

Neutrino Platform

7-4-2016

Mandate

*“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.”*

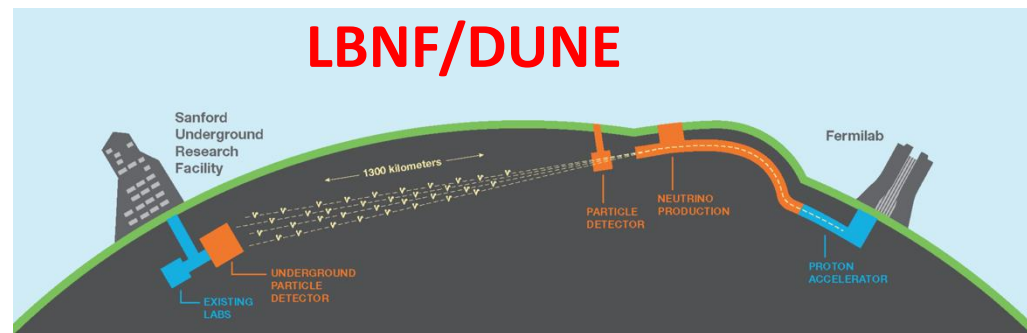
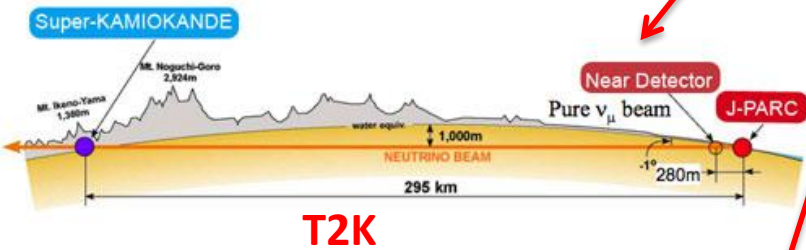
Our interpretation

- ✓ *no ν beams at CERN !*
 - ✓ *ν beams in the US and in Japan*
 - ✓ *A structure at CERN to foster an active involvement of Europe and CERN in the US and Japanese new facilities*
- **Neutrino Platform** as a project at CERN

ν future landscape (oscillation physics)

Neutrino Platform at CERN

SBN (short baseline)

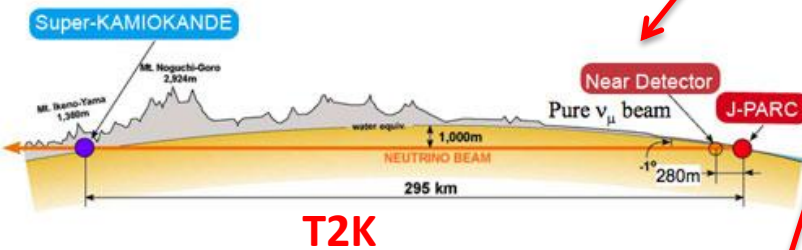


ν future landscape (oscillation physics)

Neutrino Platform at CERN

LAr technology

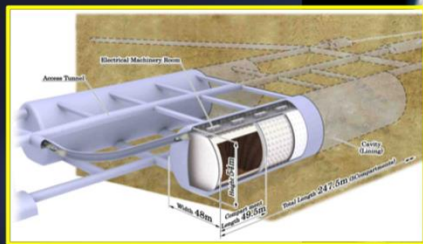
SBN (short baseline)



T2K

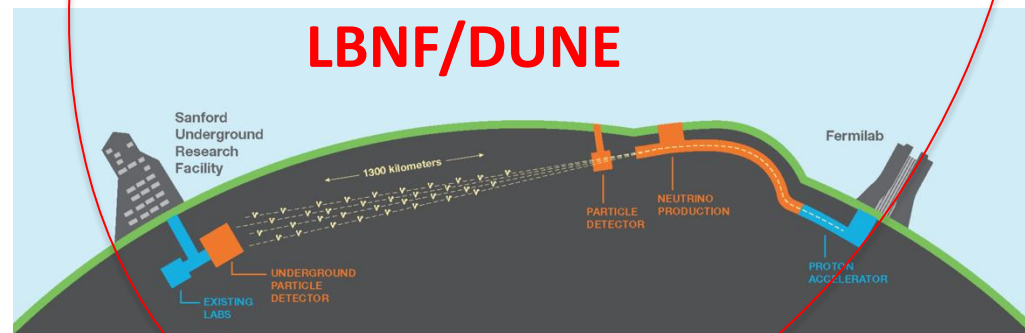
Hyper-Kamiokande in Japan

L=295km OA=2.5deg



LoL: The Hyper-Kamiokande Experiment arXiv:1109.3262v1

LBNF/DUNE



v Platform Projects (oscillation physics)

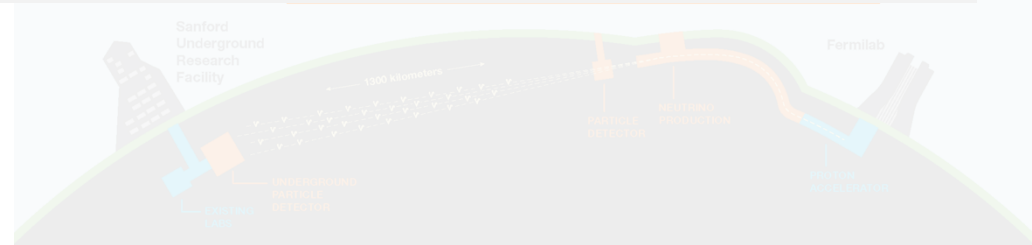
Neutrino Platform at CERN

6 Projects presented to the SPSC and approved:

- ✓ NP01: WA104, ICARUS as far detector for SBN
- ✓ NP02: WA105, demonstrator + engineering prototype for a double ph. TPC
- ✓ NP03: PLAFOND, an generic R&D framework
- ✓ NP04: ProtoDUNE, engineering prototype for a single phase TPC
- ✓ NP05: Baby Mind, a muon spectrometer for the WAGASCI experiment at T2K
- ✓ ArgonCube : a modular TPC R&D

2-3 in the pipeline

~ 5-6 MCHF/ large project (CERN)



ν future landscape (oscillation physics)

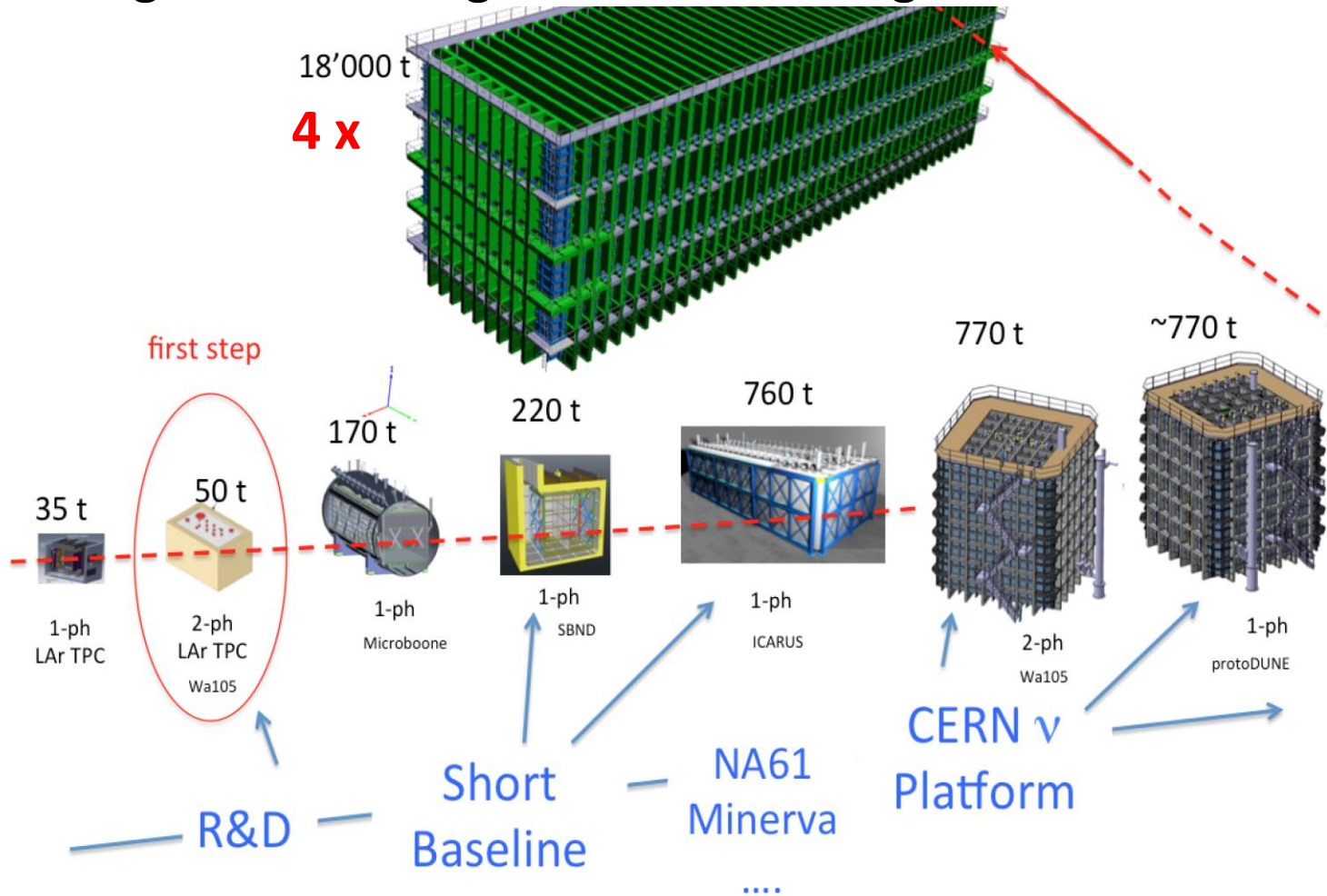
Neutrino Platform at CERN

CERN, CIEMAT Madrid, ETH Zurich, Gran Sasso Science Institute, IFIC Valencia, IN2P3, including IPNL, LPNHE, LAPP, APC, OMEGA, INFN Bari, INFN Bologna, INFN Lecce, INFN LNF Frascati, INFN LNGS, INFN Milano, INFN Milano Bicocca, INFN Napoli, INFN Padova, INFN Pavia, INFN Roma, Institut de Fisica d'Altes Energies (IFAE) Barcelona, Institute College of London, IRFU CEA Saclay, Lancaster University, National Center for Nuclear Research Otwock, NTUA Athens, Ruder Boskovic Institute Zagreb, STFC Rutherford Appleton Laboratory, Università di Bari, Università di Bologna, Università di Padova, Università di Roma 'La Sapienza', Università di Salento, University of Bern, University of Cambridge, University of Geneva, University of Glasgow, University of Jyväskylä, University of Liverpool, University of Manchester, University of Oulu, University of Oxford, University of Sheffield, University of Sofia, University of Sussex, University of Warwick, UST Cracow

European Institutions who are signing ν Platform MOU addenda (today 49)

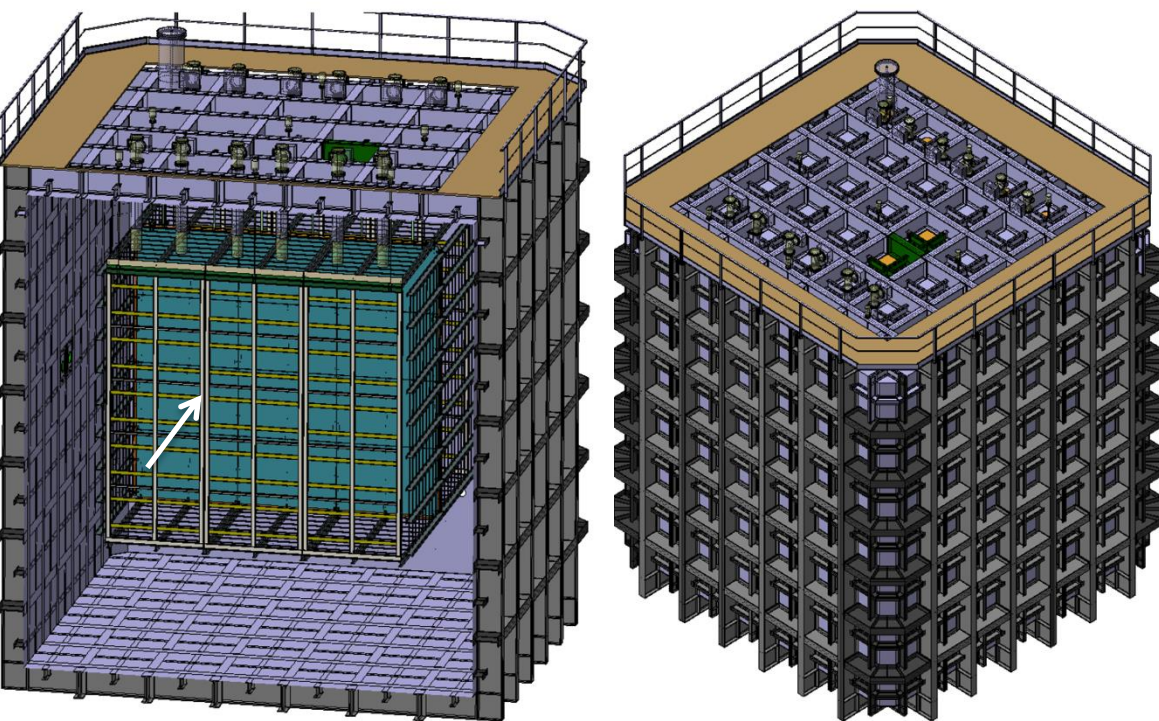
Step by step (LAr TPCs)

- the large scale is a big and new challenge

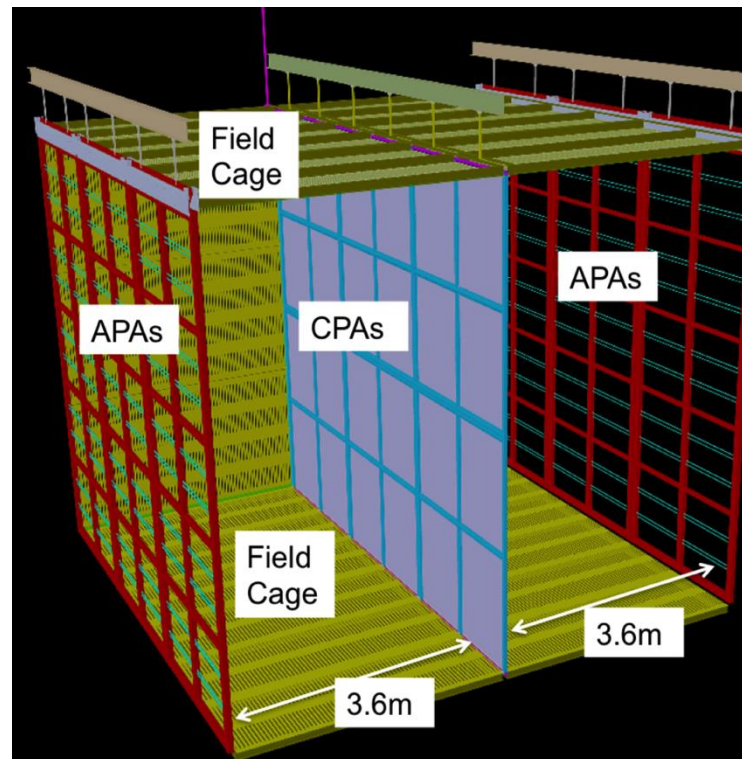


To succeed we need to proceed in steps (for cryostats, cryogenics and detectors)

Single phase protoDUNE



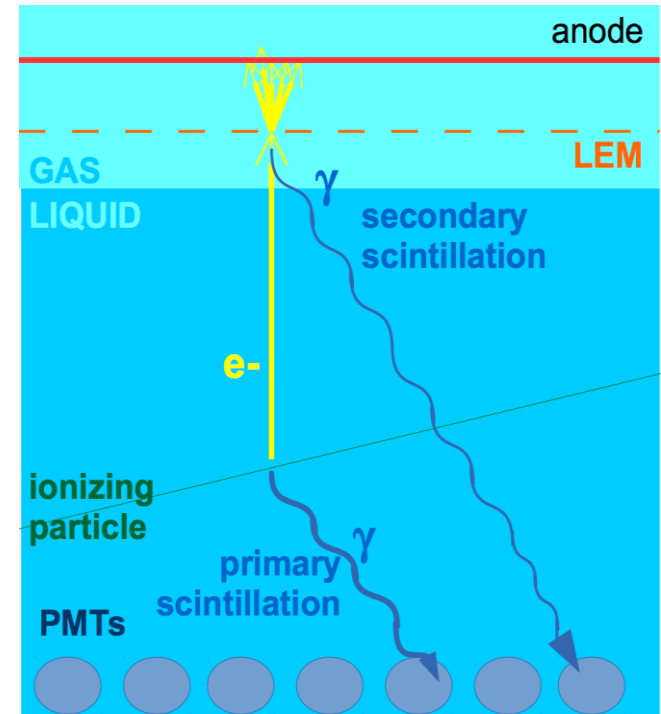
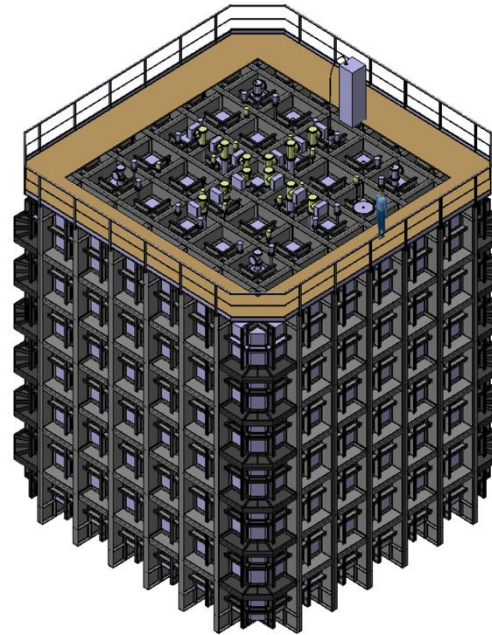
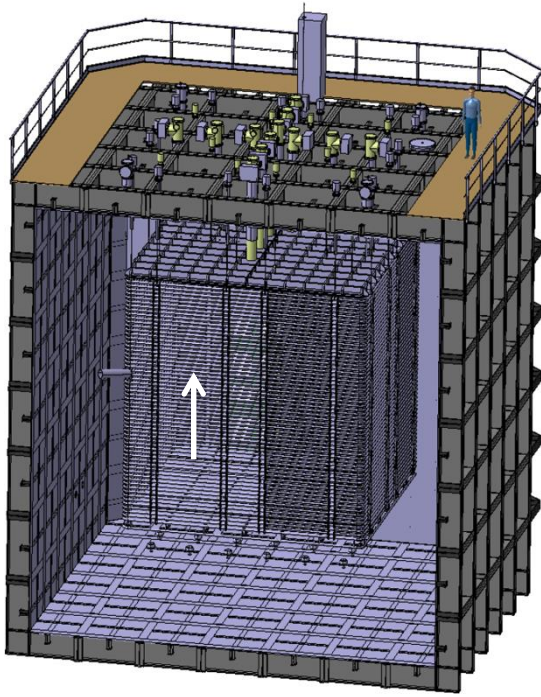
Single phase LAr TPC



Operational in 2017,
SPS calibration beams in 2018

Active volume $\sim 7 \times 7 \times 6 \text{ m}^3$

Double phase protoDUNE



Double phase LAr TPC

Operational in 2017,
SPS calibration beams in 2018

Active volume $6 \times 6 \times 6 \text{ m}^3$

Large prototyping activities for LBNF/DUNE

To learn about:

- Large cryostats of a new generation (LNG carrier technology) ~1000 tons LAr
- Very pure cryogenics at the ppt level, large plants
- New technologies for LAr Time Proportion Chamber technology (single phase, double phase)
- Large data sets (similar to LHC-heavy ions)
- New photon detector technologies (large area SiPM arrays?), interesting for other applications (space, dark matter, telescopes,...)
- Large size detector engineering integration
- Automatic pattern recognition (new in the community !)
- Team/Collaboration building in the Neutrino Community

We expect at CERN ~ 250 Collaborators, ~100 from USA

Large prototypes test area

- Extension of the nord area EHN1 building
- Most of the civil engineering work done, starting now the metallic structure
- Infrastructure (services, safety, logistics, counting rooms, ...) organised by the CERN infrastructure team (CERN technical sector). All components are under procurement or installation.
- All financed by CERN
- EHN extension beneficial occupancy for September 2016
- 2 beam lines in preparations, commissioning in late 2017

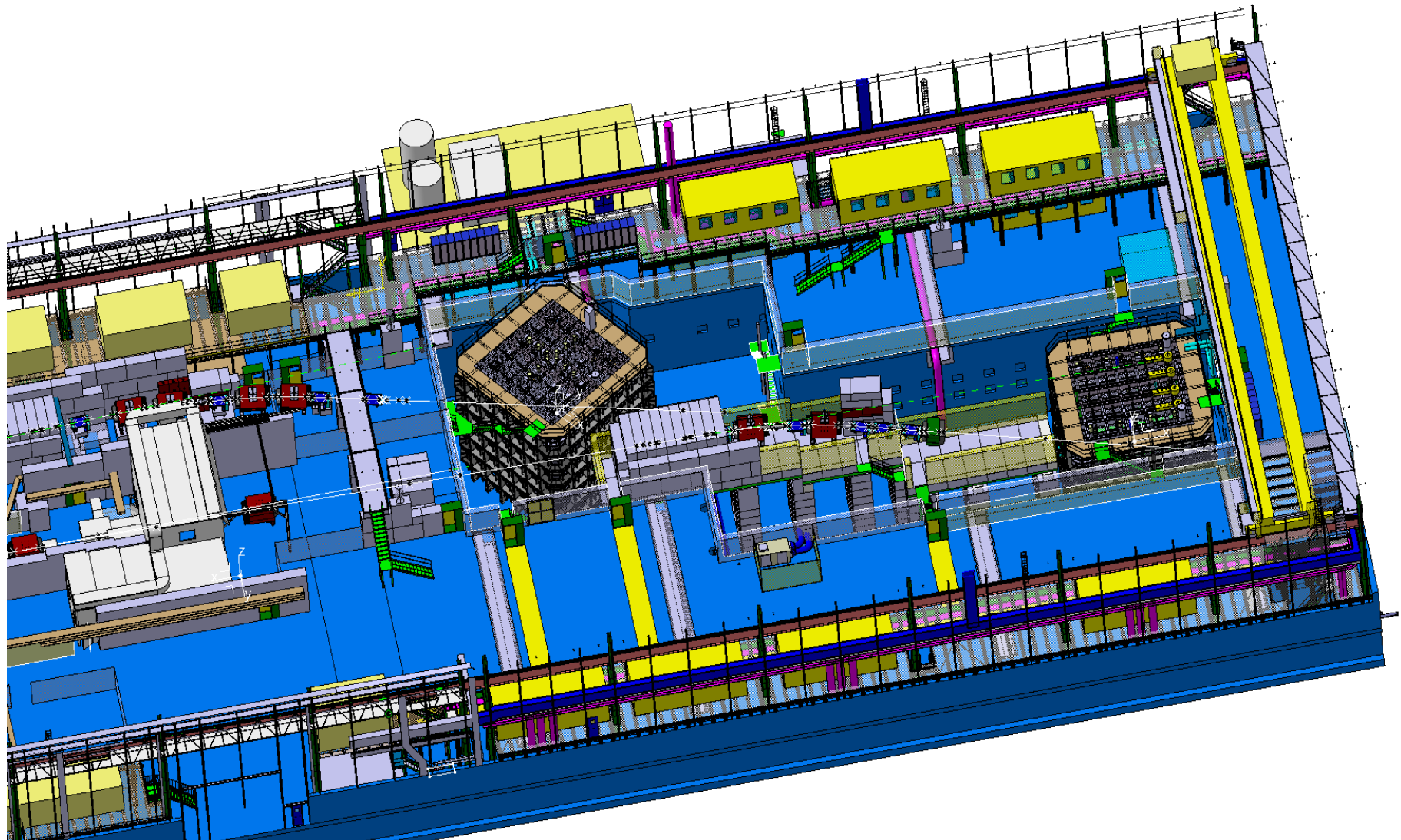
EHN1 extension status

08/03/2016

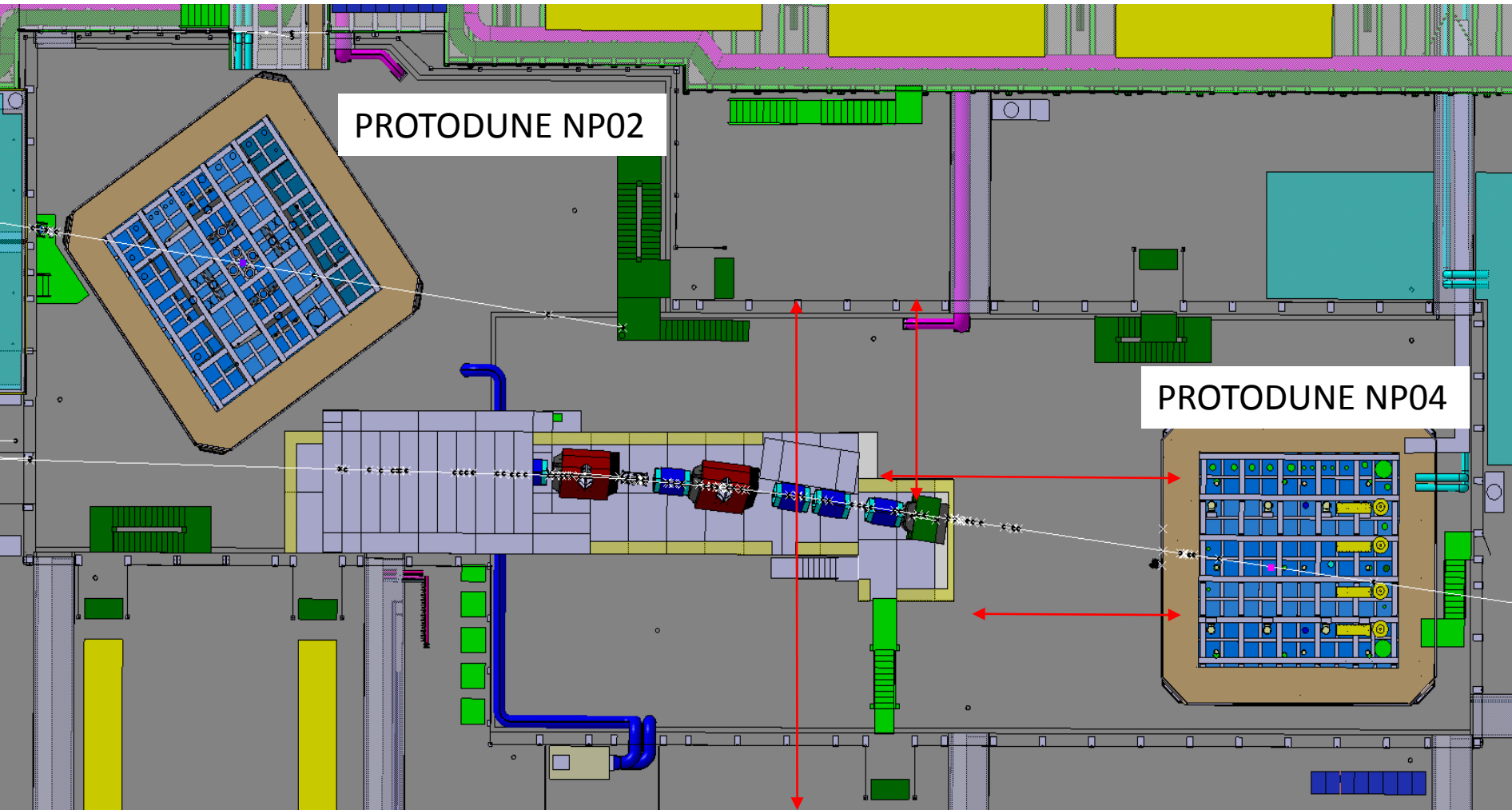
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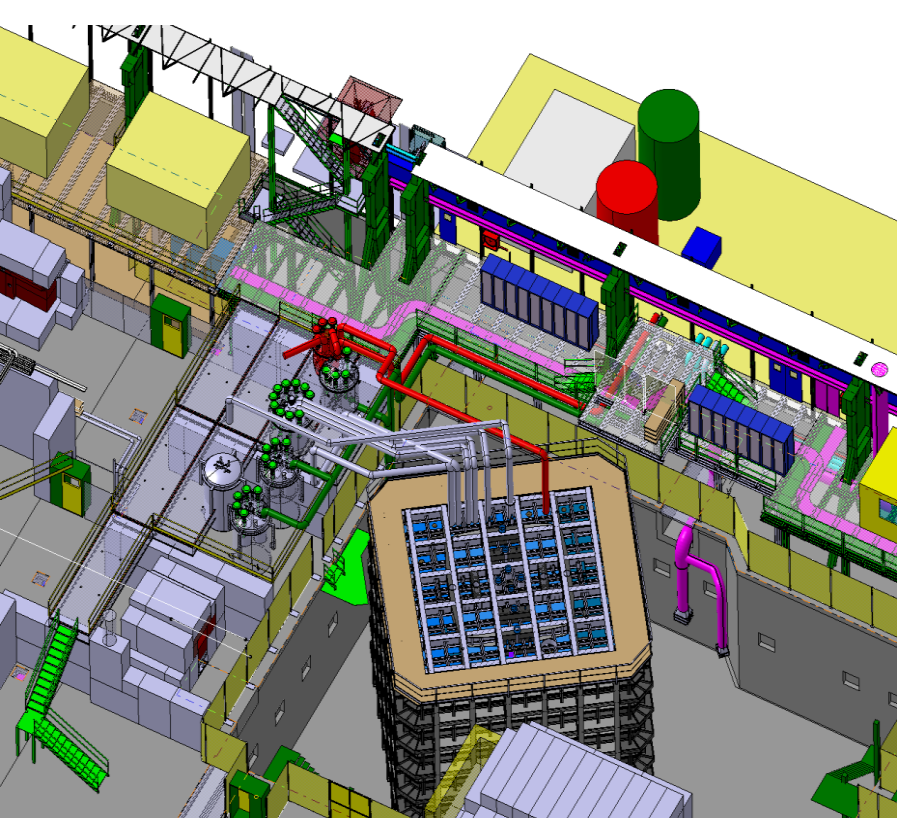


Large prototyping activities for LBNF/DUNE

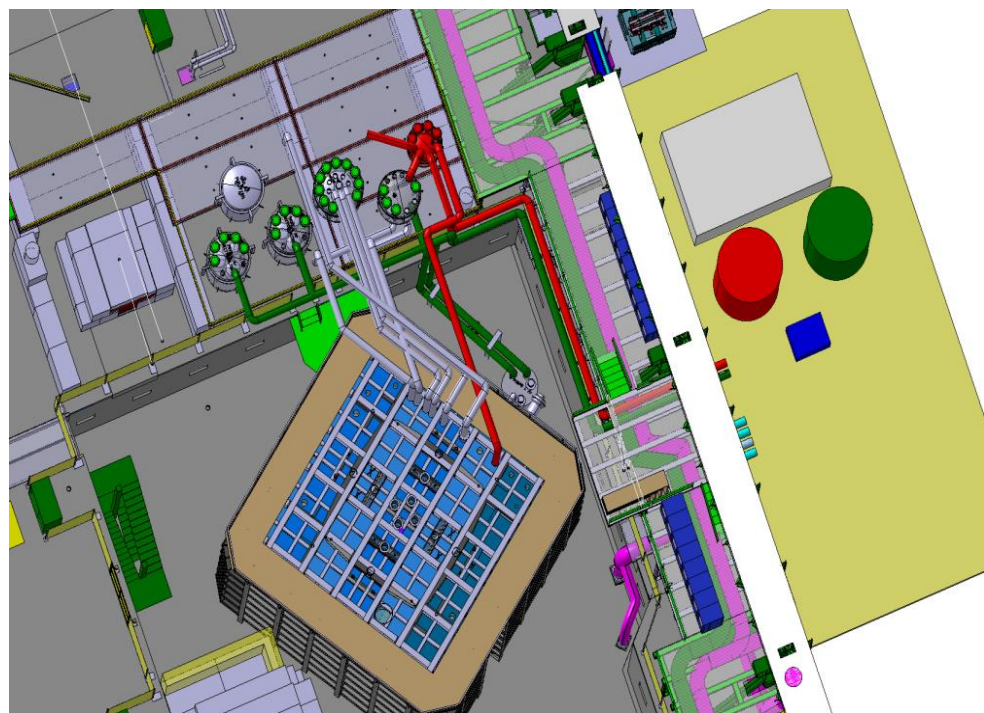


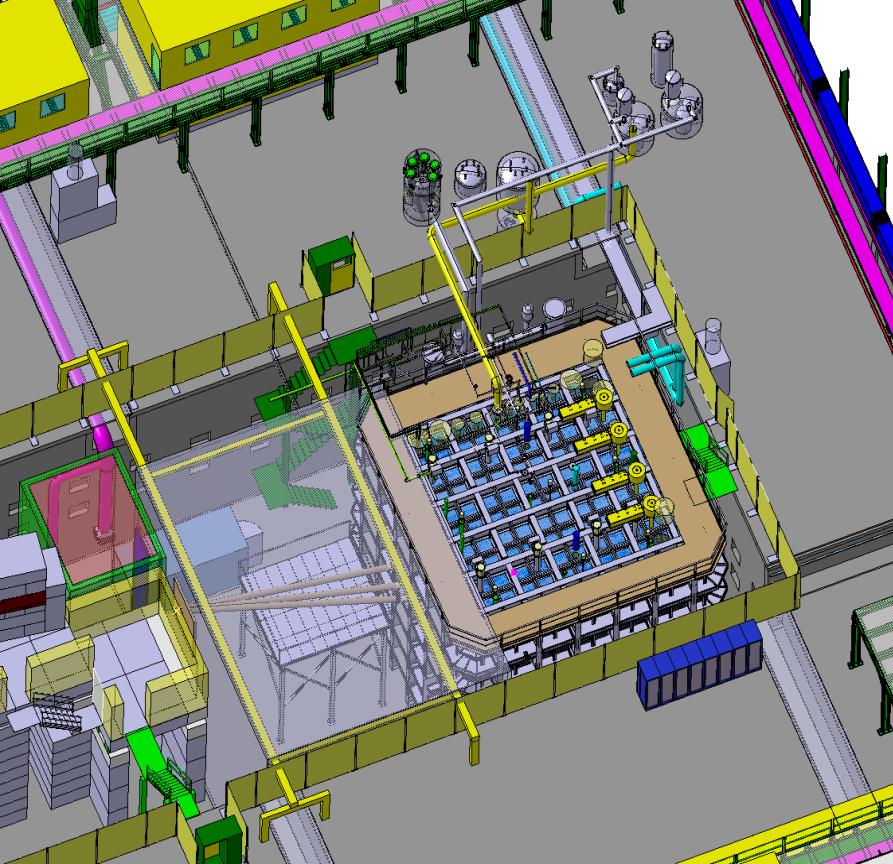
CERN provides Civil Engineering and Infrastructure, investment for the future also for other applications





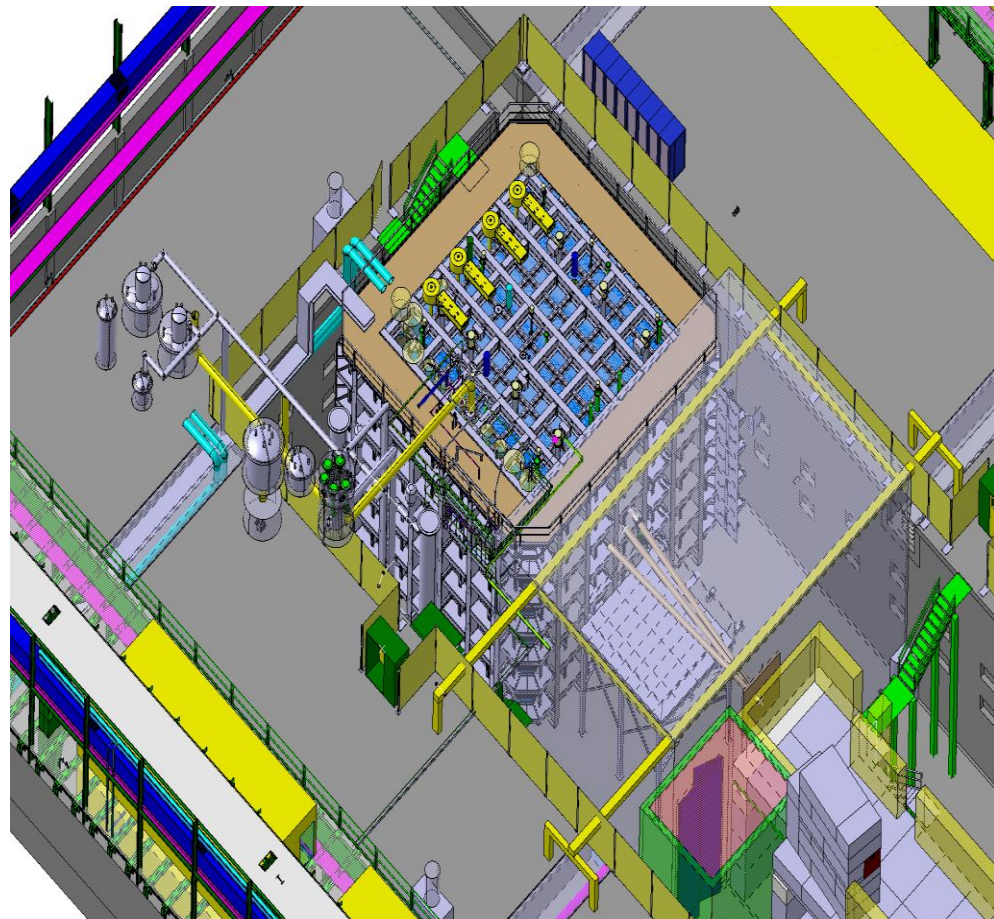
WA105/NP02
CRYOGENIC AREA





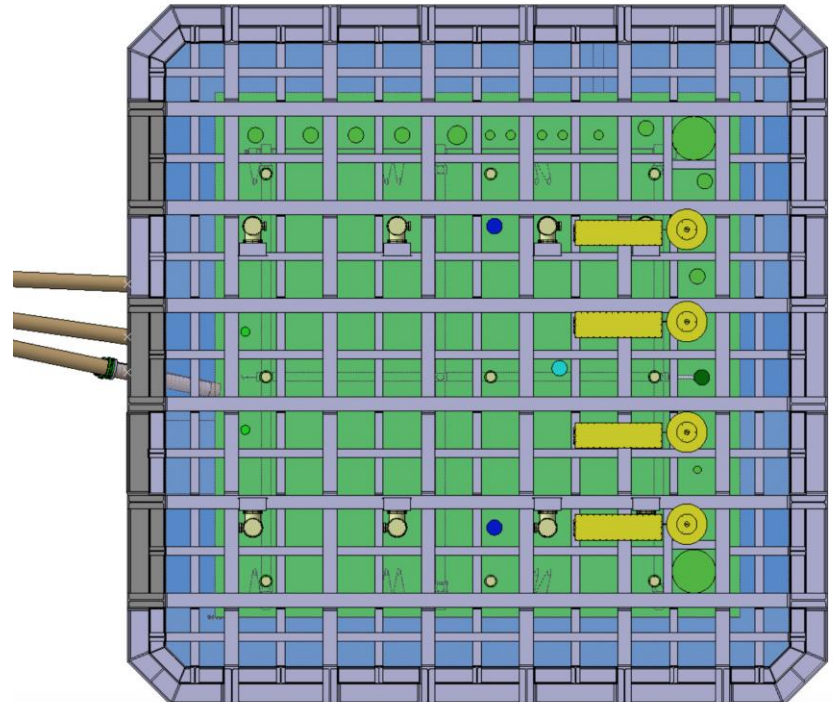
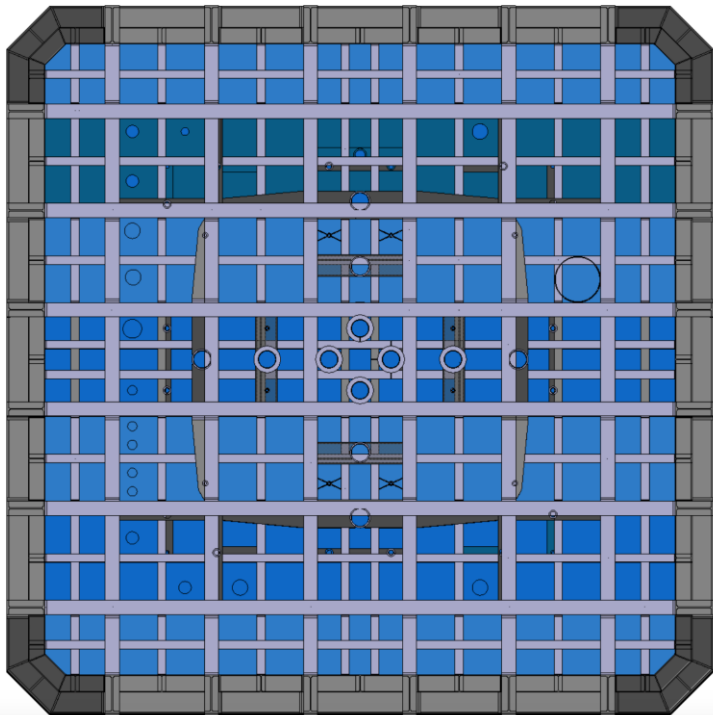
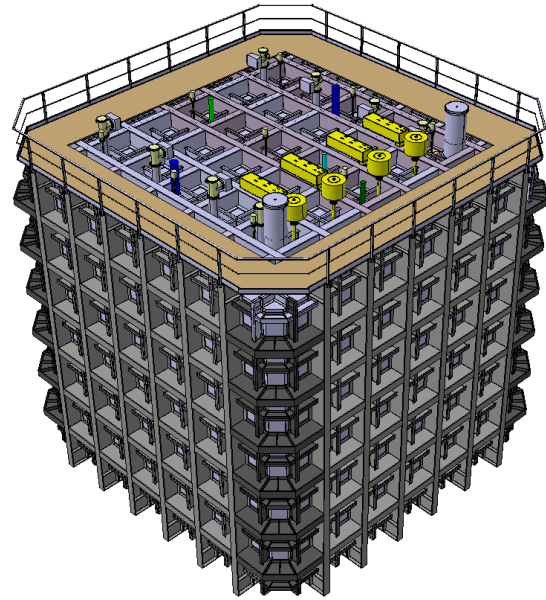
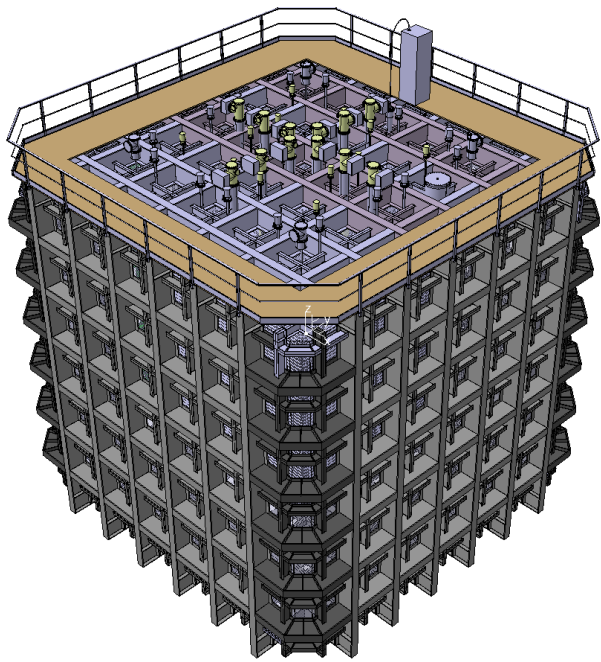
PROTO DUNE
single phase (NP04)

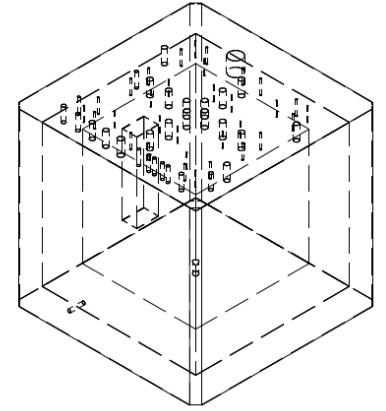
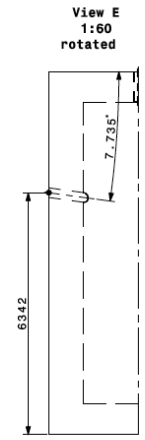
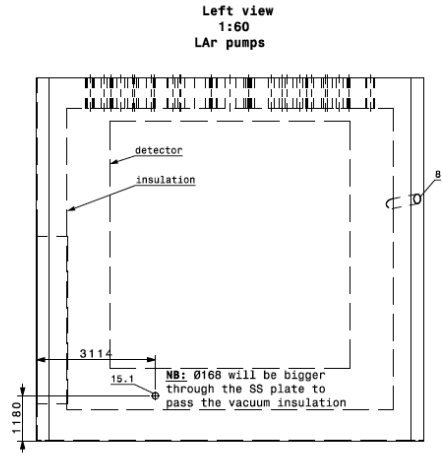
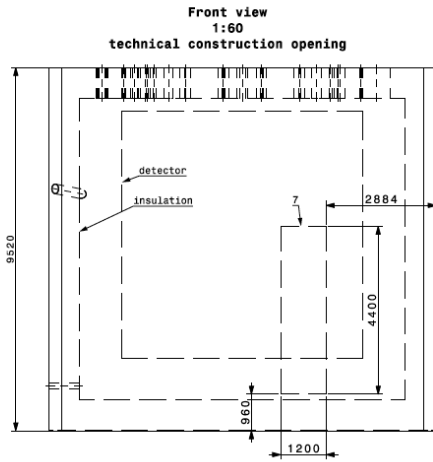
Cryogenics area + installation
clean room



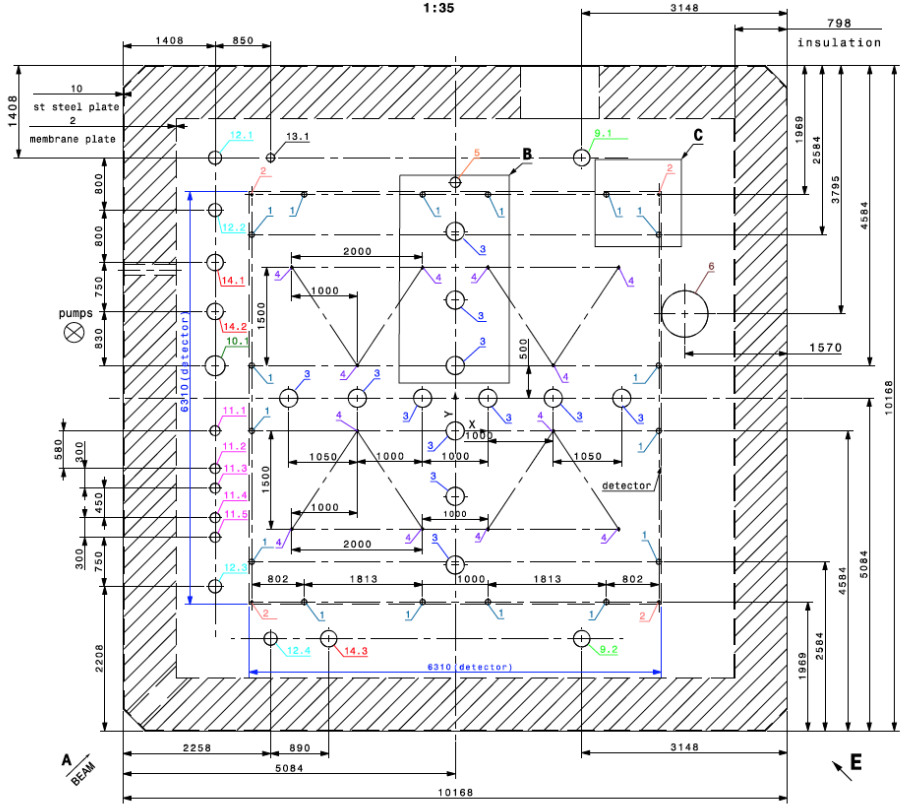
ProtoDUNE's cryostats

- Membrane cryostats + outer structures
- Outer structure CERN design done
- Membrane cryostat engineering contracted to the firm GTT in Paris
- Requirement documents approved (dimensions, thermal properties, penetration layouts, beam penetrations, internal cryogenics, ...)
- Construction contract for the outer structure in place, delivery in summer 2016
- Tendering for the membrane material ongoing, goal for delivery: end September
- Tendering for membrane + insulation installation in preparation. Work should start in October
- All costs covered by CERN for both cryostats
- Goal, cryostats ready for spring 2017





Top view
1:35

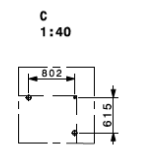
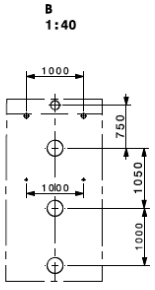


Detector penetrations

Pos.	Diameter [mm]	Qty.	Description
1	Ø80	16	Field Cage Suspension
2	Ø40	4	Slow Control Chimneys
3	Ø277	12	Signal Chimneys FTS
4	Ø40	12	Anode Suspensions FTS
5	Ø156	1	High Voltage Feedthrough
6	Ø710	1	Manhole
7	4400x1200mm	1	Temporary Construction Opening
8	Ø250	1	Beam window
9.1	Ø250	2	Spare
9.2	Ø250	2	Spare

Cryogenic penetrations

Pos.	Diameter [mm]	Qty.	Description
10.1	Ø304	1	Gar Combo
11.1	Ø152	5	LAr Cooldown
11.2			LAr Distribution
11.3			Lar to Cold Roof
11.4			LAr Cooldown to Condenser
11.5			Gar Boil Off
12.1	Ø200	4	Cryostat Pressure Relief 1
12.2			Cryostat Vacuum Relief 1
12.3			Cryostat Pressure Relief 2
12.4			Cryostat Vacuum Relief 2
13.1	Ø125	1	Instrumentation
14.1	Ø250	3	Spare & Instrumentation
14.2			Spare & Instrumentation
14.3			Spare
15.1	Ø168 (See NB in Left view)	1	LAr Pump



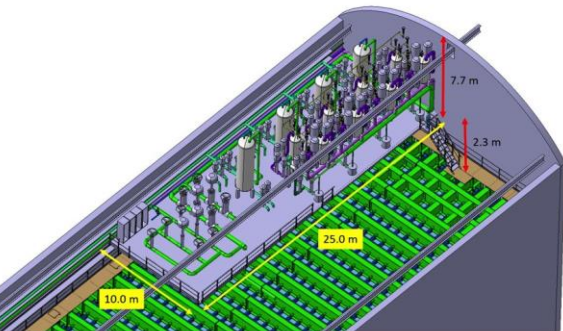
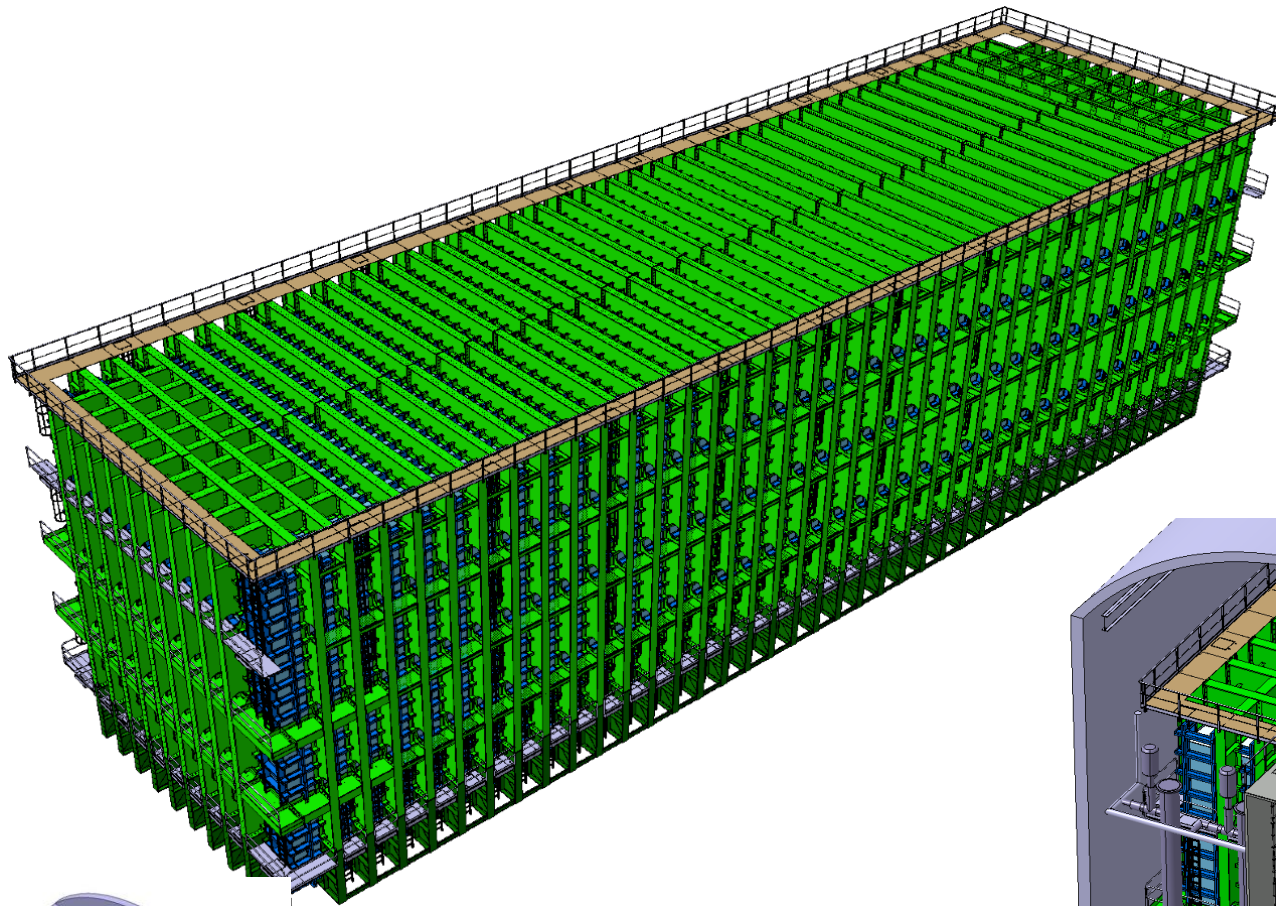
WA105 Cryostat		NAME: E. Seletskaya 2016-03-14	
WA105 PENETRATIONS		SCALE:	CONTROLLED:
10168X9520		1:1	APPROVED:
		CDR Document Number:	ST0750437_02
		REPLACES:	
NON VALABLE POUR EXECUTION NOT VALID FOR EXECUTION		SIZE	IND.
CEN105CR0109		1	1

WA105 Cryostat Penetrations
 10168X9520
 E. Seletskaya
 2016-03-14
 1:1
 ST0750437_02
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First Demonstrator (WA105)

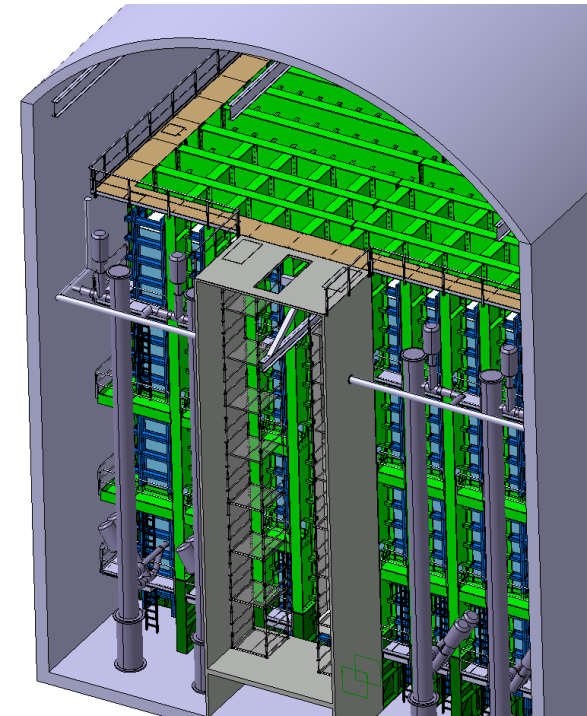


DUNE cryostat under design @ CERN

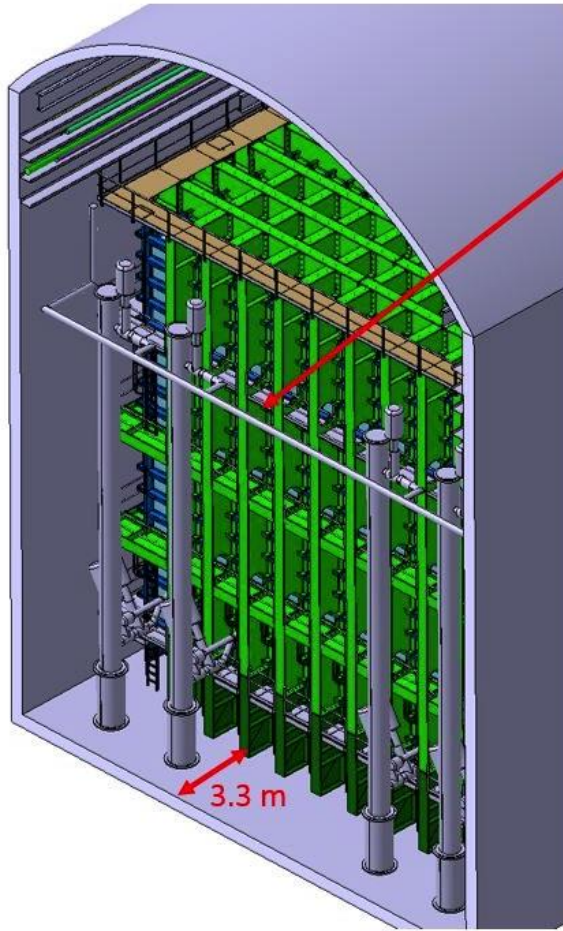


Next big step in the design:

- Penetrations definition
- Detector installation strategy



LBNF : LAr cryostat and cryogenics



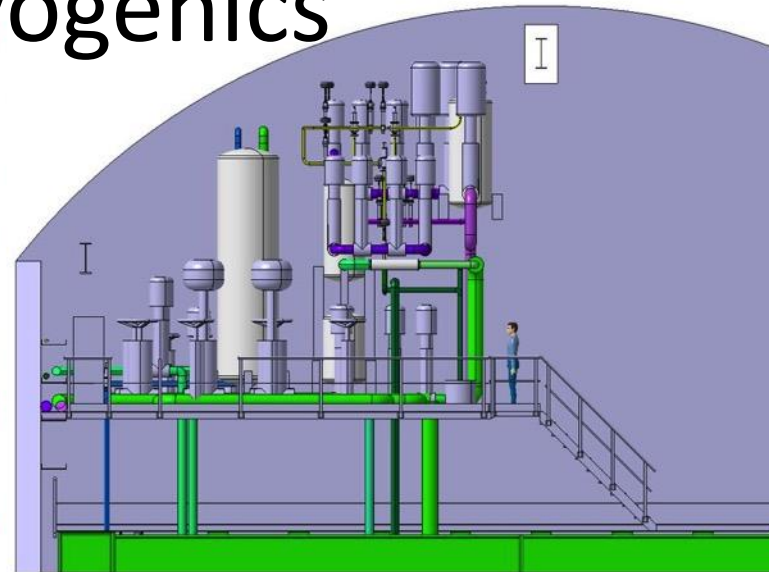
LAr pumps location

3.3 m

CERN design

7.7 m

2.3 m



Proximity cryogenics
mezzanine

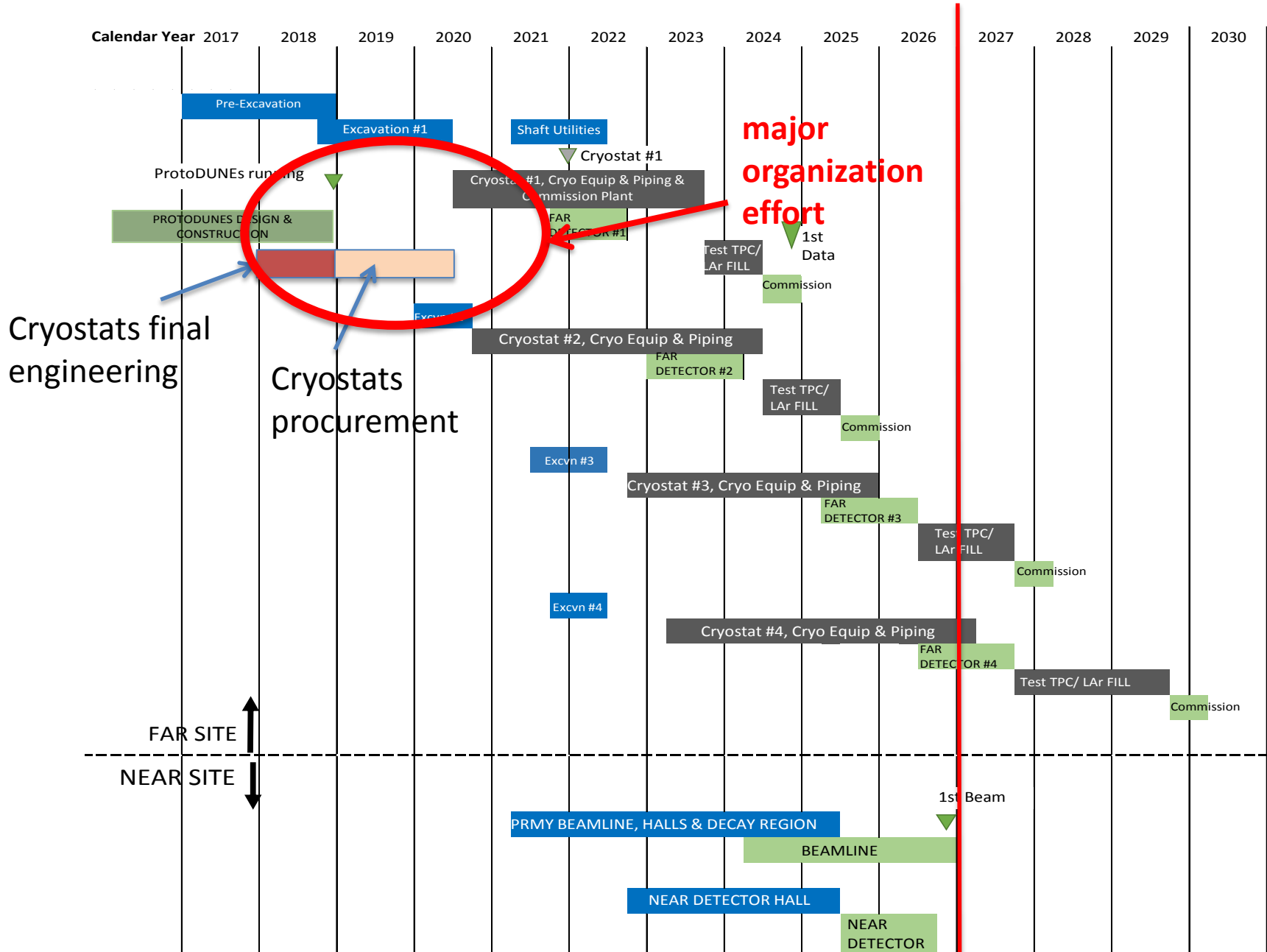
7.7 m

2.3 m

25.0 m

10.0 m

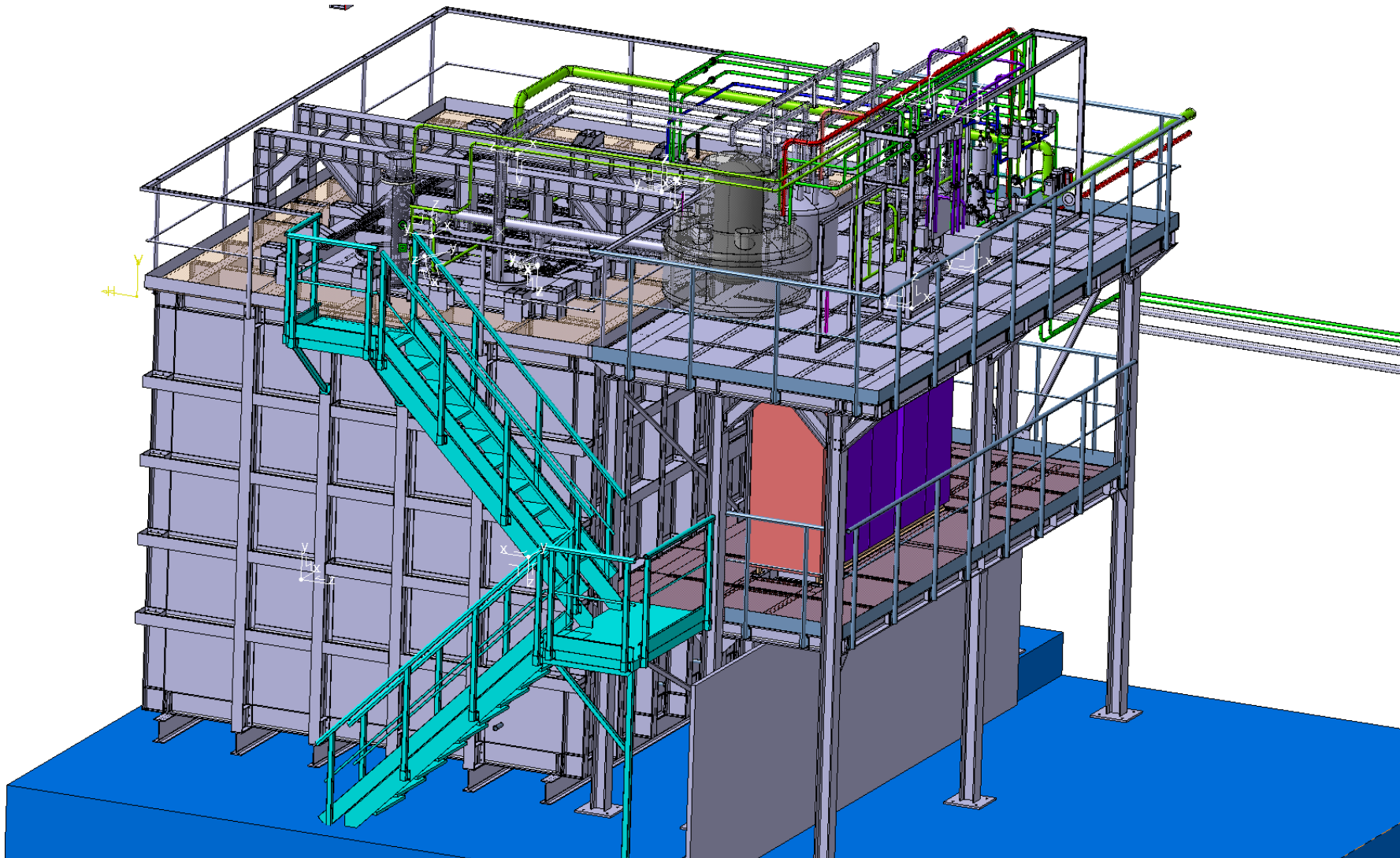
LBNF/DUNE – Construction Summary



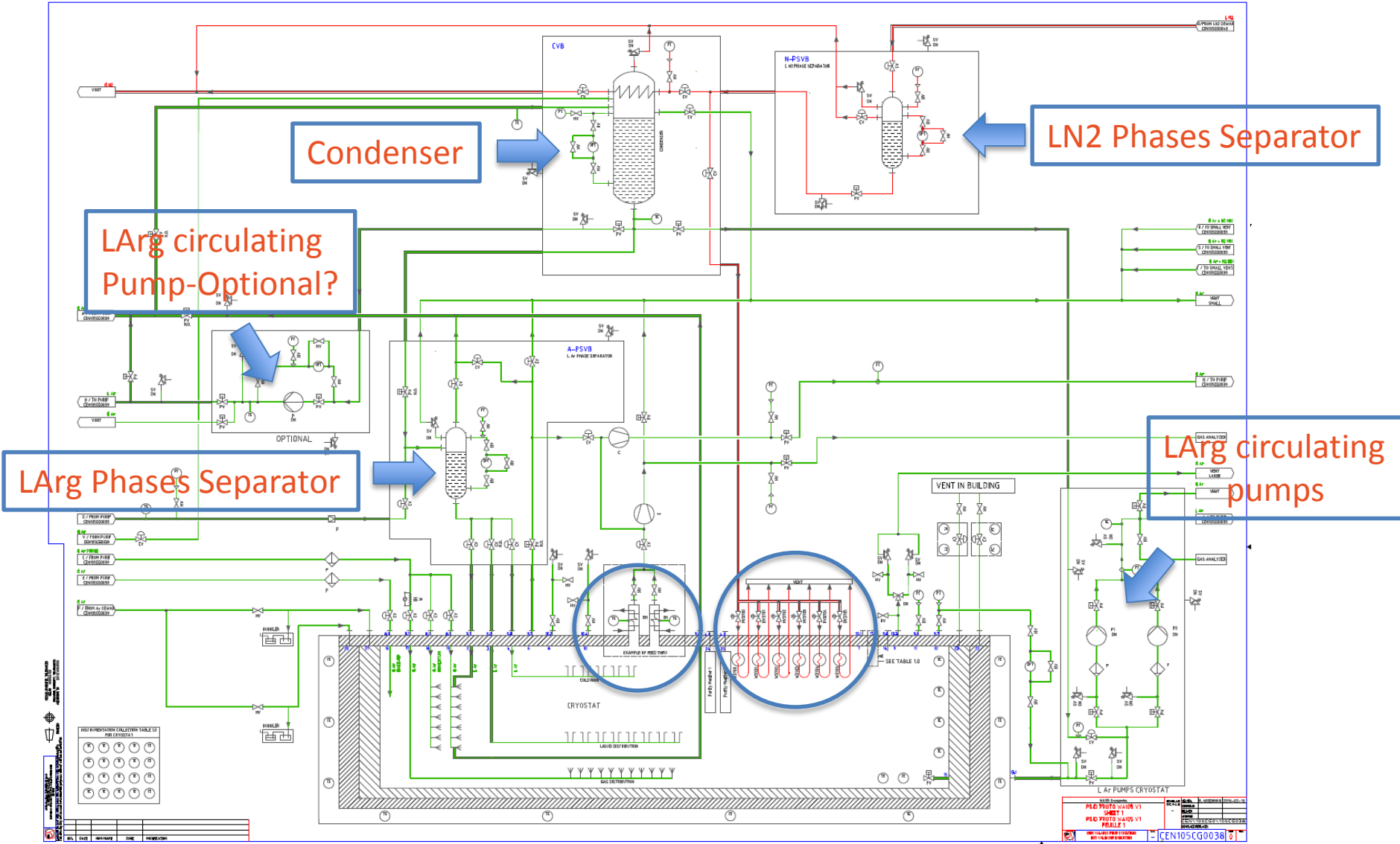
ProtoDUNE's cryogenics

- CERN has restarted a new important effort on LAr cryogenics, recreating a team in the existing cryolab
- Strong collaboration with the FNAL LAr cryogenics group, with FNAL engineers stationed at CERN
- LAr purity is the critical issue, important efforts ongoing in the test of the purification system as proposed by FNAL
- Phase 2 demonstrator (WA105) in bldg. 182 is the first plant to be constructed, contract is out. This cryo-plant should be operational in summer 2016
- Specifications documents for the protoDUNE's cryogenics in the final phase. Final review next week, before starting a large tendering process. Installation by the end of 2017

WA105 b182 cryogenics plant



ProtoDUNE's cryogenics plant (<https://edms.cern.ch/document/1566415/1>)



What else the Platform is offering to protoDUNE

- A team working on the mechanical integration of the detector inside the cryostat using the CERN engineering tools (it works already for the single phase): 1 engineer + 2 designers
- A team of physicists, engineers and technicians who will guide/participate in the installation at CERN of the detectors, in cooperation with the collaboration (clean rooms, tools, process, QA process, components acceptance,..). Link to the CERN services and organization
- A team presently working on specific detectors components : cathodes, field cage, grounding planes, HV distribution, ... This include design, R&D and specific test
- A team working on photon detectors : regular cryo-PMTS, SIPM and preparing the readout for ICARUS and for a cosmic tagger system for the short baseline. This group could collaborate in a major R&D effort on SIPM arrays
- A team working on simulation and reconstruction (already active on the single phase protoDUNE)
- A team working on a new DAQ proposal (LHC FELIX), which includes a slow control effort

ALL these teams can be inserted or be part of a larger collaboration effort, with other european partners

- Unique opportunity to rebuild a strong European Neutrino community
- Immediate physics potential with the exploitation of the short baseline at FNAL and the T2K new near detector
- Major contribution to the infrastructure of LBNF (European consortium with CERN ?)
- Design and construction of new large detector prototypes
- Generic R&D on new detectors and data handling
- Participation in the construction, commissioning and physics exploitation of the new high intensity facility