Neutrino PLATFORM

S. BORDONI

THE CERN NEUTRINO PLATFORM

EPS-HEP 2017 , Venice 5 – 12 July 2017

EUROPEAN PHYSICAL SOCIETY EPS HEP2017

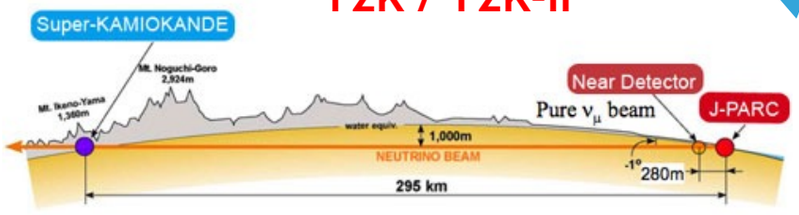
THE MANDATE

European Strategy for Particle Physics (2013)

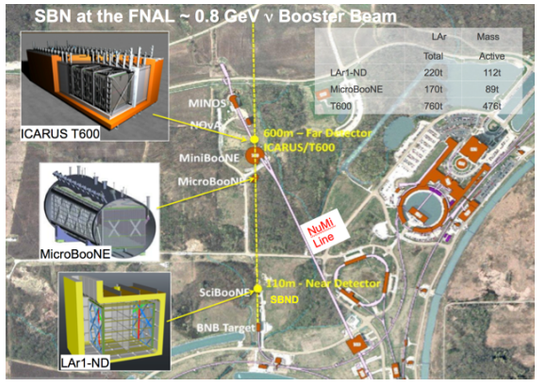
"Rapid progress in neutrino oscillation physics, with significant European involvement, has established a strong scientific case for a long-baseline neutrino programme exploring CP violation and the mass hierarchy in the neutrino sector. CERN should develop a neutrino program to ***pave the way*** *for a substantial European role in future long-baseline experiments. Europe should explore the possibility of major participation in leading long-baseline neutrino projects in the US and Japan."*

- CERN support European activities towards future LBN experiments in US and Japan
- Neutrino Platform part of the CERN Medium Term Plan (since 2015)

T2K / T2K-II



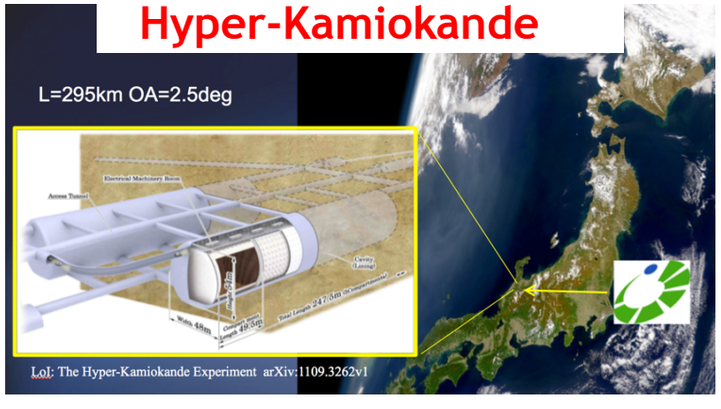
SBN (short baseline)



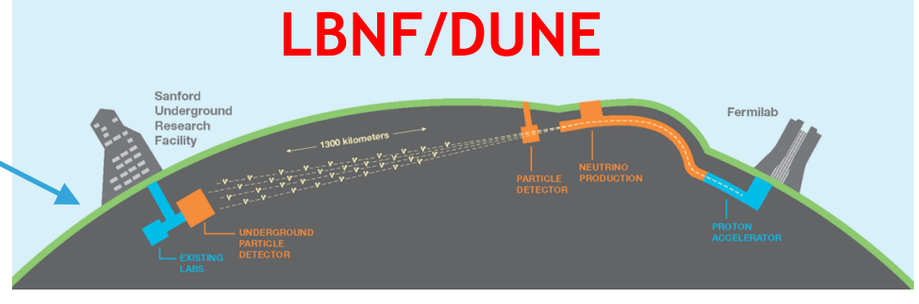
Neutrino PLATFORM

http://cenf.web.cern.ch/

Hyper-Kamiokande



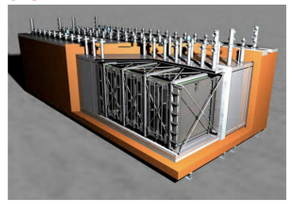
LBNF/DUNE



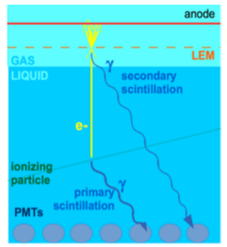
THE NP CURRENT PROJECTS

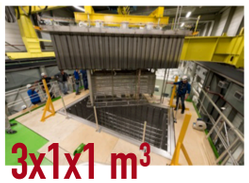
- **NP01** (WA104/ICARUS) : far detector for the US Short Baseline program

ICARUS



- **NP02** (protoDUNE-DP WA105): demonstrator + engineering prototype for a Double phase (LAr+GAr) TPC

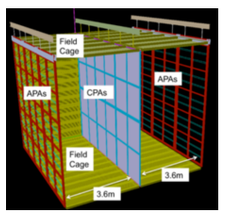




3x1x1 m³

6x6x6 m³

- **NP04** (protoDUNE-SP): engineering prototype for a LAr TPC



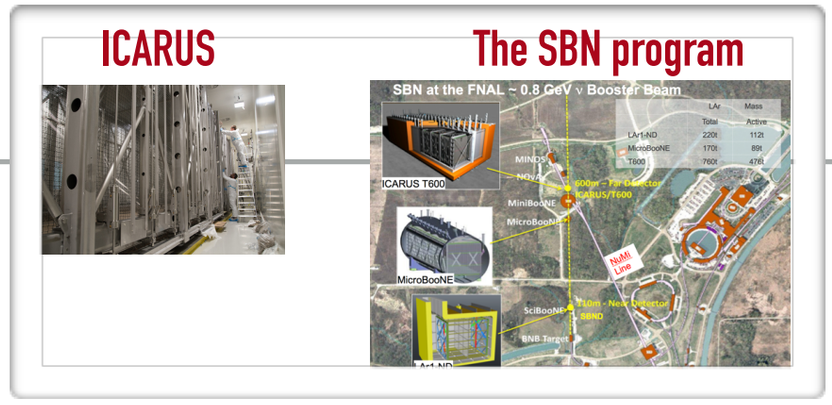
6x6x6 m³

- **NP05** (Baby MIND): a magnetised muon spectrometer for the WAGASCI experiment in Japan

Baby MIND

+

- **NP03:** generic R&D framework
- ArgonCUBE: R&D for a modular (magnetised) LAr TPC



WA104 / SBN : THE ICARUS DETECTOR

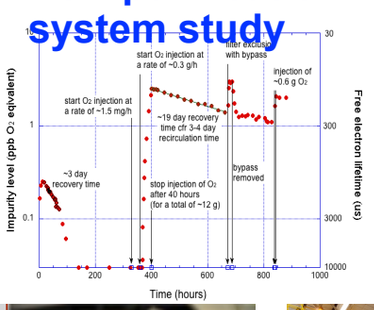
LAr TPC successfully operating at LNGS (2009–2013)

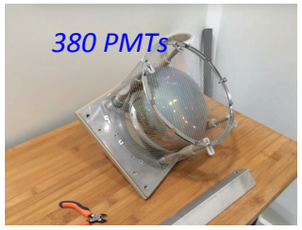
- Overhauling of the ICARUS (T600) detector : new technology developments to adapt the detector to surface operation
  - Upgrade of light collection system
  - Faster and high performance readout system
  - Top Cosmic Ray tagger (with INFN)

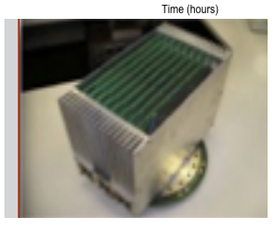
see talks from:
S. Tufanli (SBN)
F. Varanini (ICARUS)
G.Raselli (ICARUS update)

- Shipped to US to be part of the SBN program at Fermilab

New purification system study

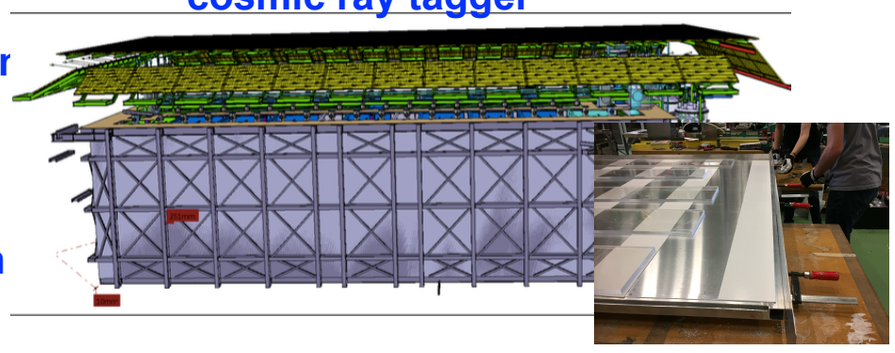




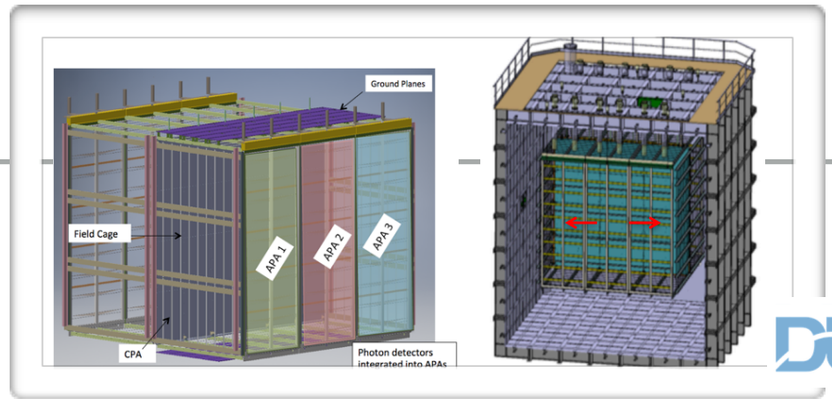


New aluminiur cold vessels

cosmic ray tagger



New readout boards, feedthrough flange and compact crate



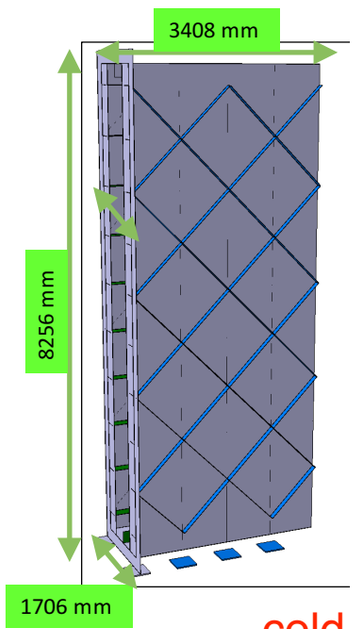
PROTODUNE-SP

see M.Potekhin talk

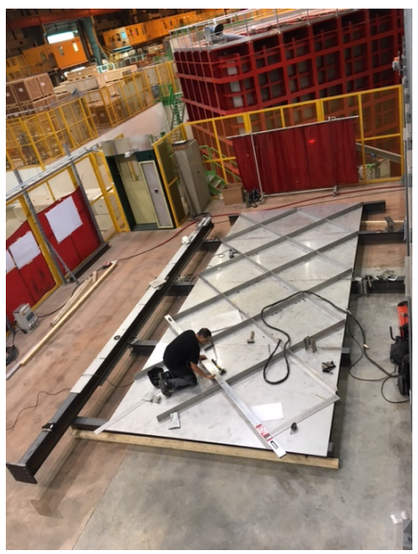
~800 tons of single phase LAr TPC: engineering prototype (1/20) for DUNE FD.

- central cathode at -180 kV
- 6x6x7 m^3 , max drift length 3.6m

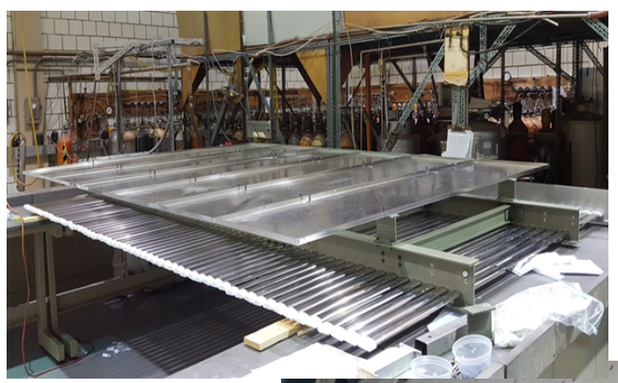
- Design and R&D for the field cage and cathode, HV feedthrough + test in LAr
- Cold box for testing the APAs with photon detection system and cold electronics before installing into the cryostat
- Participation to the detector installation



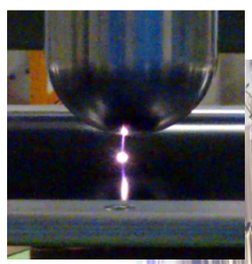
cold box

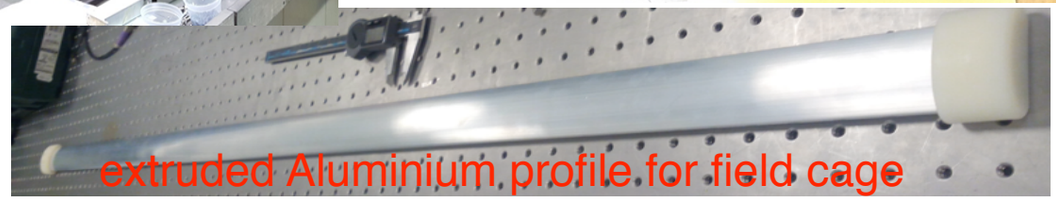


top/bottom field cage

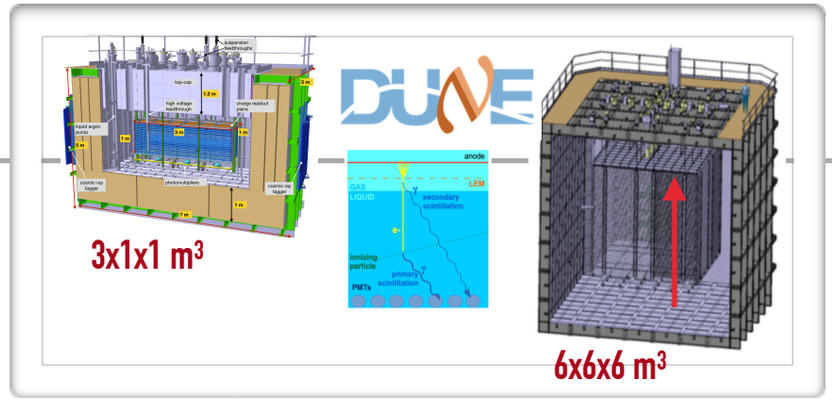


Resistive cathode concept





extruded Aluminium profile for field cage



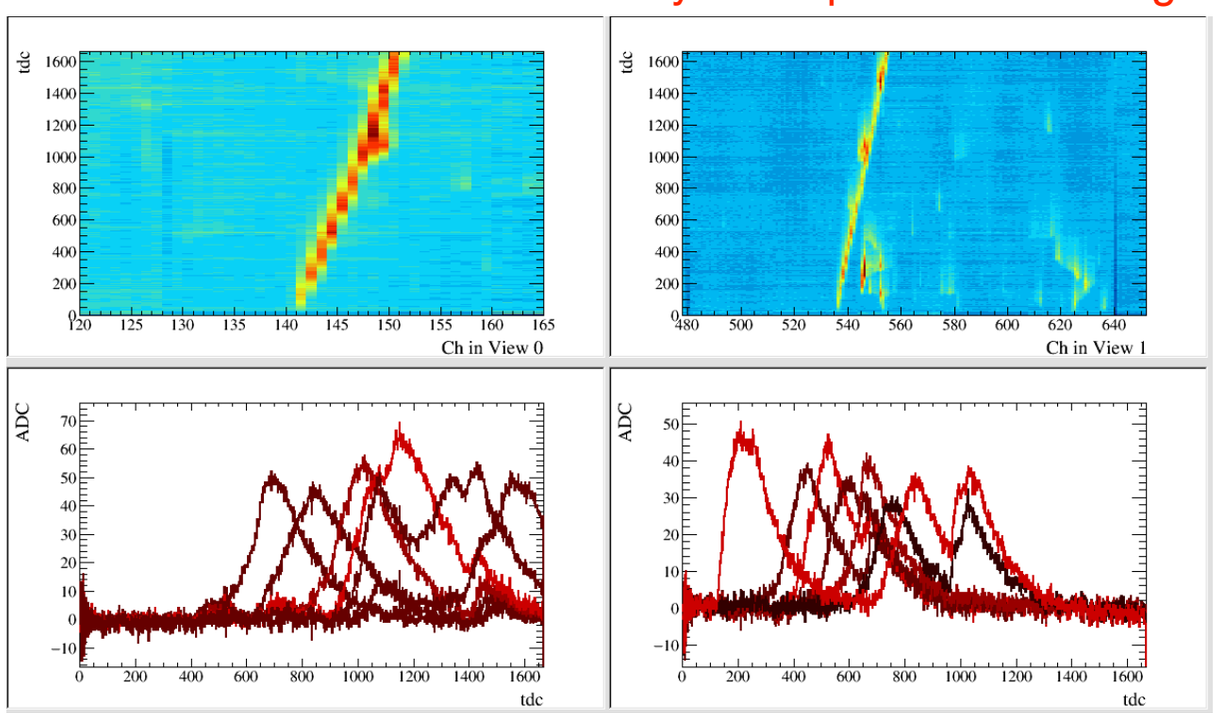
PROTODUNE-DP

proof of concept for a large scale double phase TPC

- drift in the liquid, electron amplification in the gas
- cathode at the bottom (-300kV), maximum drift length 6m

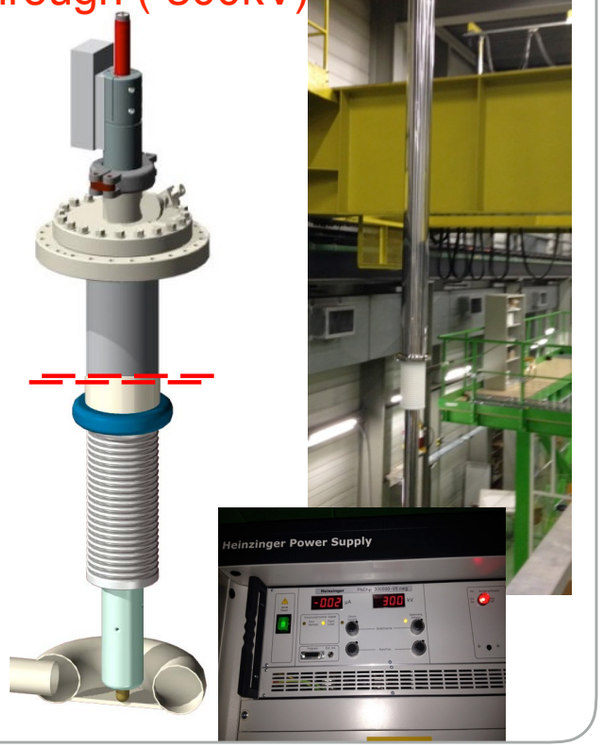
- Synergies with protoDUNE-SP for field cage, HV feed-through..
- $3x1x1m^3$ intermediate step towards protoDUNE-DP
  - First cryostat demonstrator with GTT technology
  - Detector under commissioning now

$3x1x1m^3$ first track from cosmic-ray w/ amplification in the gas

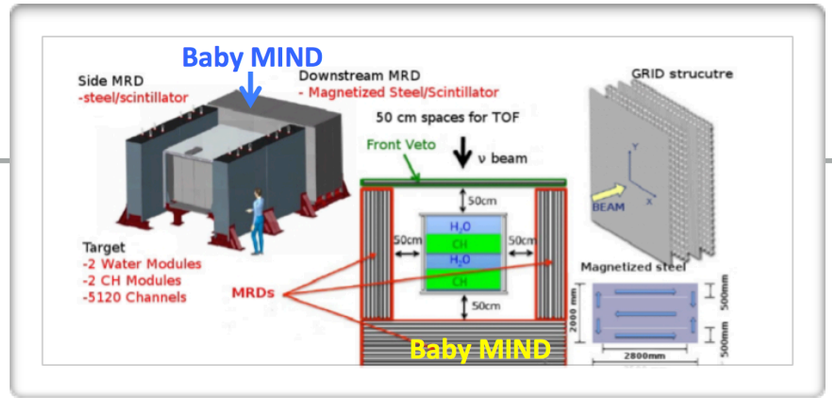


Aluminium field cage profiles

HV feed-through (-300kV)



R&D for protoDUNE-DP $6x6x6m^3$

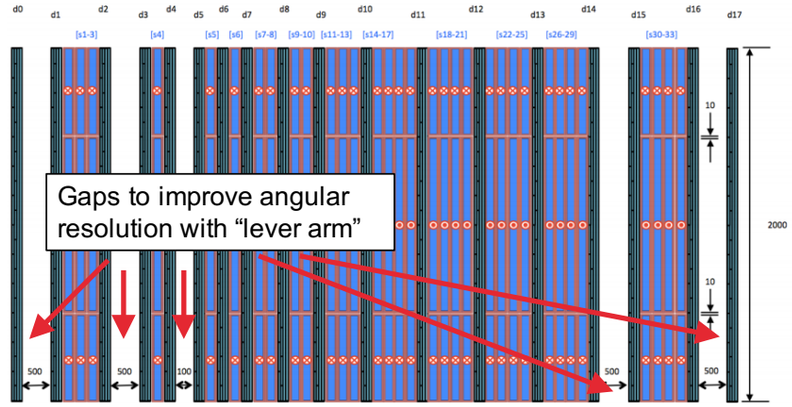


BABY MIND

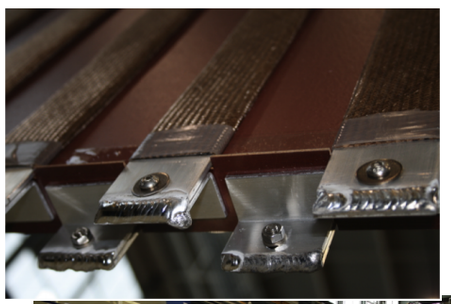
see E. Noah talk

Magnetised muon spectrometer for the WAGASCI experiment (T2K beam line)

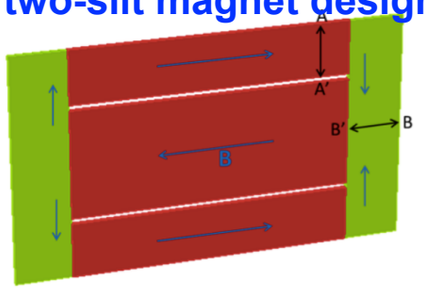
- Interleaving of magnets (33) and scintillator (18) modules
  - Two-slits design magnet providing a well defined B field in the central zone
  - scintillators bars headed together mechanically in Al support frame
- Currently in test-beam at CERN. Shipment to Japan during summer



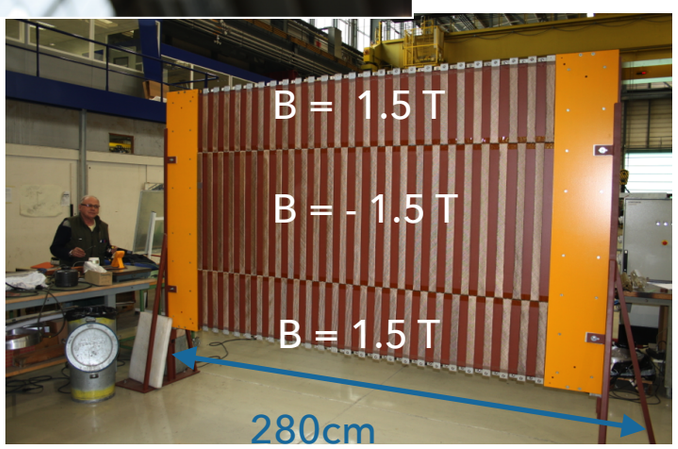
coils turns after welding



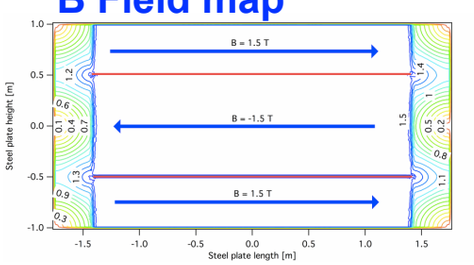
two-slit magnet design



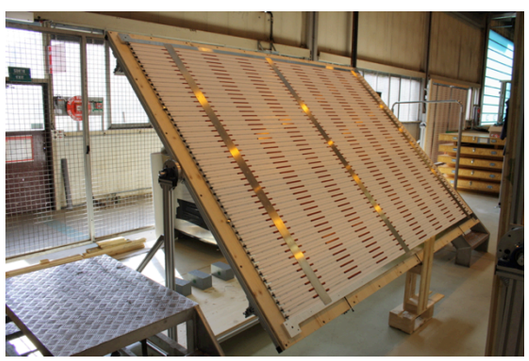
magnet module

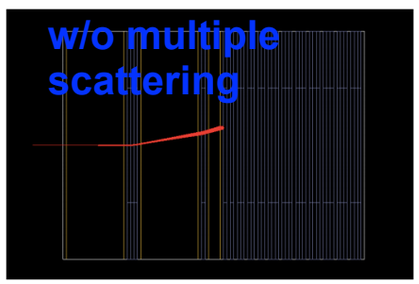


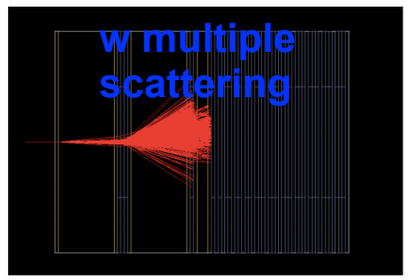
B Field map

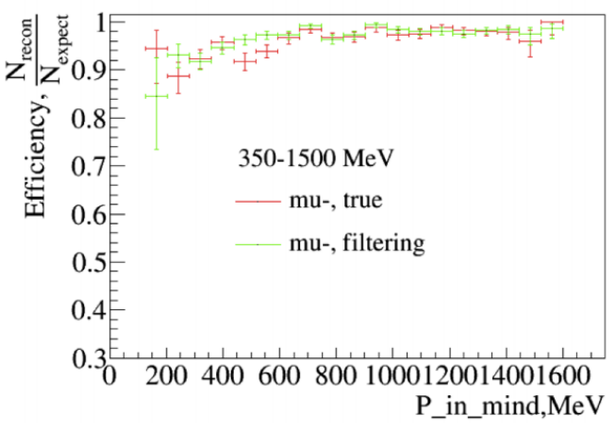


custom scintillator module



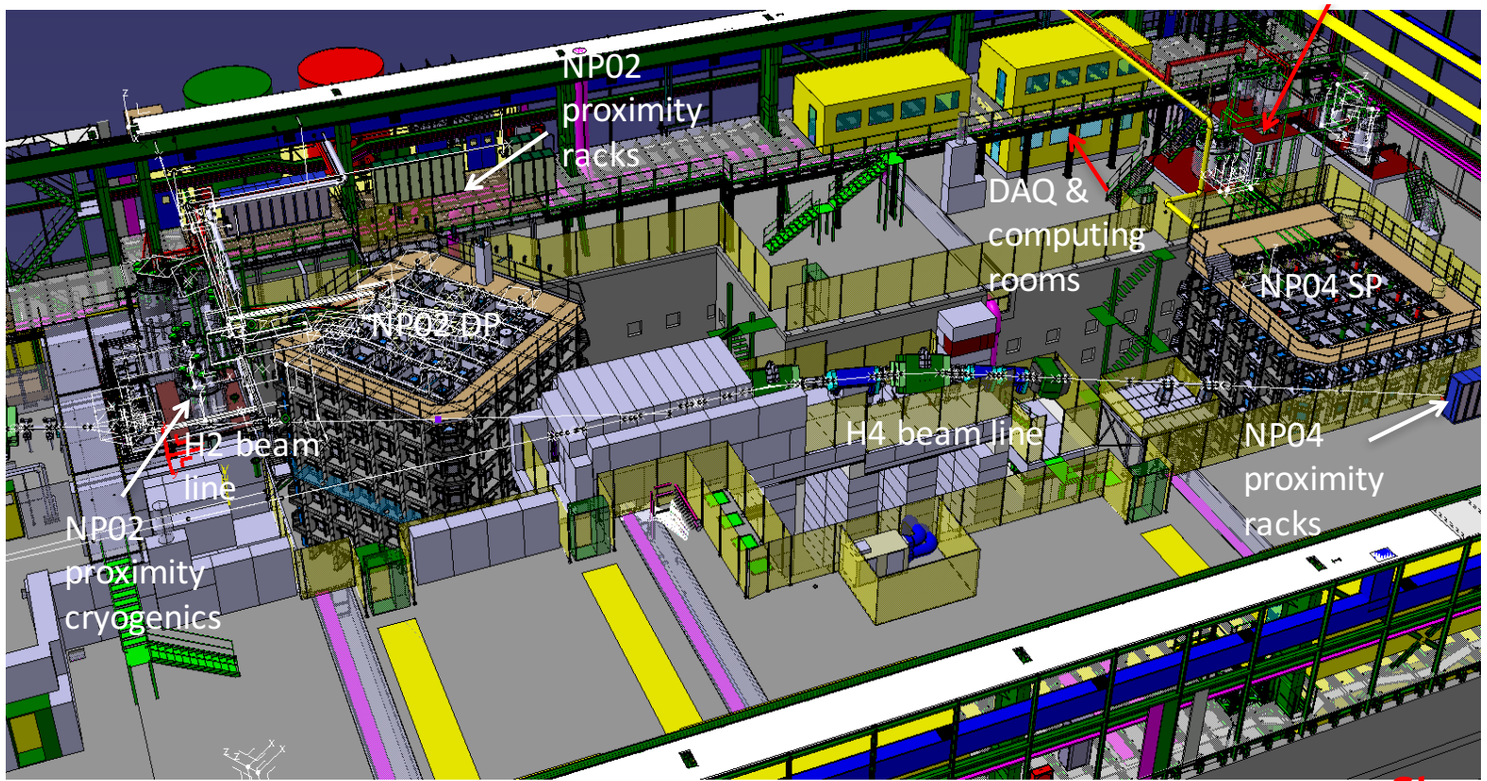






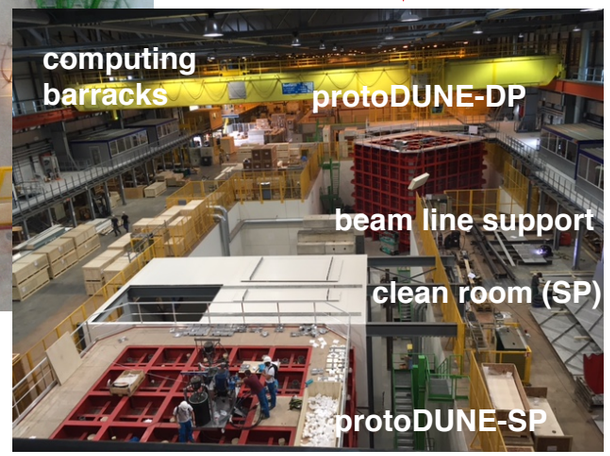
NP FACILITIES

- brand new experimental (~53000 m^3) hall for protoDUNE detectors on test beams



Beneficial occupancy in September 2016

Today



- new low E test beam lines
- 4 large clean rooms,
- 4 assembly areas,
- 2 R&D labs

protoDUNE-DP

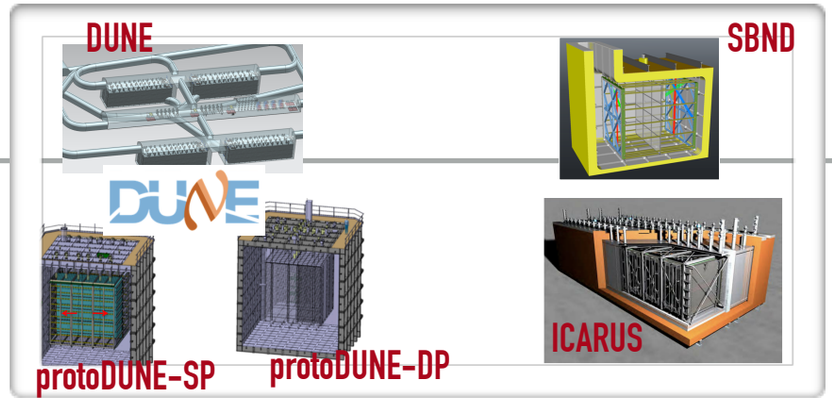
Clean room will be here

Clean room

protoDUNE-SP (behind)

3 July 2017

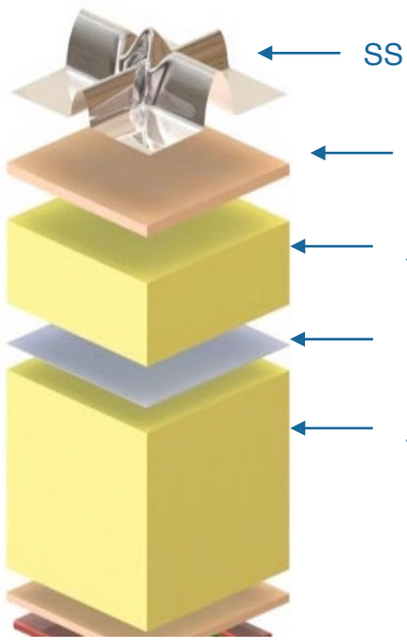
http://cenf-ehn1-np.web.cern.ch/



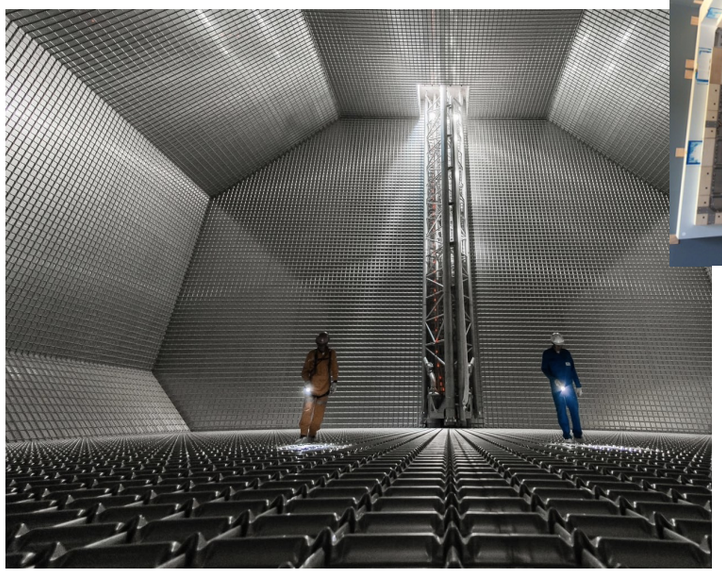
LAR CRYOSTAT AND CRYOGENICS

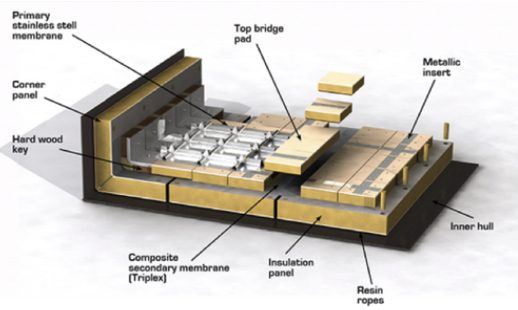
- Experimenting new technology for large volume cryostats (GTT technology)
- Creating a strong LAr cryogenics group at CERN working in close collaboration with FNAL
  - extreme purity (<0.1 ppt), safety, purge valves already successfully tested in the double-phase Ar TPC 3x1x1m^3
- Preparing new test beam facilities for large cryogenic detectors

Cryostat membrane with LNG industry technology



Gaz Transport and Technigaz (GTT) technology membrane tank model

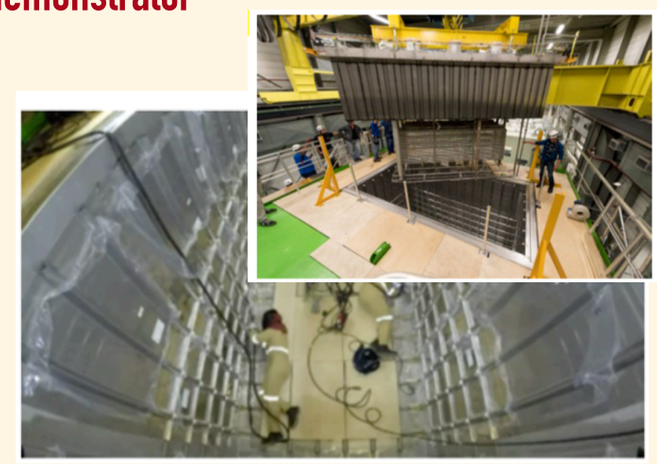




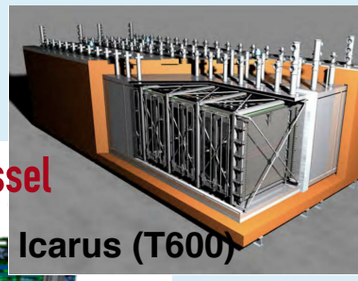
LAR CRYOSTAT AND CRYOGENICS

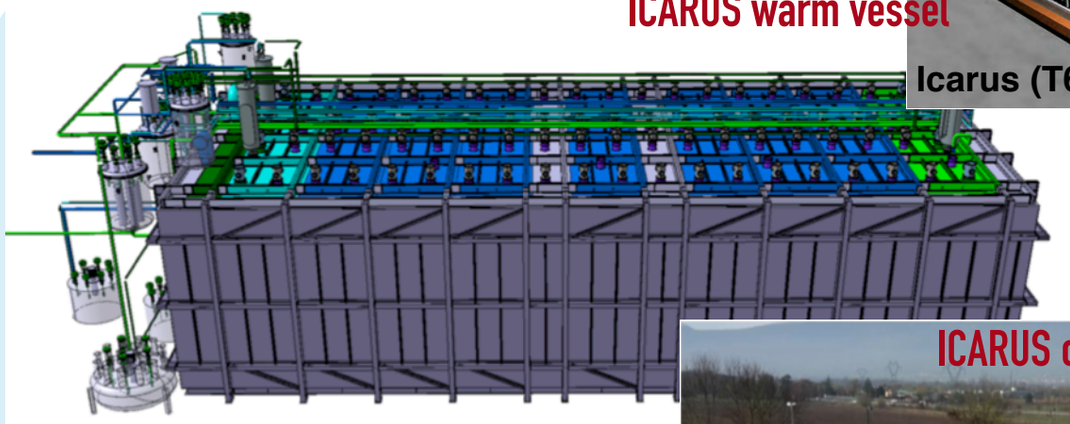
SBN Program

3x1x1m³ : first cryostat demonstrator



ICARUS warm vessel



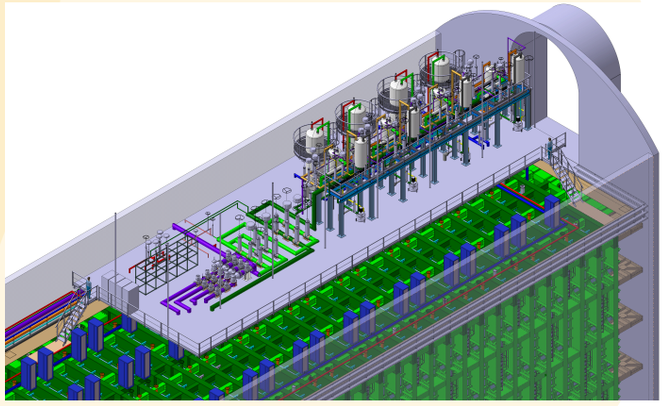


ICARUS cold vessel

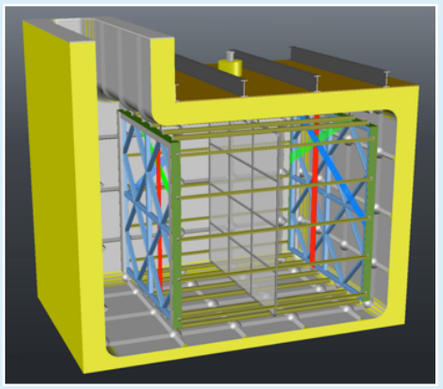
DUNE

SinglePhase ProtoDUNE-SP and DP ; 800 tons and 8x8x8 m3 warm cryostat

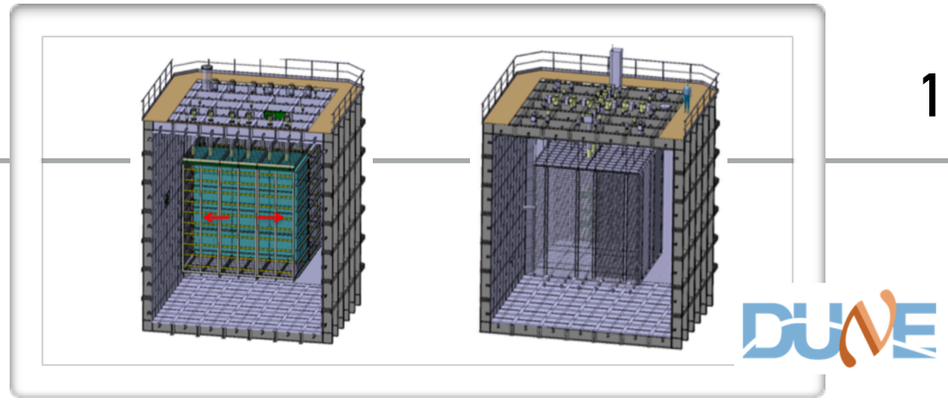
design for the first LBNF cryostat and cryogenics



SBND cryostat and cryogenics



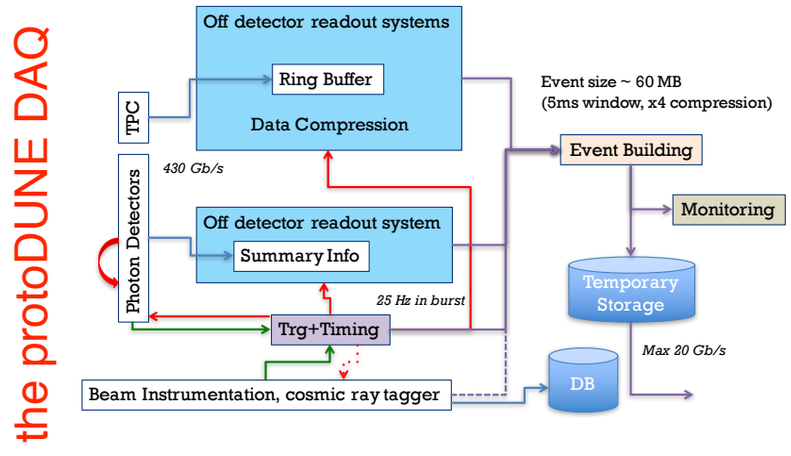
LARGE DATA HANDLING



DAQ:

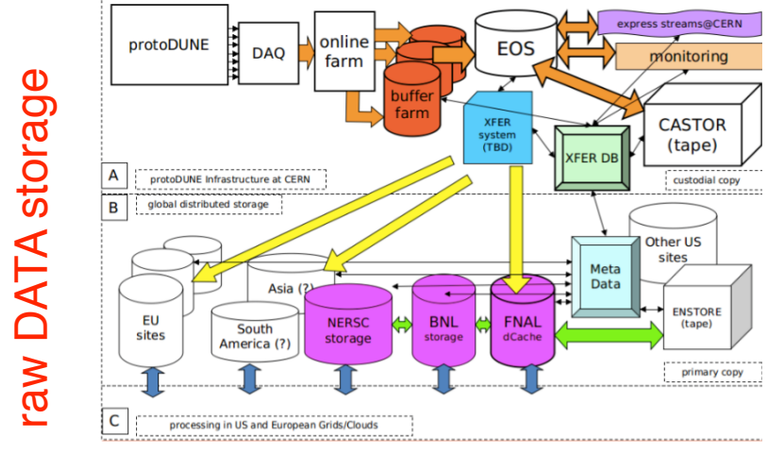
HEP2017 *see M.Potekhin talk*

- Large amount of data (~Tb/s) from protoDUNE detectors
- 2 DAQ systems used to receive data:
  - Reconfigurable Computing Elements (RCE) *from 35tons*
  - **Front-End-Link-EXchange** (FELIX) *from ATLAS*

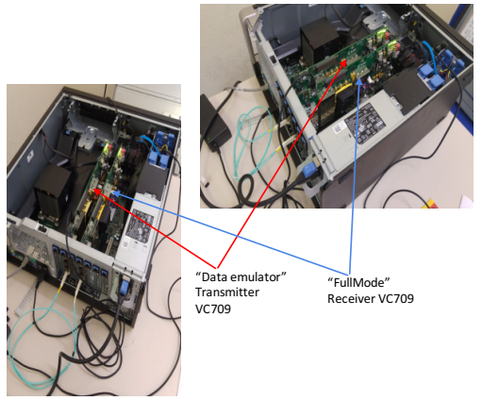


Computing:

- Data storage based on EOS (LHC experience)
- Tier0 for protoDUNE data
- Data processing operation
- Data transfer management monitor



test of FELIX setup

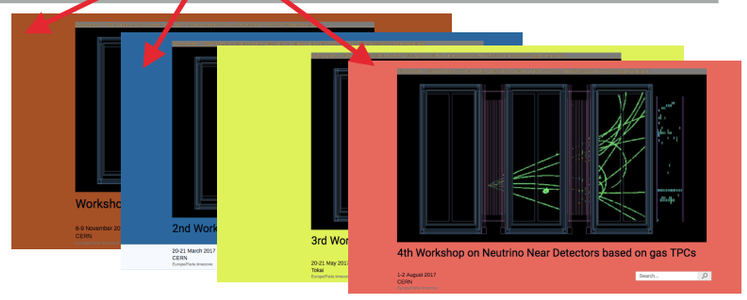


7th June: First DAQ equipment

water cooling system

15th May.: All racks installed

OTHER PROJECTS AND CONCLUSIONS



https://indico.cern.ch/event/644360/

- Other projects in the pipe-line (ArgonCube, ENUBET, ND280upgrade, ..)
- Large interest and expertise in Europe in near detector (ND) for next LBL experiment: serie of successful workshops on ND based on gas TPCs , contribution to DUNE ND effort, CERN as hub for European activities.. https://twiki.cern.ch/twiki/bin/view/CENF/NearDetector
- Activities in event reconstruction, simulations, data analysis with CERN EP-NU

To conclude:

- The NP offers to the neutrino community support for detector R&D and later construction for both US and Japanese activities
- A large neutrino test area with charged beam is just constructed and will be soon operational. Neutrino Platform involved in R&D, installation and commissioning of LAr detectors
- More activities to assist DUNE and T2K/HK in the definition of their future near detector are being planned