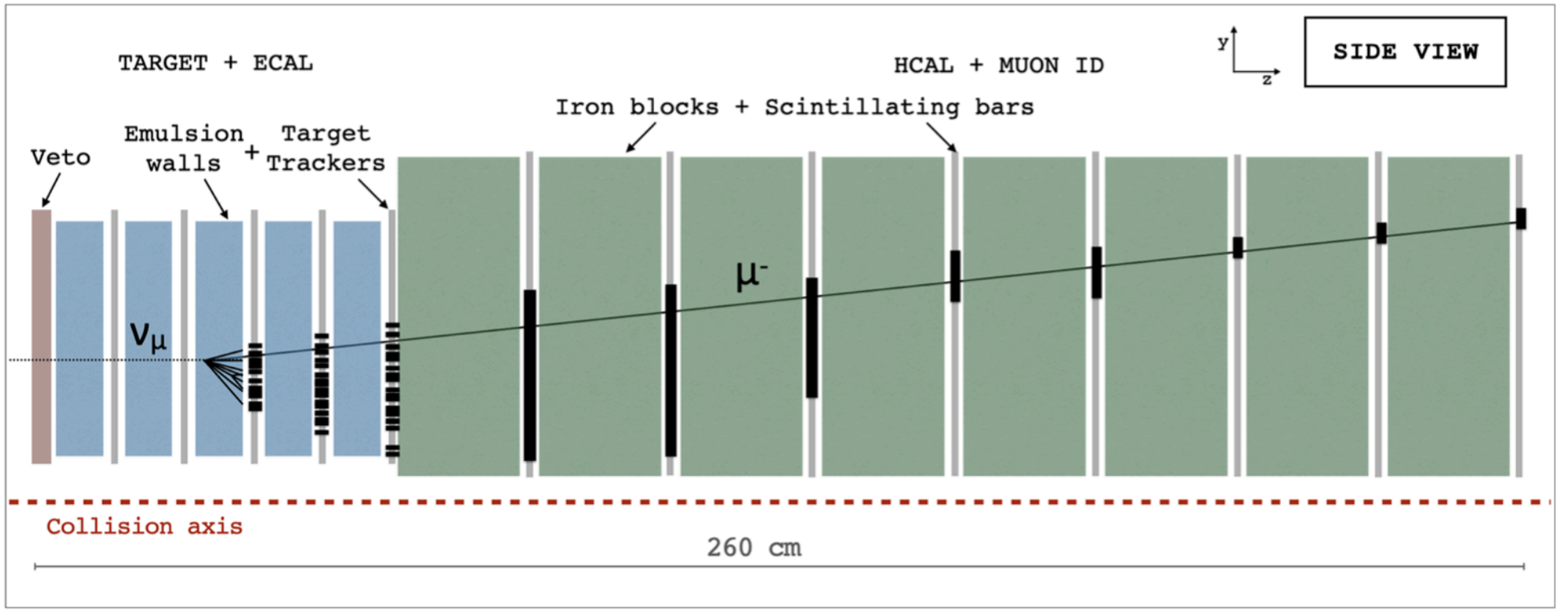
SND in TI18 pictures

older pics

newer pics

SND@LHC is a compact and stand-alone experiment to perform measurements with neutrinos produced at the LHC in a hitherto unexplored pseudo-rapidity region of $7.2 < \eta < 8.6$, complementary to all the other experiments at the LHC. The experiment is located 480 m downstream of IP1 in the unused TI18 tunnel. The detector is composed of a hybrid system based on an 800 kg target mass of tungsten plates, interleaved with emulsion and electronic trackers, followed downstream by a calorimeter and a muon system. The configuration allows efficiently distinguishing between all three neutrino flavours, opening a unique opportunity to probe physics of heavy flavour production at the LHC in the region that is not accessible to ATLAS, CMS and LHCb. This region is of particular interest also for future circular colliders and for predictions of very high-energy atmospheric neutrinos. The detector concept is also well suited to searching for Feebly Interacting Particles via signatures of scattering in the detector target. The first phase aims at operating the detector throughout LHC Run 3 to collect a total of 290 fb^{-1}. The experiment





PHYSICAL REVIEW LETTERS **131,** 031802 (2023)

Editors' Suggestion

Observation of Collider Muon Neutrinos with the SND@LHC Experiment

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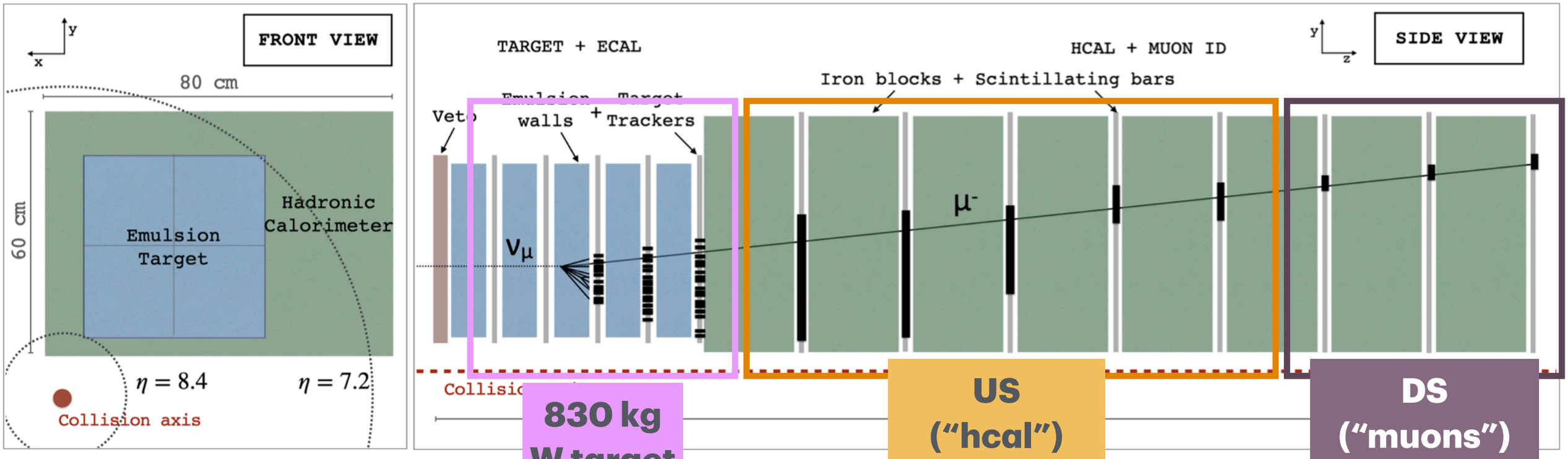

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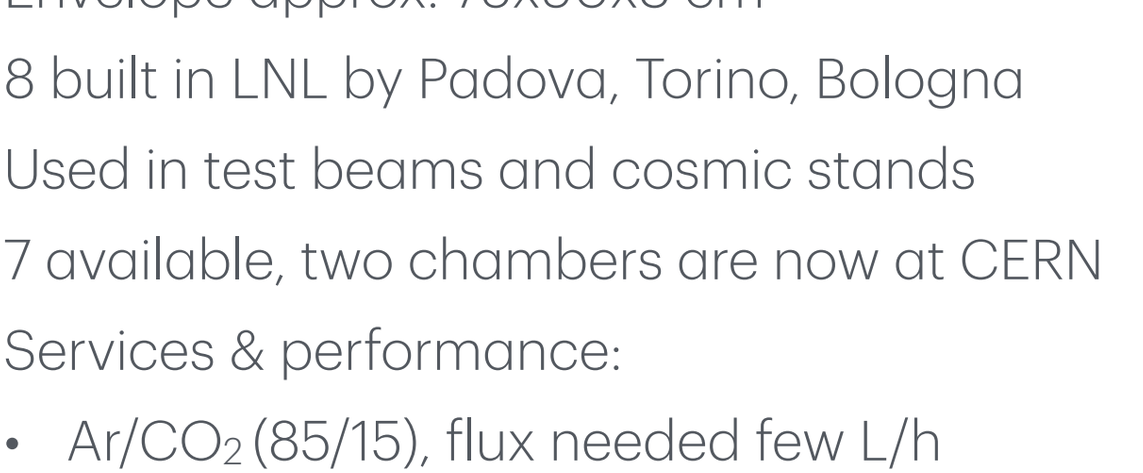
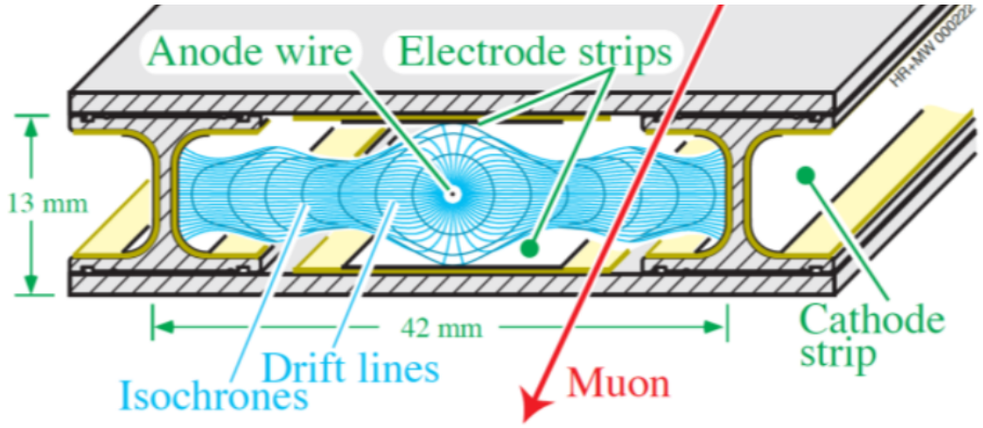
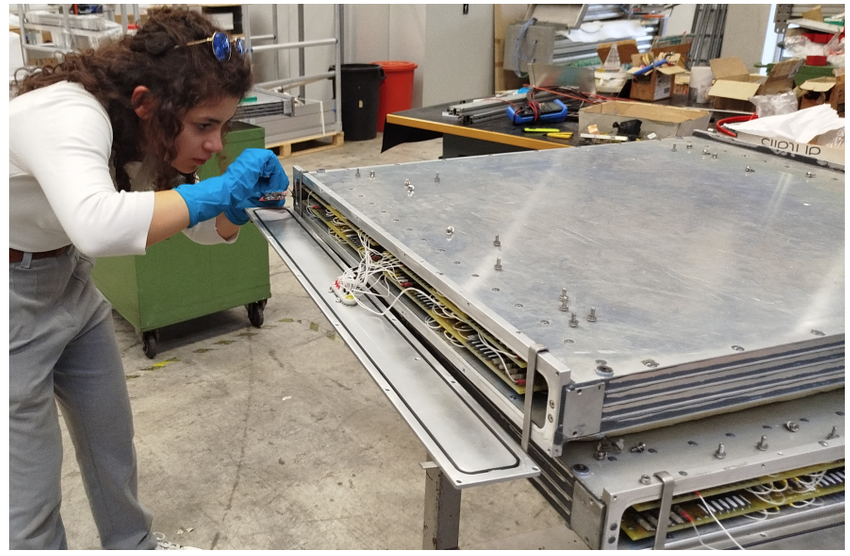
Observation of Collider Muon Neutrinos with the SND@LHC Experiment

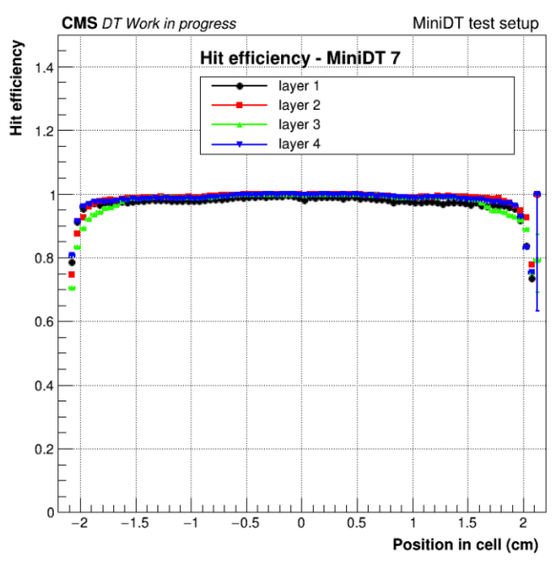
MiniDT chambers

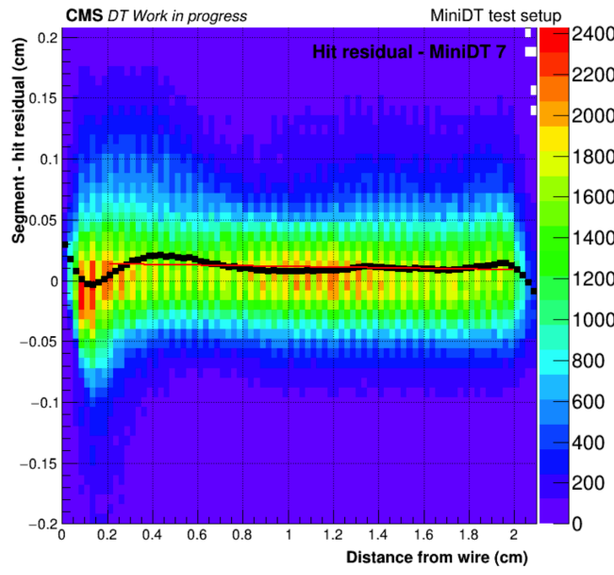
- MiniDT = small (4x16=64 channels) super layer of CMS Drift Tubes
- Envelope approx. 75x90x8 cm^3
- 8 built in LNL by Padova, Torino, Bologna
- Used in test beams and cosmic stands
- 7 available, two chambers are now at CERN
- Services & performance:
  - Ar/CO_2 (85/15), flux needed few L/h
  - HV(3600,1800,-1200), LV(12V), I2C control
  - max drift time ~400 ns,
    good space-time linearity
  - >95% hit efficiency, ~250 um resolution
  - Segments: position ~150 um, angle ~10 mrad





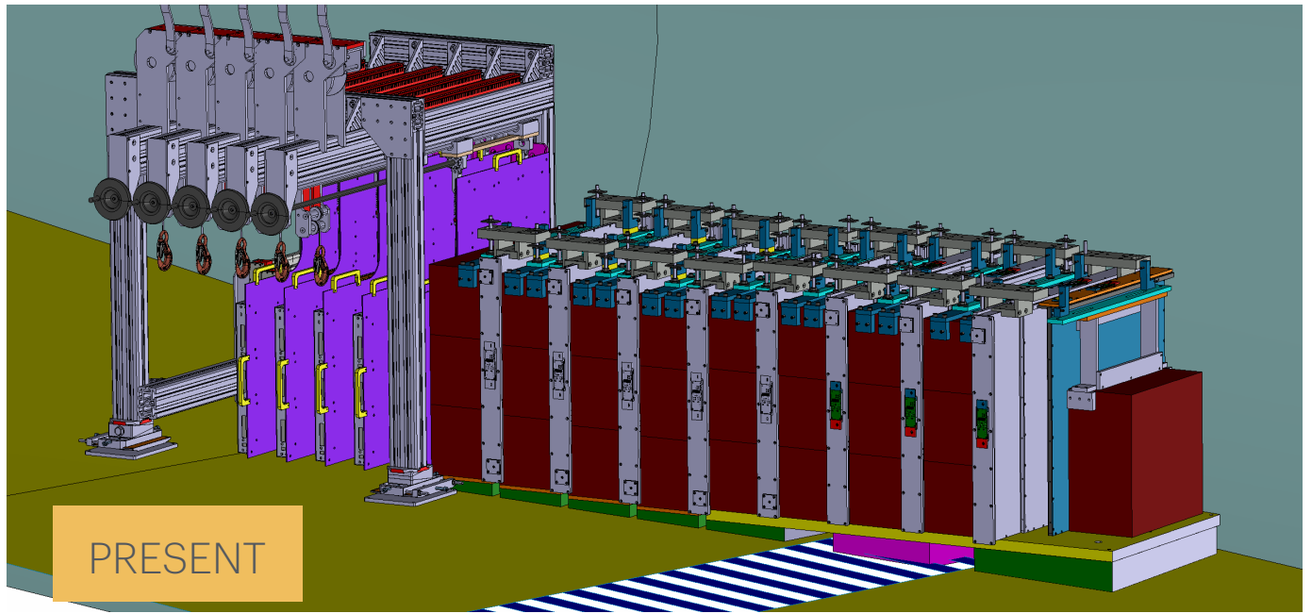


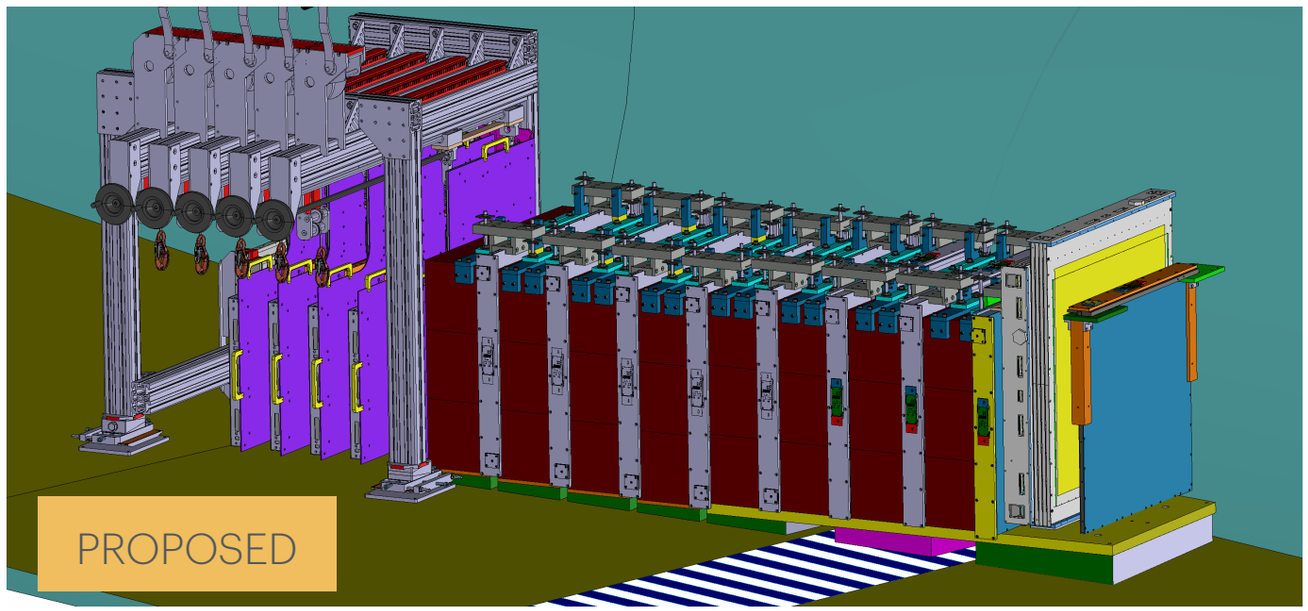




Proposal: MiniDTs in SND@LHC

- Space available behind DS3/4 for the installation of **two (x,y) chambers** with minimal changes to existing structures
  - Achieves ~85% **coverage of target** projection along z axis (wall, floor constraints)
- Improved tracking translates into a tighter matching of back-extrapolated muon tracks with SciFi hits (residuals from > 3 cm r.m.s. to ~ 1.3 cm r.m.s)





Muon flux & data rate

Muon flux at the DS system: 2.35 ± 0.01(stat) ± 0.10(sys) × 10^4 fb/cm^2 [from https://doi.org/10.1140/epjc/s10052-023-12380-3]

$$\text{Muon Flux} = 2.35 \pm 0.01(\text{stat}) \pm 0.10(\text{sys}) \times 10^4 \text{ fb/cm}^2$$

$$\text{Area} \simeq 60 \times 70 \text{ cm}^2 = 4200 \text{ cm}^2$$

$$\text{Inst. Lumi} \approx 2 \times 10^{34} \text{ cm}^{-2}\text{s}^{-1}$$

$$\text{Rate} = (\text{Muon Flux})(\text{Inst. Lumi})(\text{Area}) \simeq 1.7 \text{ kHz}$$

Two MiniDTs = 8 layers. Put a factor of 10 for safety, noise. Total hit rate

$$\text{Hit Rate} = (\text{Rate})(\text{Layers})(\text{Safety}) < 140 \text{ kHz}$$

One hit = 64 bits. So the data rate

$$\text{Data Rate} = (\text{Hit Rate})(\text{bits/Hit}) < 9 \text{ Mbit/s}$$

Schedule?

- Chambers + services @ CERN since Nov 18th
  - Retesting with cosmics and CMS readout @ P5 in next weeks
- Standalone test of readout system: before the end of 2024?
- Integration test with SND DAQ slice accomplished: early Jan 2025?
- End of mechanics and gas system design: end 2024?
- End of mechanics production: end Jan 2025?
- End of gas system preparation: mid Feb 2025?
- Other services preparation ended: mid Feb 2025?
- Ready for installation: end of February 2025

Summary

- Good opportunity to improve SND@LHC physics
- Good opportunity to exercise in a different environment, with 24/7 running & monitoring, a piece of CMS DT Phase2 upgrade
- Good opportunity for students to see detector, electronics, integration issues etc before the end of Run3
- I hope we're having fun!

- NB: next week SND collaboration week, including a tutorial on SND offline simulation & analysis software. Consider joining if you're interested!

Today

MiniDT @ SND@LHC

Tuesday 26 Nov 2024, 16:00 → 18:00 Europe/Zurich

zoom MiniDT @ SND@LHC — Join

16:00 → 16:10 **Introduction** — 10m
Speaker: Luigi Guiducci (Universita e INFN Bologna (IT))

16:10 → 16:20 **MiniDT@SND simulation** — 10m
Speaker: Giulia Paggi (Universita e INFN, Bologna (IT))

16:20 → 16:35 **Mechanics** — 15m
Speaker: Antonio Crupano (INFN Sez Bologna)

16:35 → 16:50 **Gas system** — 15m
Speaker: Domenico Dattola (Universita e INFN Torino (IT))

16:50 → 17:05 **Readout system** — 15m
Speakers: Alvaro Navarro Tobar (CIEMAT - Centro de Investigaciones Energéticas Medioambientales y Tec. (ES)), Cristina Fernandez Bedoya (CIEMAT - Centro de Investigaciones Energéticas Medioambientales y Tec. (ES)), Casimiro Baldanza (Universita e INFN, Bologna (IT))

17:05 → 17:20 **MiniDT@SXA5** — 15m
Speakers: Luigi Guiducci (Universita e INFN Bologna (IT)), Giulia Paggi (Universita e INFN, Bologna (IT)), Licia Mozzina (Universita e INFN, Bologna (IT)), Ignacio Redondo Fernandez (CIEMAT - Centro de Investigaciones Energéticas Medioambientales y Tec. (ES))

17:20 → 17:35 **TTC/DAQ/DCS test and integration plans** — 15m
Speakers: Federico Cindolo (Universita e INFN, Bologna (IT)), Daniele Fasanella (Universita e INFN, Bologna (IT))