

Prospettive per la fisica del neutrino da acceleratori (a CT)

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European Strategy for Particle Physics

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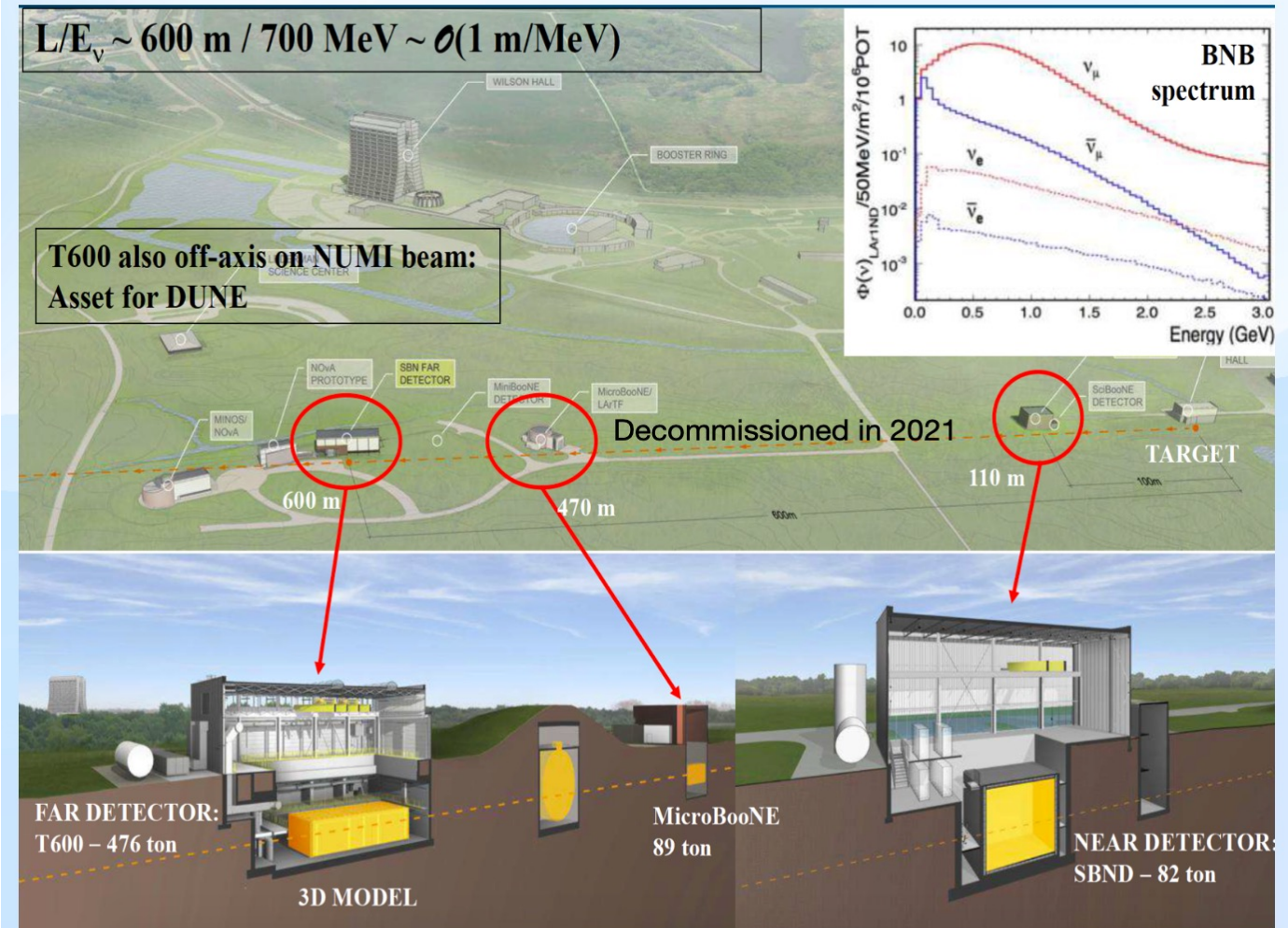
ICARUS

High-granularity Liquid Argon Time Projection Chamber (LArTPC), located at shallow depth along the Booster Neutrino Beam (BNB) at Fermilab.

GOALS

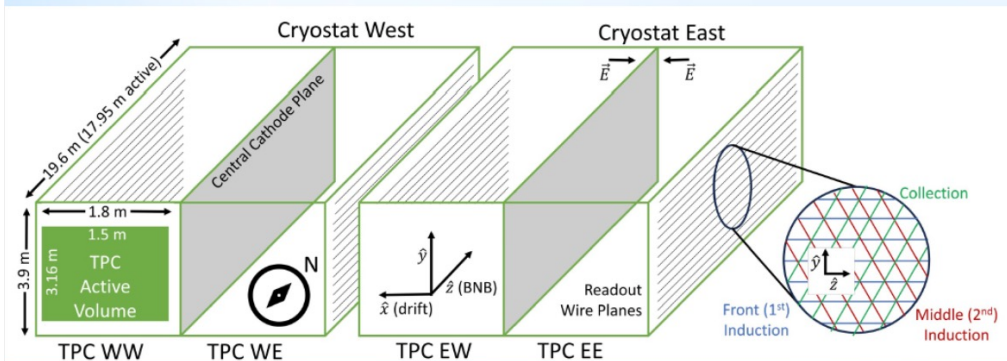
- definitive search on the existence of eV-scale sterile neutrinos with world-leading sensitivity in both the ν_e -appearance and ν_μ -disappearance channels
- rich stand-alone program on ν -Ar cross-sections and on the search for a Neutrino-4-like anomaly at the BNB and with the off-axis Neutrinos from the Main Injector (NuMI) beam

SBN Experiment Overview

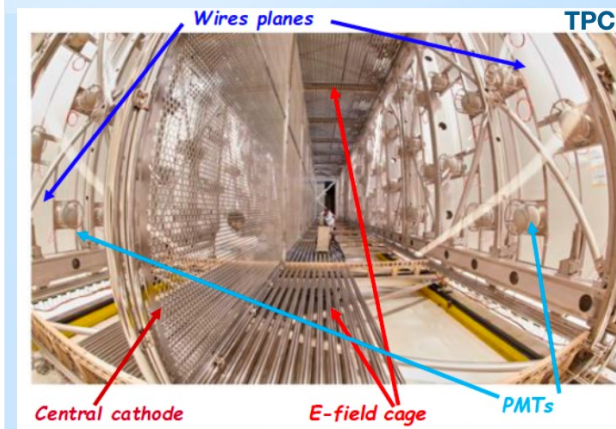


ICARUS

- ICARUS is the largest liquid argon detector currently in operation (~476 active tons).



- Two identical cryostats, filled with about 760 t of ultra-pure liquid argon at $89\text{ K} \pm 1\text{ K}$, 1.5 m drift, $ED = 0.5\text{ kV/cm}$;
- Each cryostat houses two TPCs with 1.5m maximum drift path, sharing a common central cathode.
- Anode: 3 parallel wire planes; about 54000 wires;



The information of the ionization track occurrence time, combined with the electron drift velocity provides the event coordinate in the drift direction.

The composition of the three views from the TPC wires yields the track projection on the anode plane.

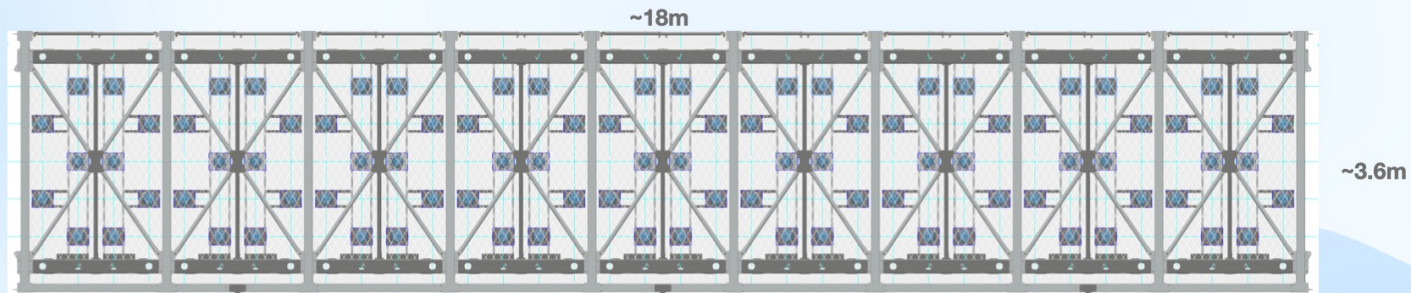
This information allows obtaining a **full 3D reconstruction of the tracks, with a spatial resolution of about 1 mm^3** .

ICARUS PMT

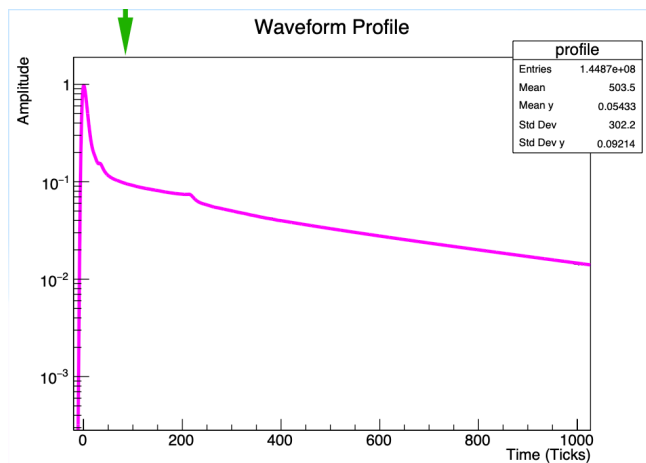
360 Hamamatsu R5912-MOD 8" PMTs mounted behind the anode wires.

Gain about 10^7 .

The new ICARUS PMTs mounted behind the wires of one TPC



PMT Waveforms Sim/Reco – V. Brio

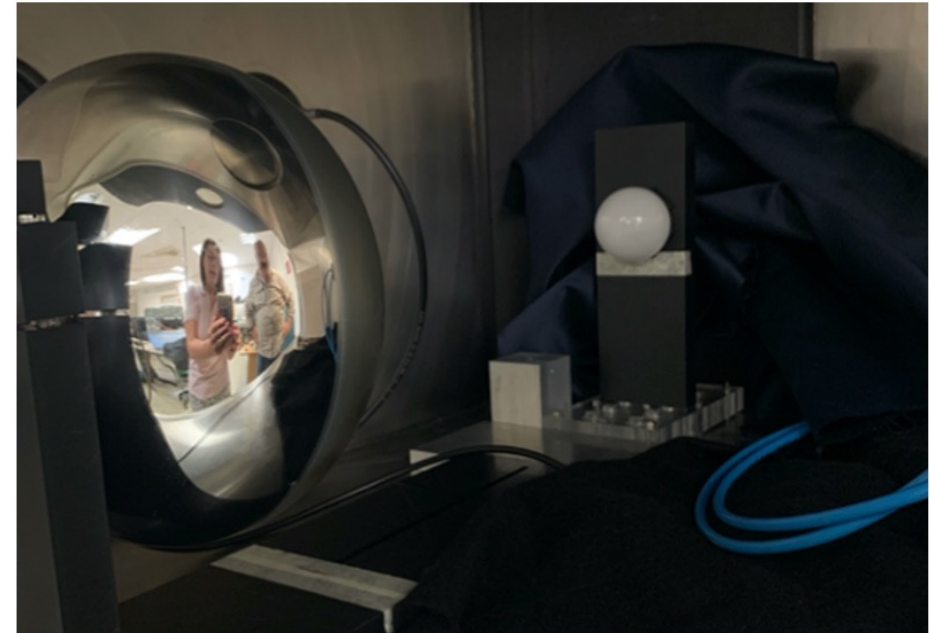
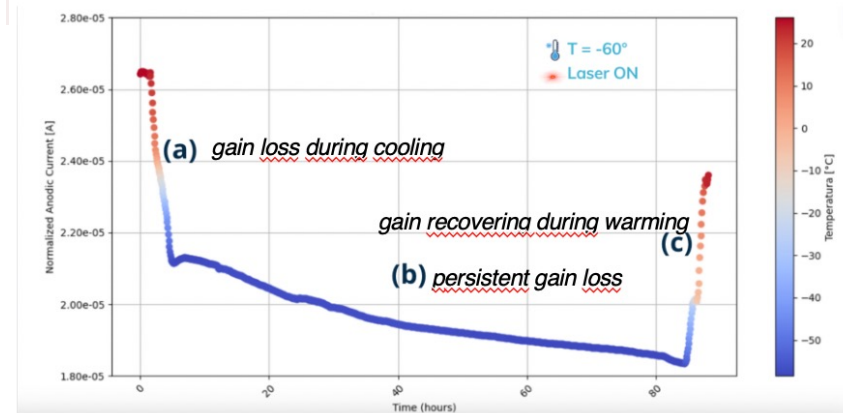
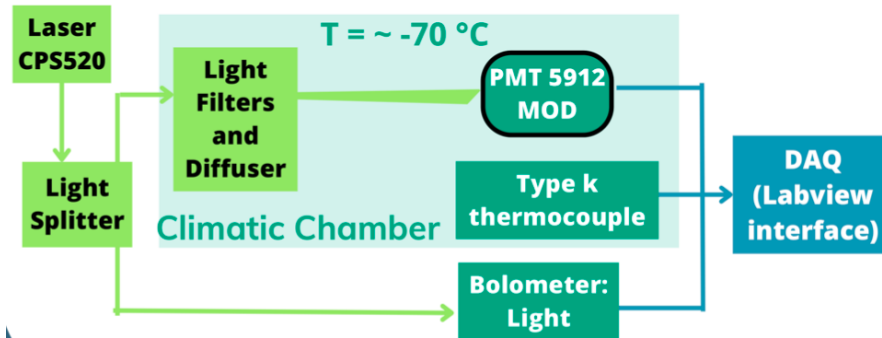


- Placed in a “honeycomb” structure on the four TPC “walls” (90 per TPC wall, 180 per module);
- TPB coating for 128nm sensitivity;
- 24 CAEN V1730B digitizers (500 MSa/s), 15 PMTs + 1 spare channel per board.

ICARUS PMT

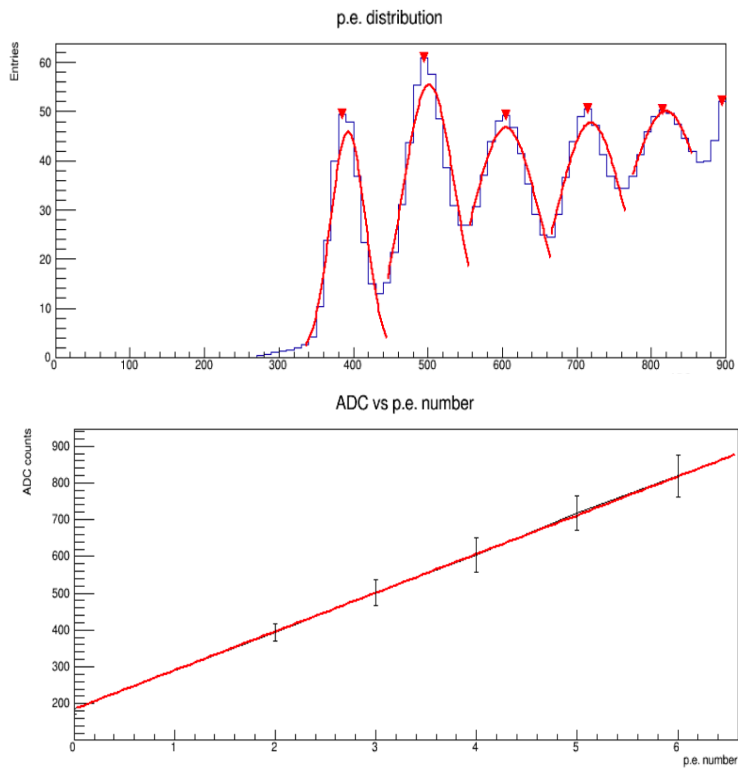
PMT Gain Stability – C. Saia

	Gain loss rate	Mean gain
RUN2	0.64% /month	$0.46 \times 10^7 \pm 2.1\%$
RUN3	0.31% /month	$0.39 \times 10^7 \pm 1.5\%$

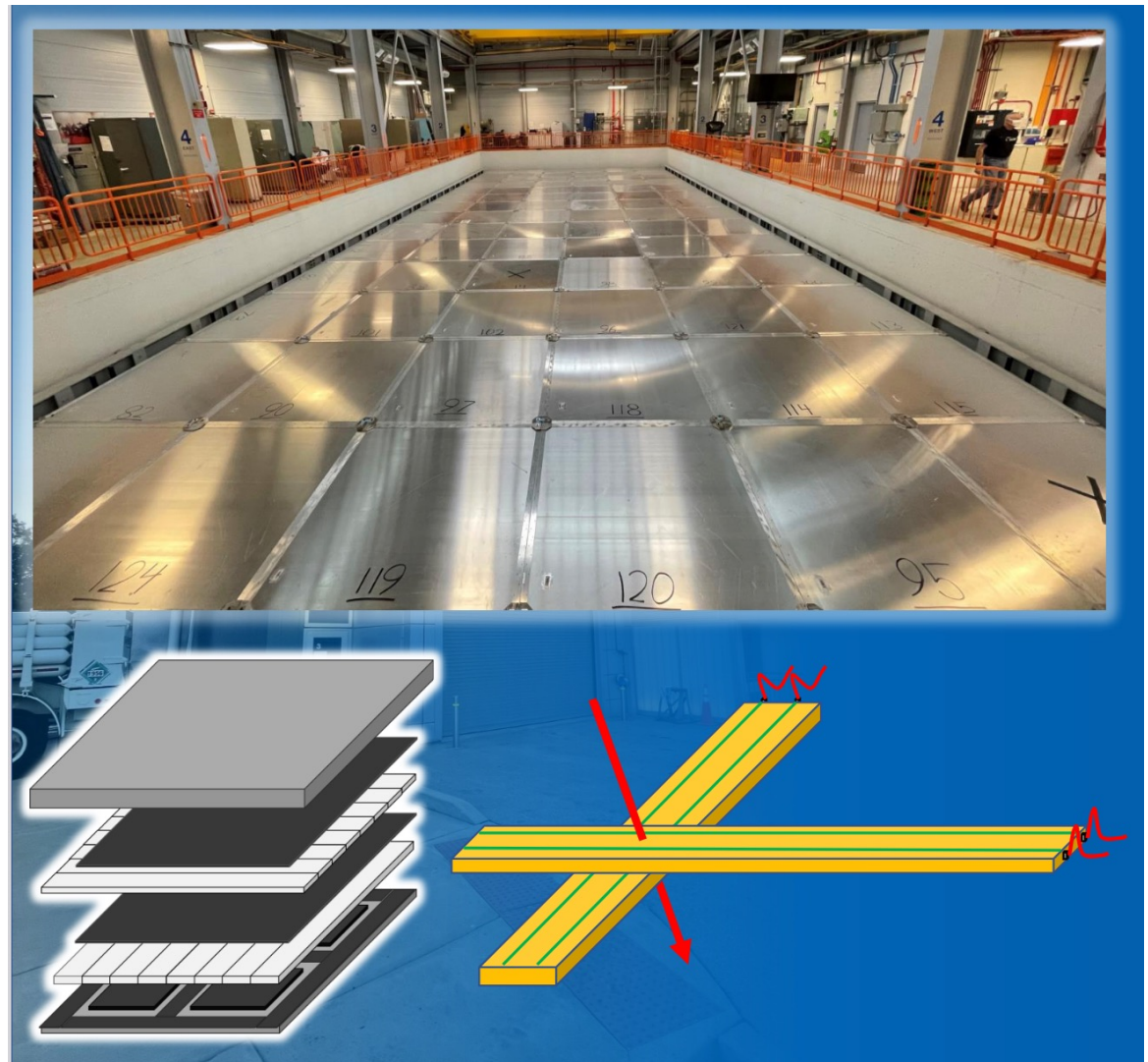


ICARUS CRT

CRT SiPM calibration/monitoring – S. Vitellaro



30/10/24

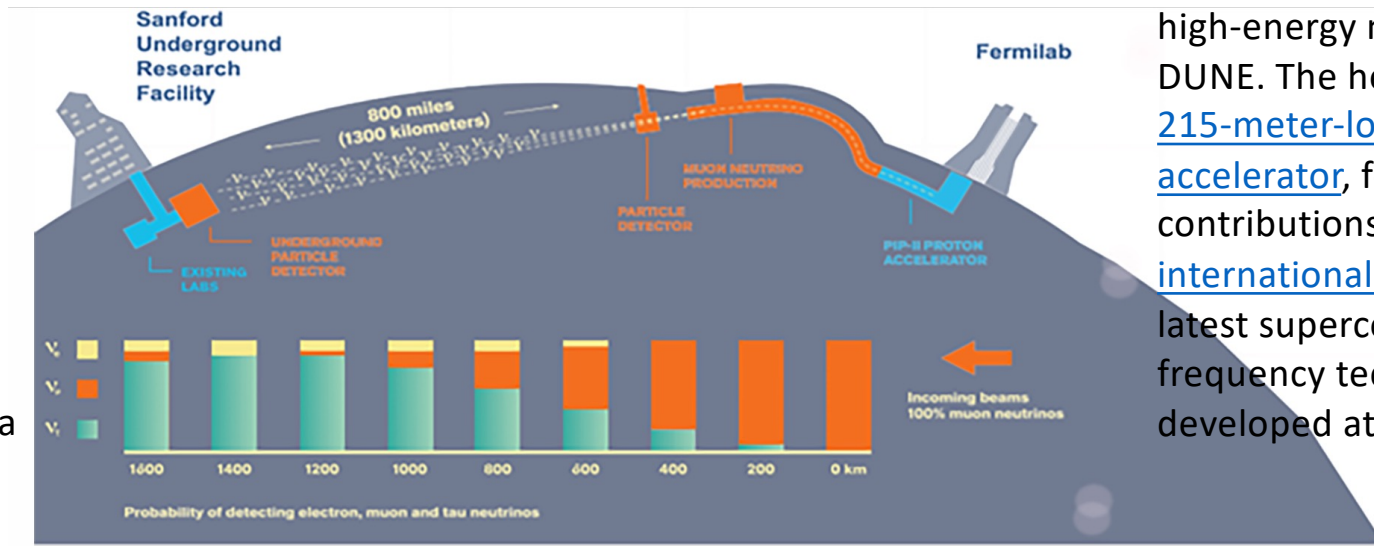


European Strategy for Particle Physics - Catia Petta

Prospettive – DUNE

(Deep Underground Neutrino Experiment)

The far detector will be the largest of its type ever built and record neutrino interactions with unprecedented precision. A global [computing infrastructure](#) will make data analysis possible.



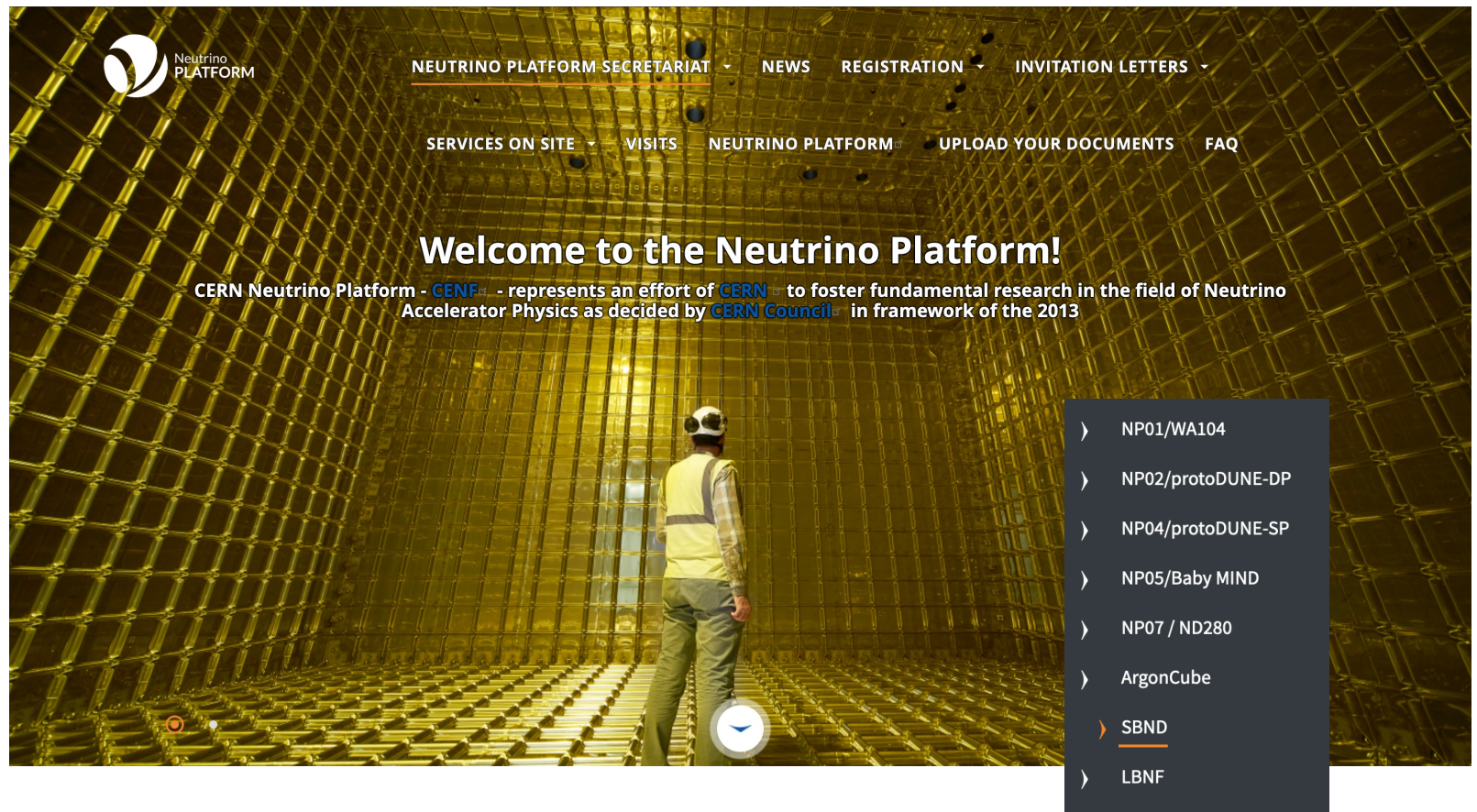
PIP-II will be the “first gear” of the Fermilab accelerator complex and power the [world’s most intense beam](#) of high-energy neutrinos for DUNE. The heart of PIP-II is a [215-meter-long particle accelerator](#), featuring major contributions from [international partners](#) and the latest superconducting radio-frequency technology developed at Fermilab.

The far detector will be composed of four modules. Each module will have a total mass of 17 kton of liquid argon. The first module will be a Single-Phase LAr-TPC and the second a Vertical-Drift LAr-TPC. The design of the third and fourth modules remains open.

The Long Baseline Neutrino Facility (LBNF) will provide a powerful beam of neutrinos to the Near and Far Detectors. It will start operating at 1.2 MW and will be upgraded to 2.4 MW after 6 years. A linear proton accelerator will deliver 10^{21} Protons-on-target/year with an energy range from 60 to 120 GeV to a graphite target.

La Neutrino Platform al CERN

CERN Neutrino Platform - represents an effort of [CERN](#) to foster fundamental research in the field of Neutrino Accelerator Physics as decided by [CERN Council](#) in framework of the 2013 [European Strategy](#).



Take-home messages

- La fisica del neutrino da acceleratore a Catania riguarda ICARUS ed SBN al Fermilab ed ha come immediato orizzonte DUNE
- Le attività al CERN sono fondamentali nel R&D, nella costruzione e supporto degli esperimenti e degli acceleratori in USA e in Giappone
- Catania è inserita in questa rete ed ha interesse a mantenere e sviluppare questa sinergia