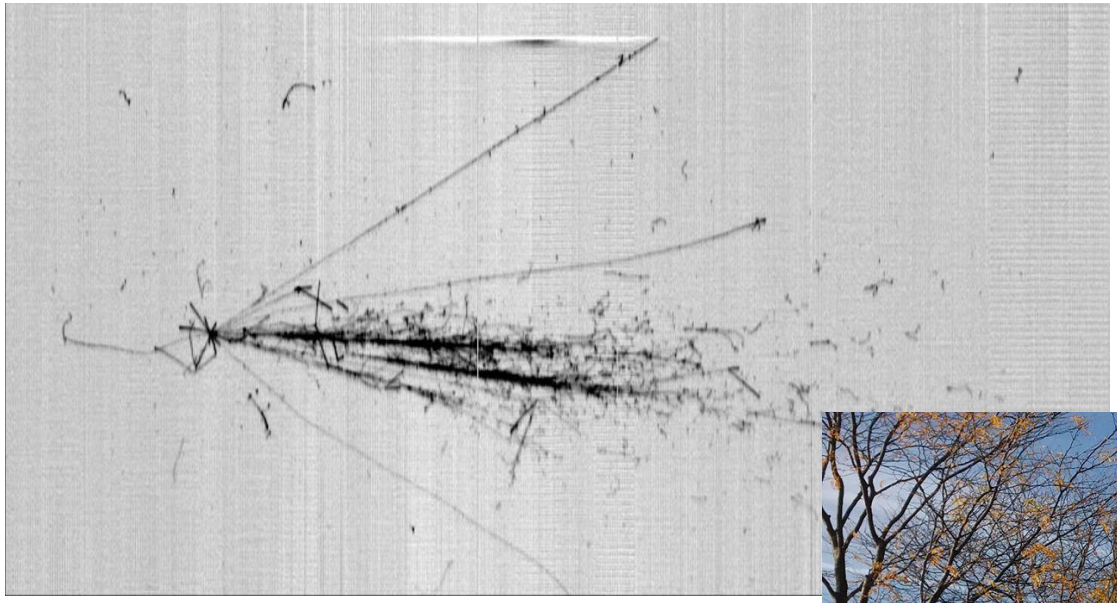
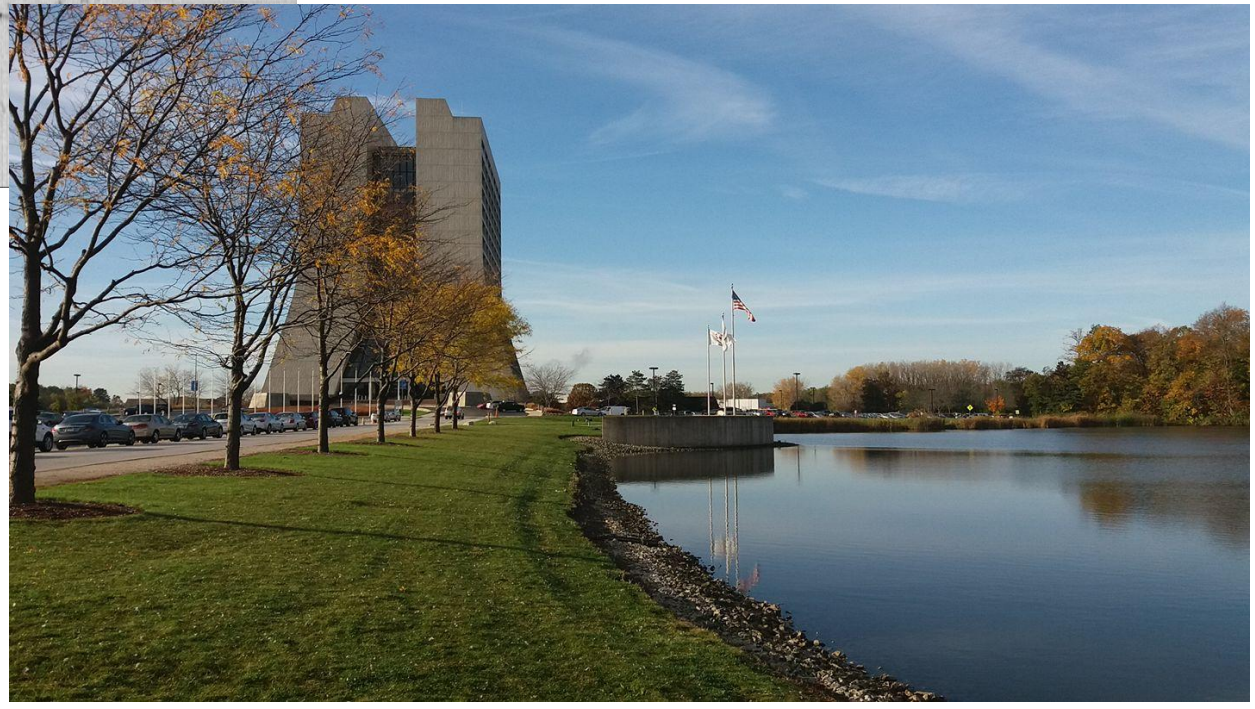
The deployment of ICARUS at SBN



A. Menegolli
University and INFN Pavia (Italy)

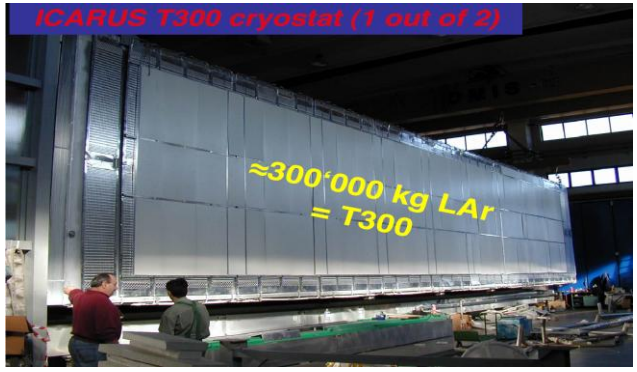
on Behalf of the
ICARUS Collaboration



Neutrino Town Meeting
CERN - October 22nd 2018

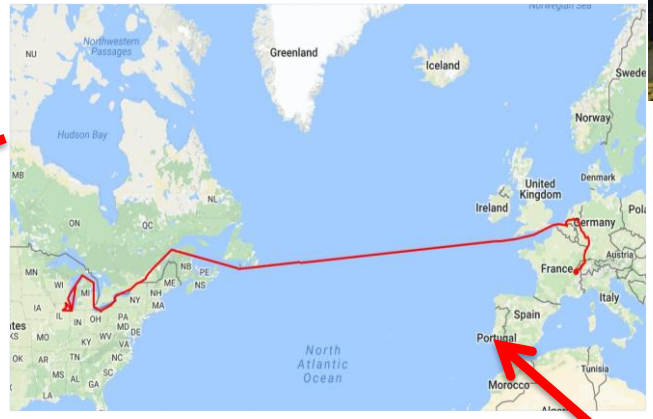
ICARUS T600: a long journey in time and space!

- First proposed in a seminal paper by C. Rubbia in 1977.
- Long R&D effort by INFN, in collaboration with industry, culminating in the first large-scale LAr-TPC physics experiment: ICARUS-T600.



2001: T600 in INFN Laboratories in Pavia (Italy)

2010-2013: T600 @ LNGS (CNGS and cosmics)

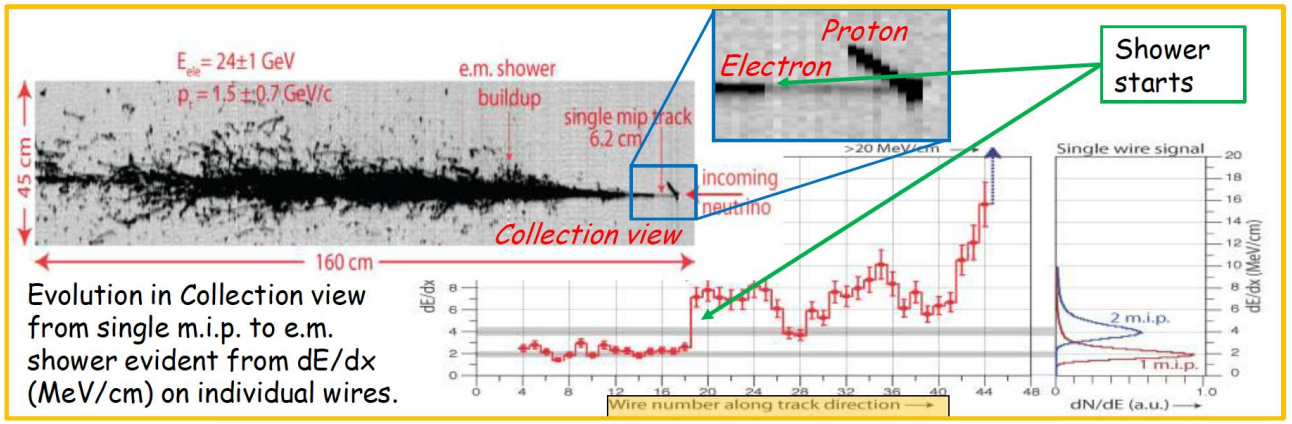


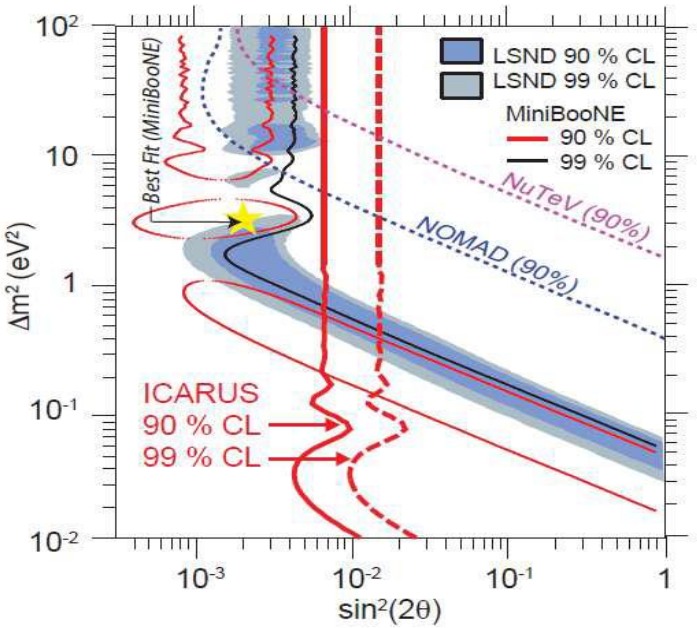
June-July 2017: from CERN to Fermilab

arriving at SBN Far site building at FermiLab, July 26th 2017

2014-2017: T600 @ CERN (WA104 refurbishing)

Sterile neutrino searches with ICARUS



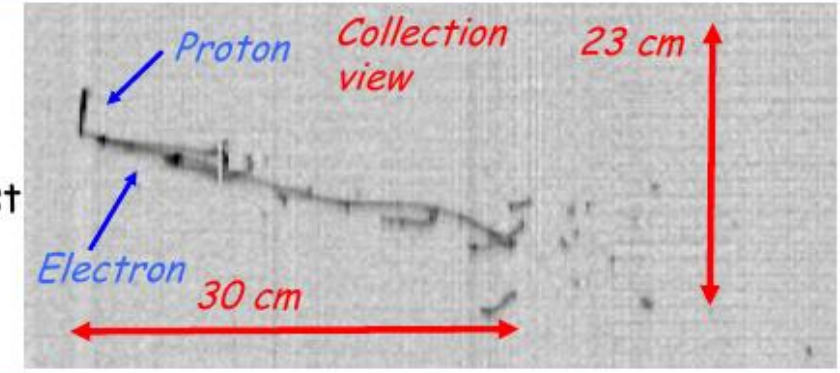


- Sterile neutrino physics @ LNGS: LSND-like anomaly investigated by searching for νe appearance in the CNGS beam, constraining allowed parameter space to a small region around Δm^2~1eV^2, sin^2 2θ~0.005, confirmed by OPERA.

- T600 also exposed to atmospheric neutrinos (0.74 kt year) at LNGS: interesting sample to validate reconstruction: similar energy range as in SBN!

Downward-going, quasi elastic ν_e event.
deposited energy: 240 MeV

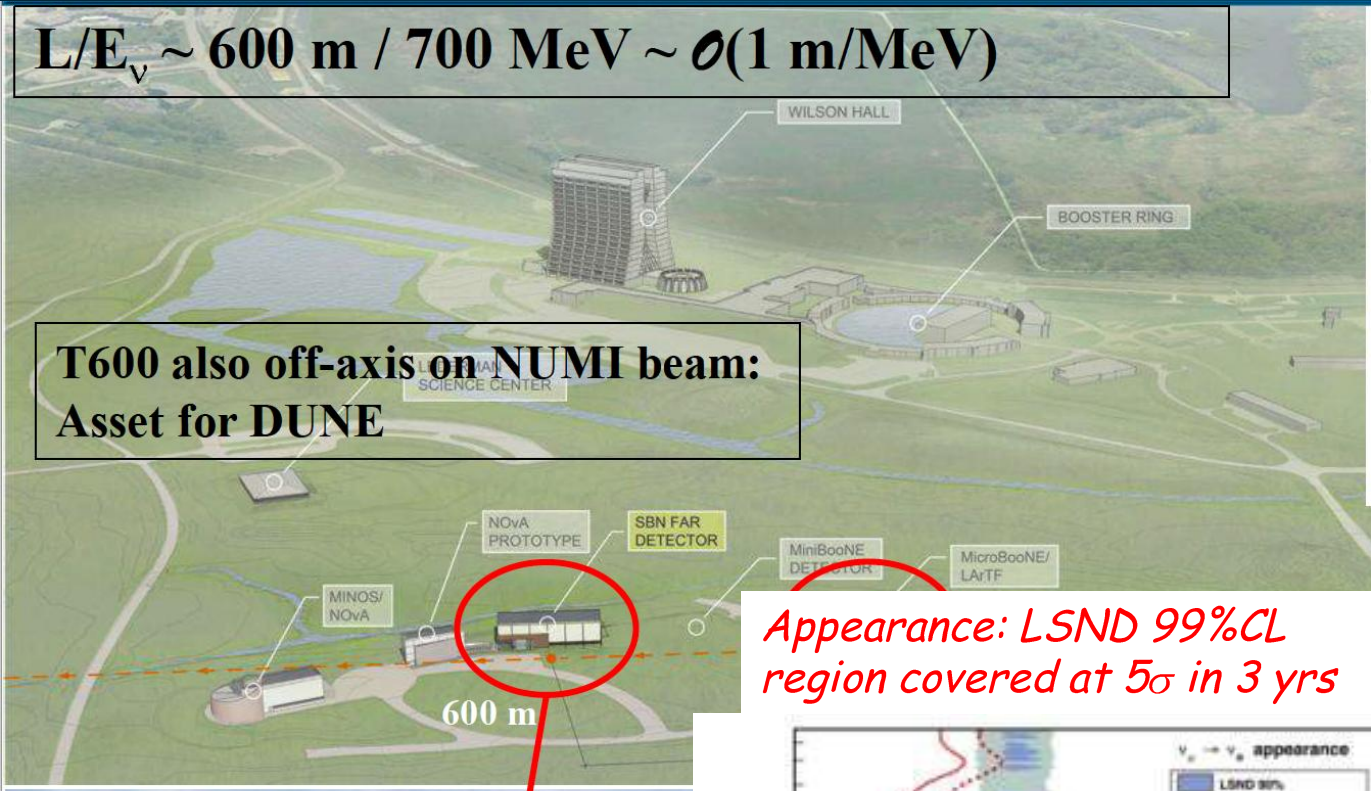
- dE/dx ~ 2.1 MeV/cm measured on first wires corresponds to a m.i.p.
- Short proton track recognized.

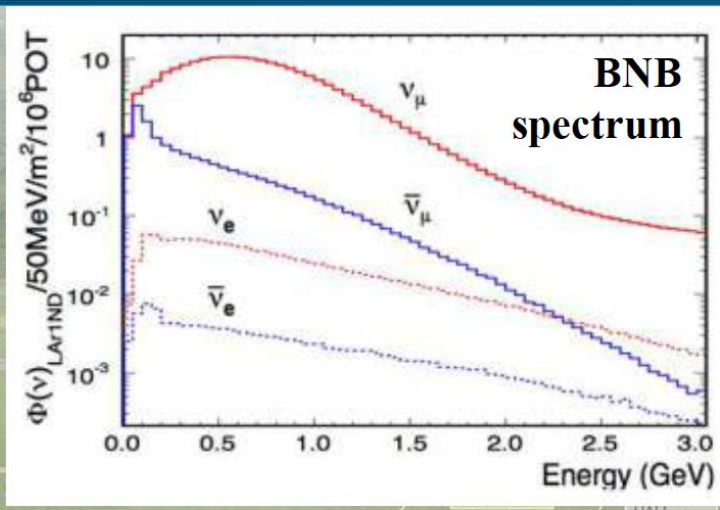


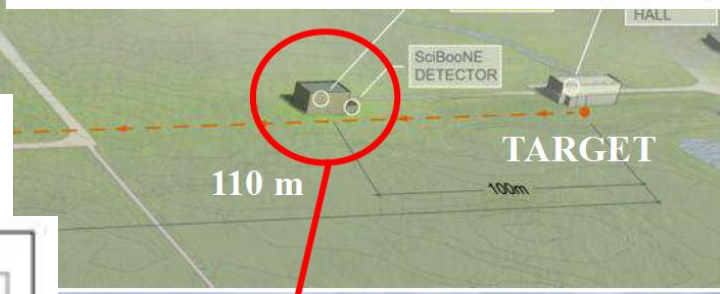
The SBN project

$L/E_\nu \sim 600$ m / 700 MeV $\sim O(1$ m/MeV$)$

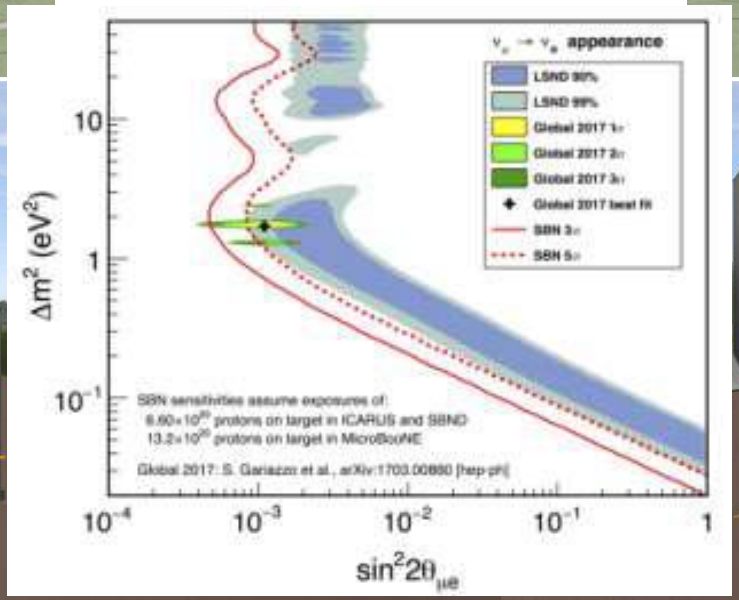
T600 also off-axis on NUMI beam: Asset for DUNE

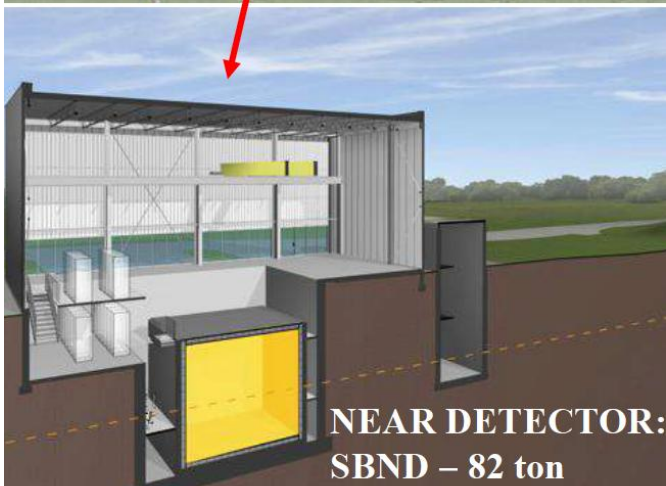






Appearance: LSND 99%CL region covered at 5σ in 3 yrs





The ICARUS collaboration

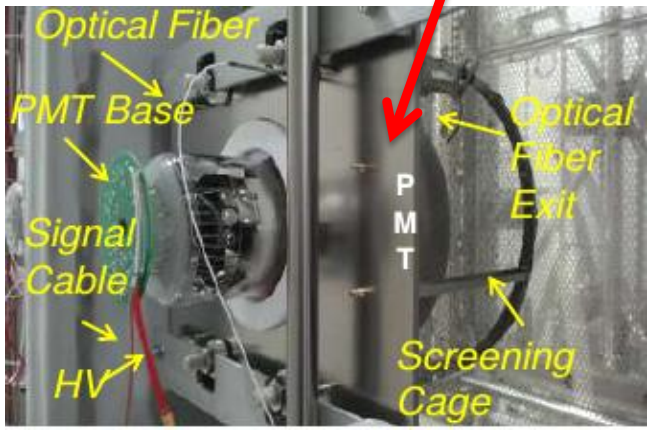
Catania (INFN and Univ.)
GSSI
LNGS
INFN Milano Bicocca
INFN Napoli
Padova (INFN and Univ.)
Pavia (INFN and Univ.)

Brookhaven (BNL)
Colorado State
FNAL
Houston
Pittsburgh
Rochester
SLAC
Texas (Arlington)

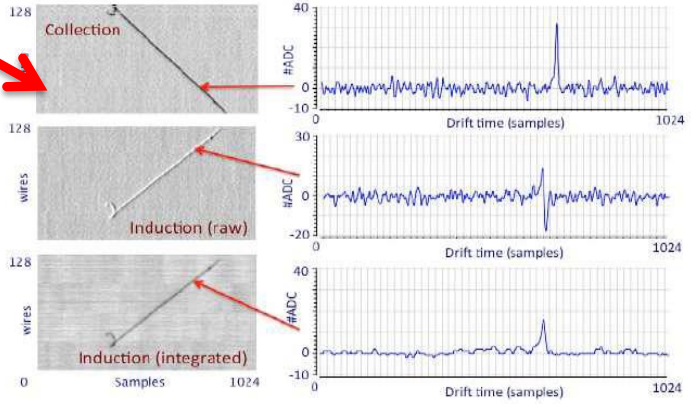
Spokesman: C. Rubbia (GSSI)

T600 overhauling at CERN (WA104/NP01)

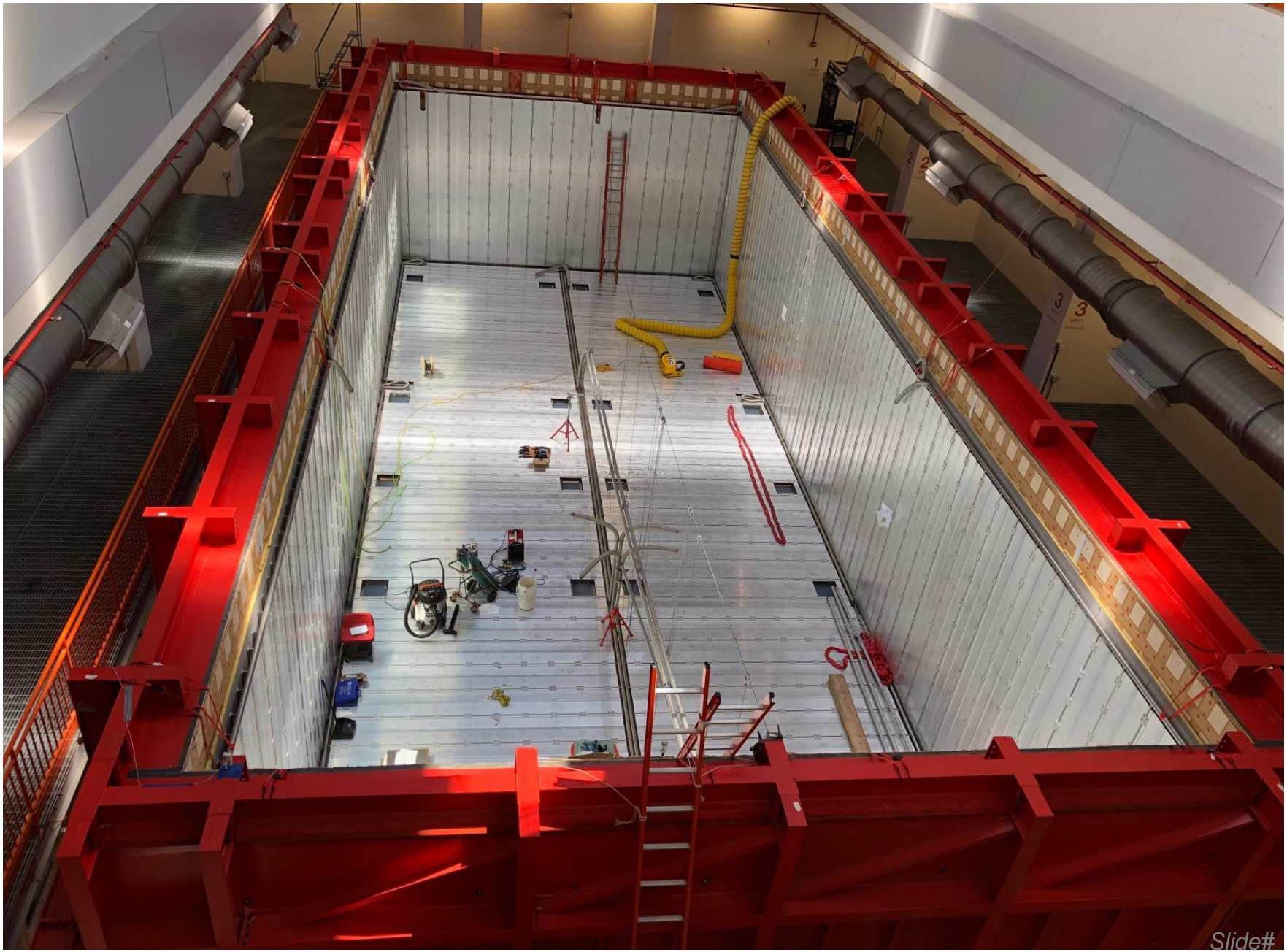
- To face the new experimental conditions at FNAL (shallow depth, higher beam rate) T600 underwent intensive overhauling at CERN (WA104/NP01), before shipping to US.
- Purely passive insulation coupled with standard N_2 cooling shield, redesigned and tested at CERN.
- New cold vessels made of extruded Aluminum profiles, welded together at CERN.
- Cathode panels flattened by thermal/mechanical treatment, reducing the residual non-planarity by a factor ~10.
- The new light collection system features 360 PMTs (90 per chamber, 15 phe/MeV) - *arXiv:1807.08577.*



- Wire front-end electronics redesigned to improve reconstruction and performance - *arXiv:1805.03931.*

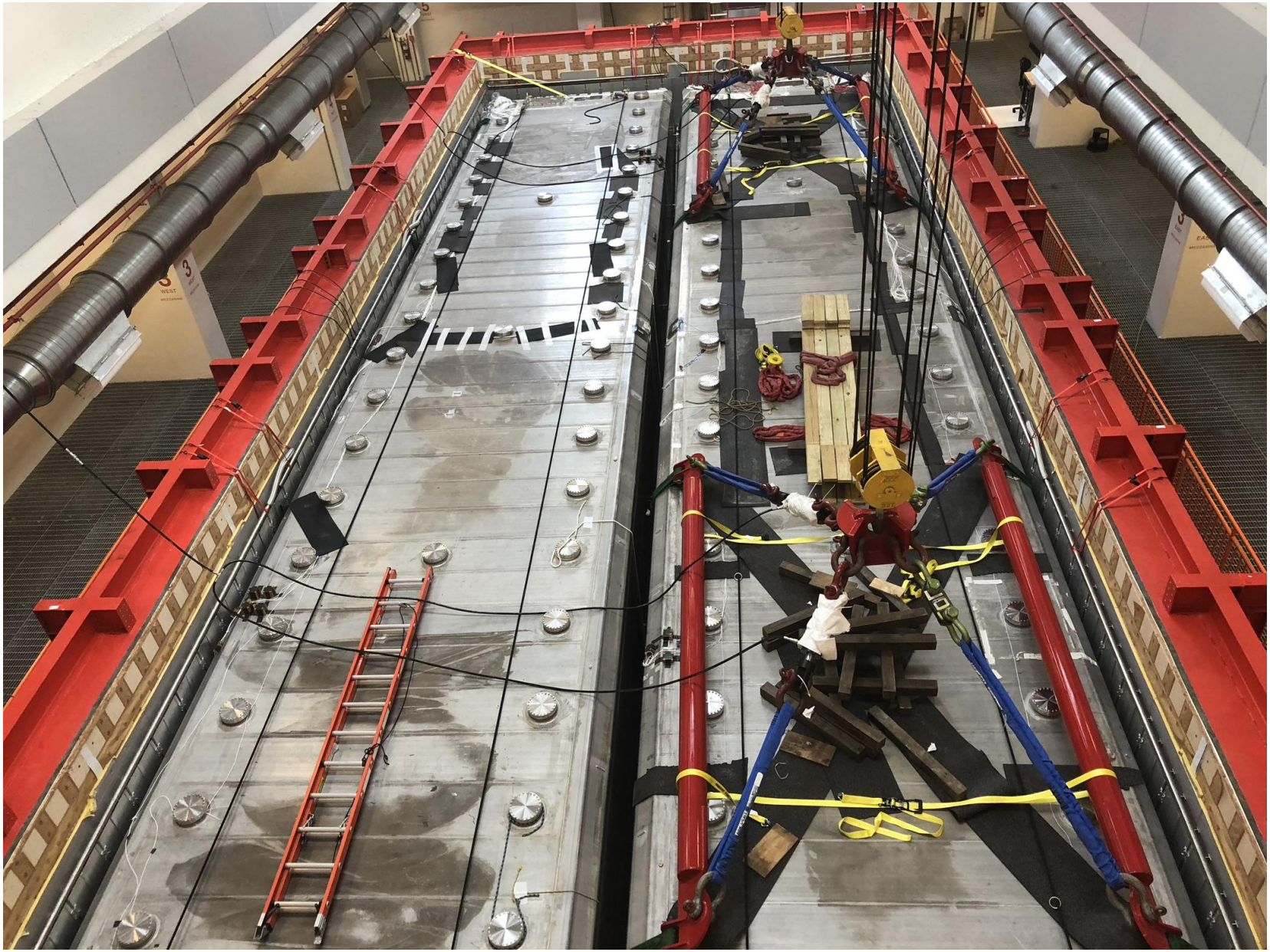


Warm Vessel & Cold shields (June 2018)



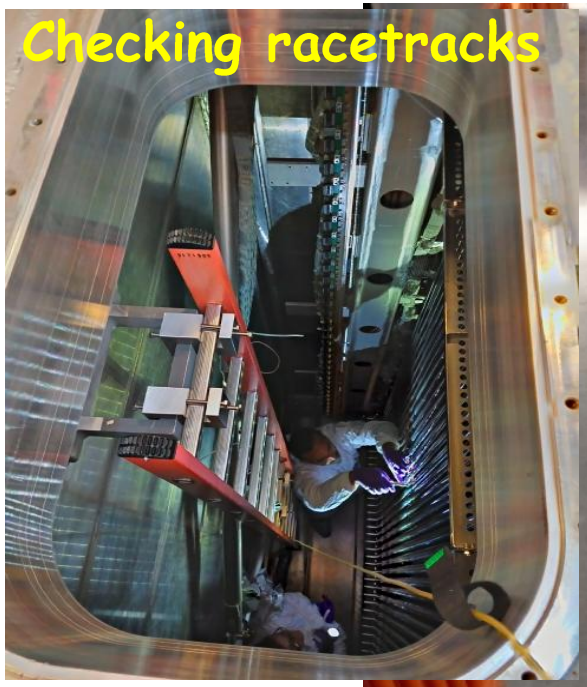
Second Cold Vessel Rigging (August 14, 2018)

Second Cold Vessel in place (August 14, 2018)



ICARUS installation at FNAL - status

- Rigging of both modules and placement in the pit was done by August 2018.
- All chimneys installed on top of detector by mid September.
- Continuity tests carried out on all TPC wires soon after.



ICARUS at FNAL – plans and commissioning

- Top side of cold shield is being installed followed by top of warm vessel.
- Cross flanges installation will start at the end of November.
- Activities on the top will begin during fall: cryogenics/purification/vacuum system, feedthrough flanges, read-out/decoupling boards, etc.)
- Vacuum pumping should start at the beginning of 2019, until TPCs are ready to cool down.

Commissioning will be then organized in three phases:

- CRYOGENICS: vacuum (1 month), cooling (15 days), filling (15 days), purification (1 month), stabilization (1 month).
- TPC/PMT (2 months): HV system, PMT supply, calibrations, DAQ/trigger commissioning.
- Cosmic Ray Tagger (in parallel with the other two phases).

The strong cooperative effort by INFN, CERN and FNAL will allow to start commissioning and data taking in early 2019!


Thank you!