



NP04

status and plans

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Filling order (I)

In the past several months recommendations from SPSC, LBNC and DUNE EB to prioritise the program of the NP02 VD detector (functional integration still to be demonstrated)

- Initial plan to expose both NP02 and NP04 to beam in 2024 is no longer plausible due to the lack of availability of LAr in 2023.

Dedicated Task-Force appointed to evaluate in pros and cons of two alternative options

1) Fill first NP04 for a beam test in spring 2024 before transferring the LAr to the NP02:

- This would allow for a rapid completion of the scientific program started in 2018
- Validate the latest design changes of the HD detector configuration
- More time to finalise the NP02 (guarantee adequate performance of the detector)

2) First fill of NP02 (without beam) to complete integration tests before the end of the summer:

- Enabling a series of PRRs scheduled in Jun/Jul
- Move LAr to NP04 for beam test around end of September
- Eventually transferring back LAr to NP02 in 2025, with the opportunity to install at a later stage beam instrumentation and optimised detector components

Filling order (II)

Report from the Task-Force released at the end of 2023

- The task-force urges the Collaboration ... to start as soon as the Liquid Argon becomes available purging and filling NP04, allowing to complete the critical validation program of the VD detector components and of its integration.
- This recommendation is based on the need of minimizing all the risks that may incur either during production, integration and installation, and that may impact the performance of the final DUNE VD detector during operations
- It is the opinion of this Task-Force that the impact on the construction schedule of the VD detector is minimal or none.

The DUNE Executive Board endorsed the report recommendations on 20th of Dec:

- An additional point was raised on the need of guaranteeing beam data to students and younger physicists in the Collaboration to allow them to complete adequate analyses, which wouldn't be necessary possible if NP02 is filled first in the early spring, not having the possibility of installing the beam plug in the cryostat nor having the required the beam instrumentation

Liquid argon procurement

No availability of LAr in 2022. In 2023 price estimates ~4x prices of 2021:

- Followed price development in 2023 through informal estimates from European suppliers
- Tendering process initiated in October (invitation of 13 both EU and US suppliers)
- Tendering completed successfully. Price accepted after negotiation
- Cost of LAr covered by US LBNF/DUNE
- Detailed delivery schedule in definition, starting from late February
- TE-CRG group started the recommission of the cryogenic system in January

Additional liquid argon required to top up NP02 after transferring the bulk from NP04
Procurement of this second batch will start once the timeline of NP02 is defined

Liquid argon procurement

LAr procurement contract signed in January.

Kickoff meeting held on Friday 26th of January.

First two trucks expected on the 20th and 22nd of February

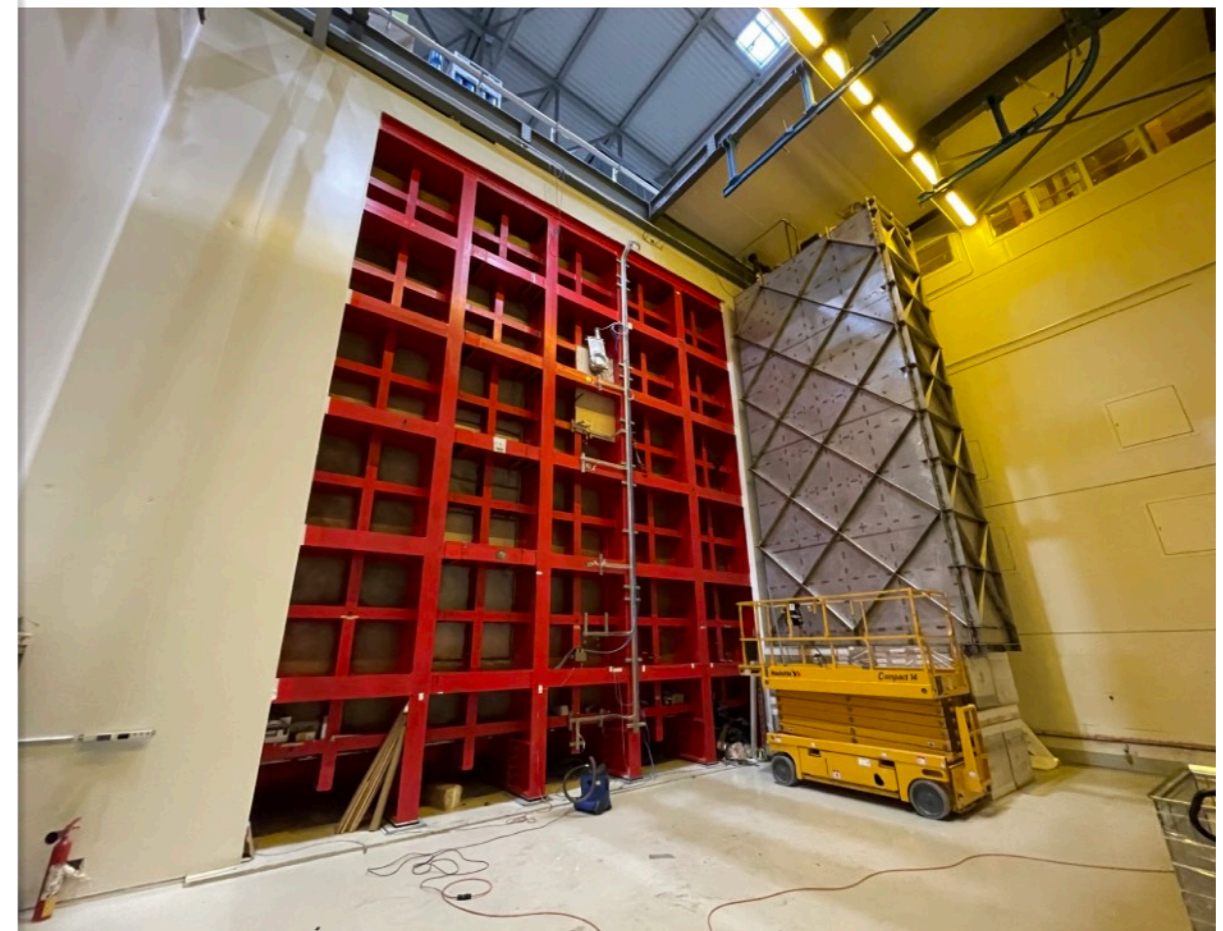
Nominal deliveries from the 4th of March:

- 5 containers/week by train to Lyon, and by truck to CERN
- 2 trucks/week in addition
- max two deliveries/day
- lower delivery rate than expected <160 ton/week instead of 200 ton/week
- 6 weeks of filling
- purification to reach ~3 ms (100 ppt O₂^{eq}):
 - * 2 weeks from 2 ppb O₂^{eq},
 - * 3 weeks from 10 ppb O₂^{eq}

NP04 TCO closure

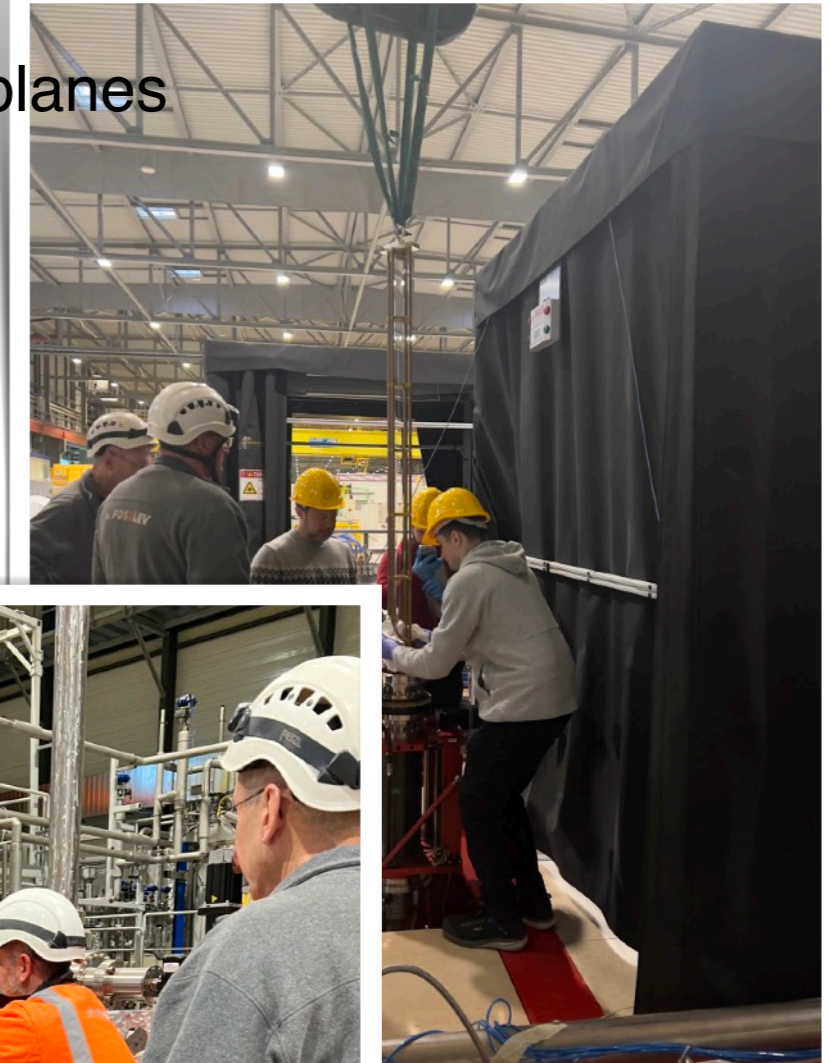
Completed before end of the year break

- Setup a physical separation and appropriate ventilation to avoid dirt into the detector
- Installation of tertiary barrier, insulation, secondary and primary barriers
- No leaks found after reparation of one found during the leak tests with He
- Insulation space under moderate vacuum
- Zone cleaned and dirty room dismantled

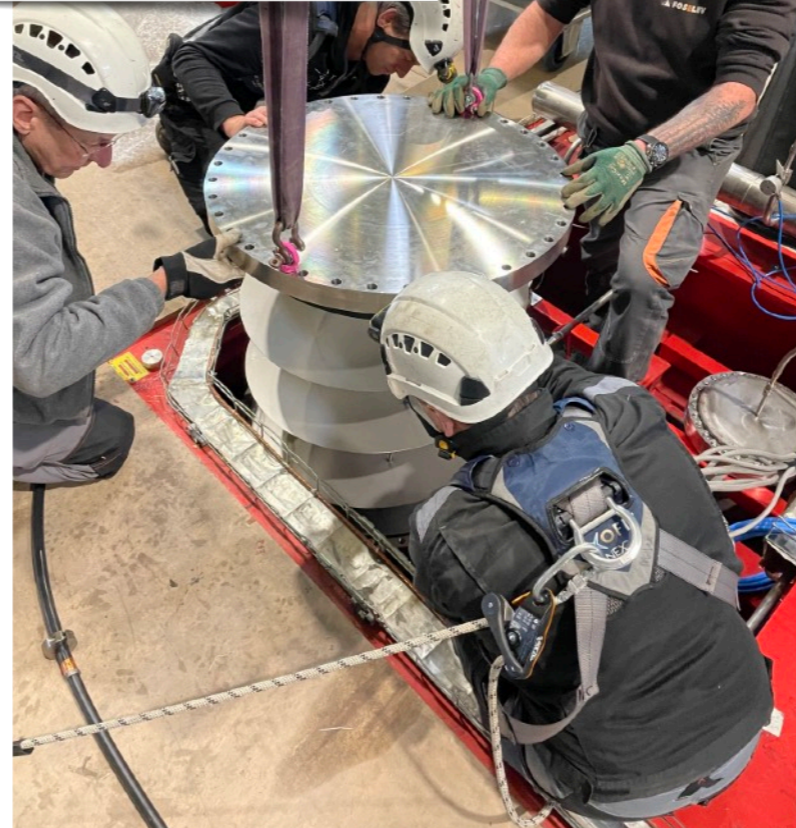
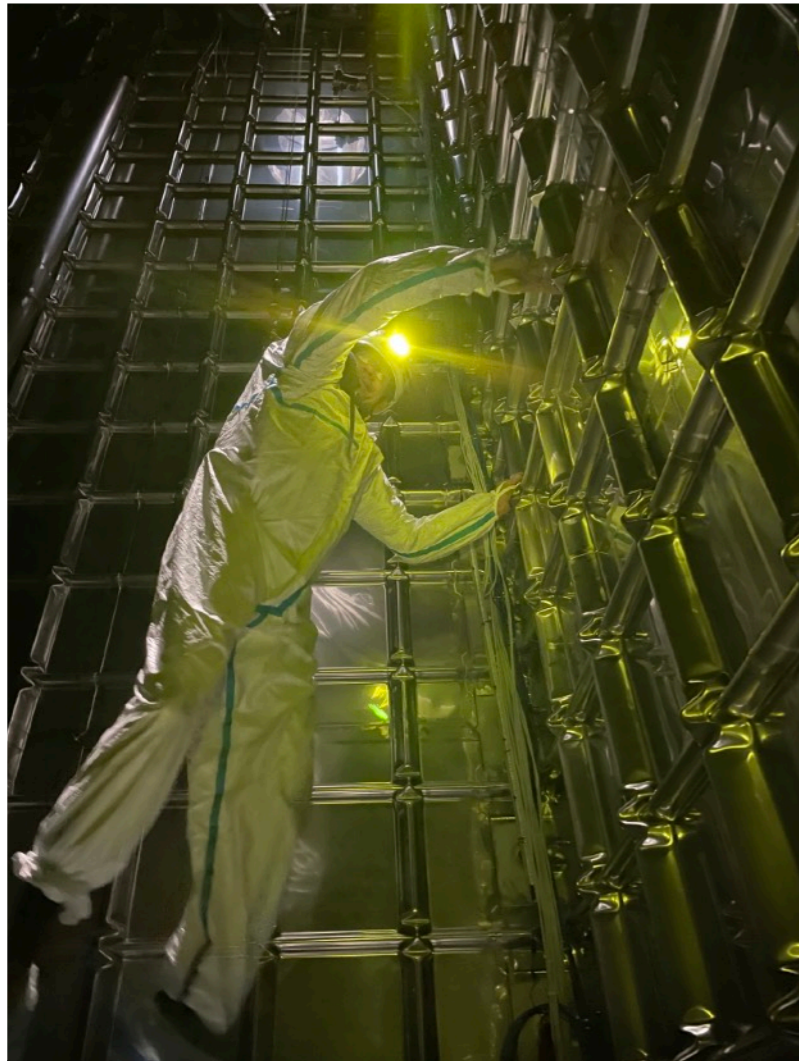
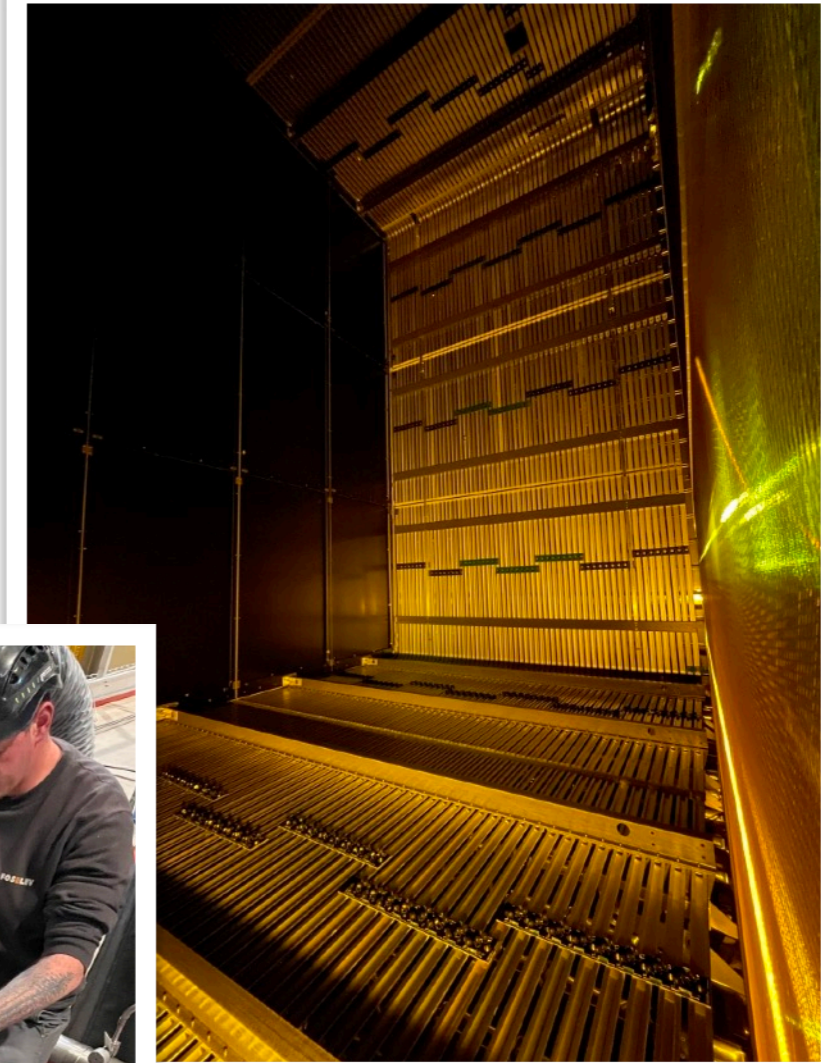
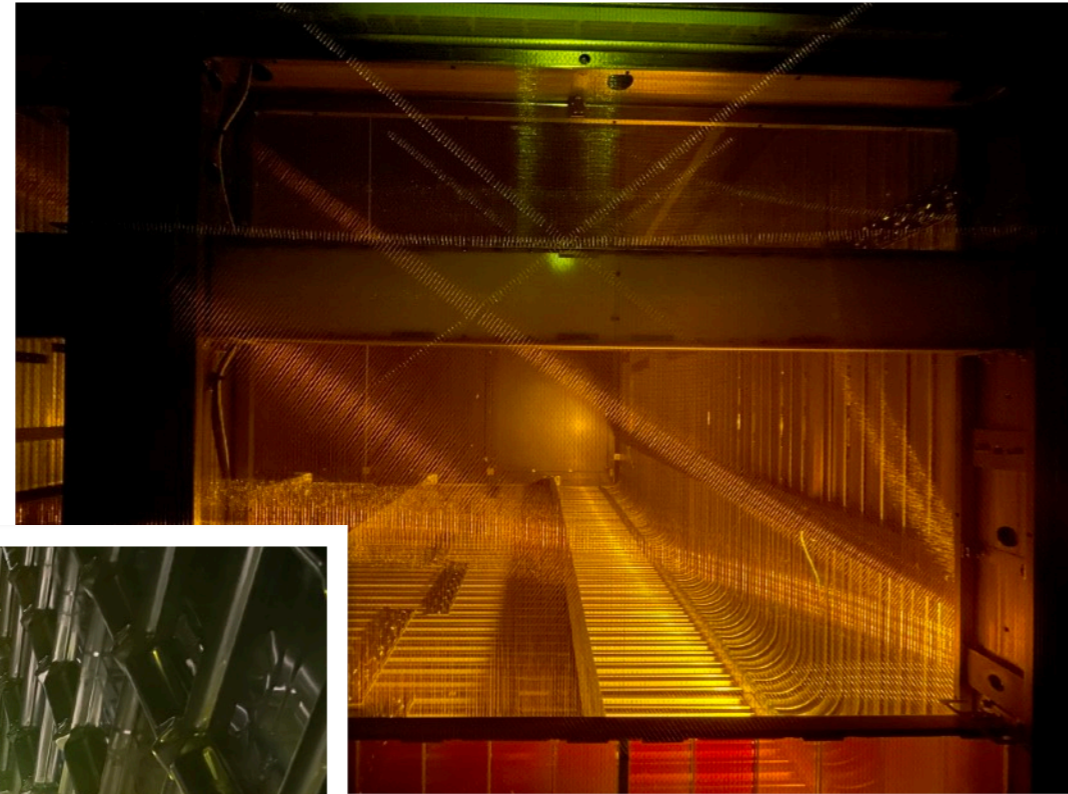


Steps after TCO closure

- ✓ - HV test (up to 15kV)
- ✓ - Removal of the false floor, installation of the missing ground planes
- ✓ - Installation of the cameras and lights
- ✓ - Installation and alignment of the Ionisation Laser Periscopes
- ✓ - Installation of the Purity Monitor
- ✓ - removal of APA protection panels and false floor
- ✓ - Installation of the ^{207}Bi source on cathode
- ✓ - Sealing of all flanges
- ✓ - Remove of access scaffolding
- ✓ - installation of CRTs
- ✓ - Installation of beam platform



Lasts steps



Cryogenic commissioning

- ✓ - Activated the maintenance contract
- ✓ - Check and refurbish the vacuum insulation (lines and boxes)
- ✓ - Pirani vacuum sensors calibrated or changed
 - Control functionality of all the valves (replacing connectors, calibrating) - ongoing
- ✓ - Global check of control system
- ✓ - Check alarms propagation towards other systems (evacuation, CV, access, FB, ...)
- ✓ - Refurbish redundant compressed air circuit
 - Check of Protego valve functionality (ongoing)
 - Filter regeneration (LAr completed, the other ongoing)
- ✓ - All safety valves leak tested and calibrated
- ✓ - Check power line for LAr pump

Beam request

Beam request for 8 weeks (before end of August) submitted to the SPSC in December
Beam request for NP02 will be done for 2025

High precision measurements of hadron-argon cross sections are very important to understand

- final-state interactions of hadrons within the argon nucleus,
- the secondary scattering of primary hadrons produced in neutrino interactions.

Two of the largest systematic uncertainties in long-baseline neutrino oscillation experiments.

Integrate the data taken in 2018 concentrating on low momenta (~ 1 GeV/c) and including both polarities (in 2018 only positive polarity was taken). Main goals:

- Benchmark the performance of the detector (PID, calorimetry with charge and light)
- Characterisation of the detector response and energy resolution to pions and protons
- Inclusive and exclusive pion and proton cross sections
- Differential cross sections for a number of different final states as a function of the child particle kinematics

Beam in the North area expected to start on April 17th

SPSC met last week. Informal:

- SPSC will support our request, but 8 weeks will not be granted
- concern with the 2 weeks requested for measurements with 1 GeV/c kaons
- request details on the run plan and minimal beam operation