

The CERN Neutrino Platform

The background of the slide is a complex, abstract image with a deep blue color palette. It features numerous thin, glowing lines and streaks that radiate from various points, creating a sense of dynamic movement and energy. These lines resemble particle tracks or data paths in a scientific context. In the upper right quadrant, there is a more defined, circular structure that looks like a cross-section of a particle detector or a complex piece of machinery, with some internal components and lights visible. The overall effect is one of high-tech, futuristic science.

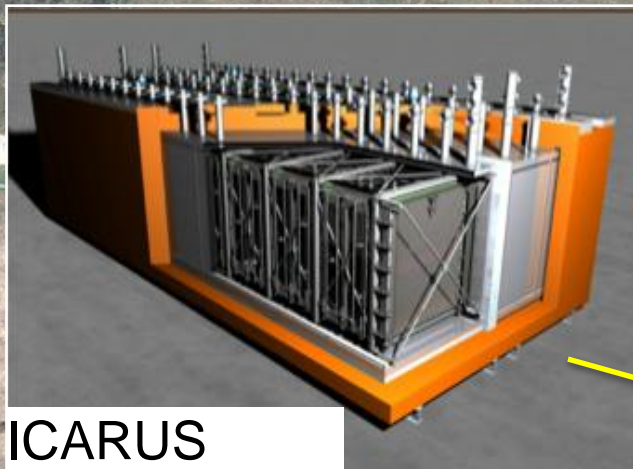
2nd December 2014, What Next-Padova

Marzio Nessi, CERN & University of Geneva

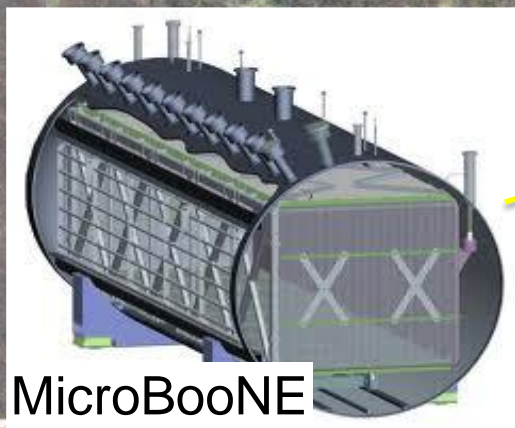
The future possible landscape for new Neutrino Accelerator Infrastructure (as far we understand today!)

- ✓ *no beams at CERN!*
- ✓ *US and/or Japan ?*

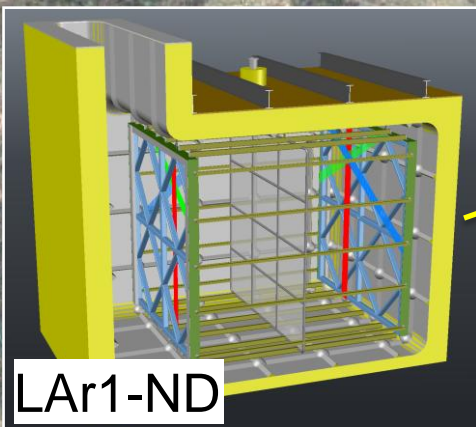
SBL at the FNAL ~ 0.8 GeV ν Booster Beam



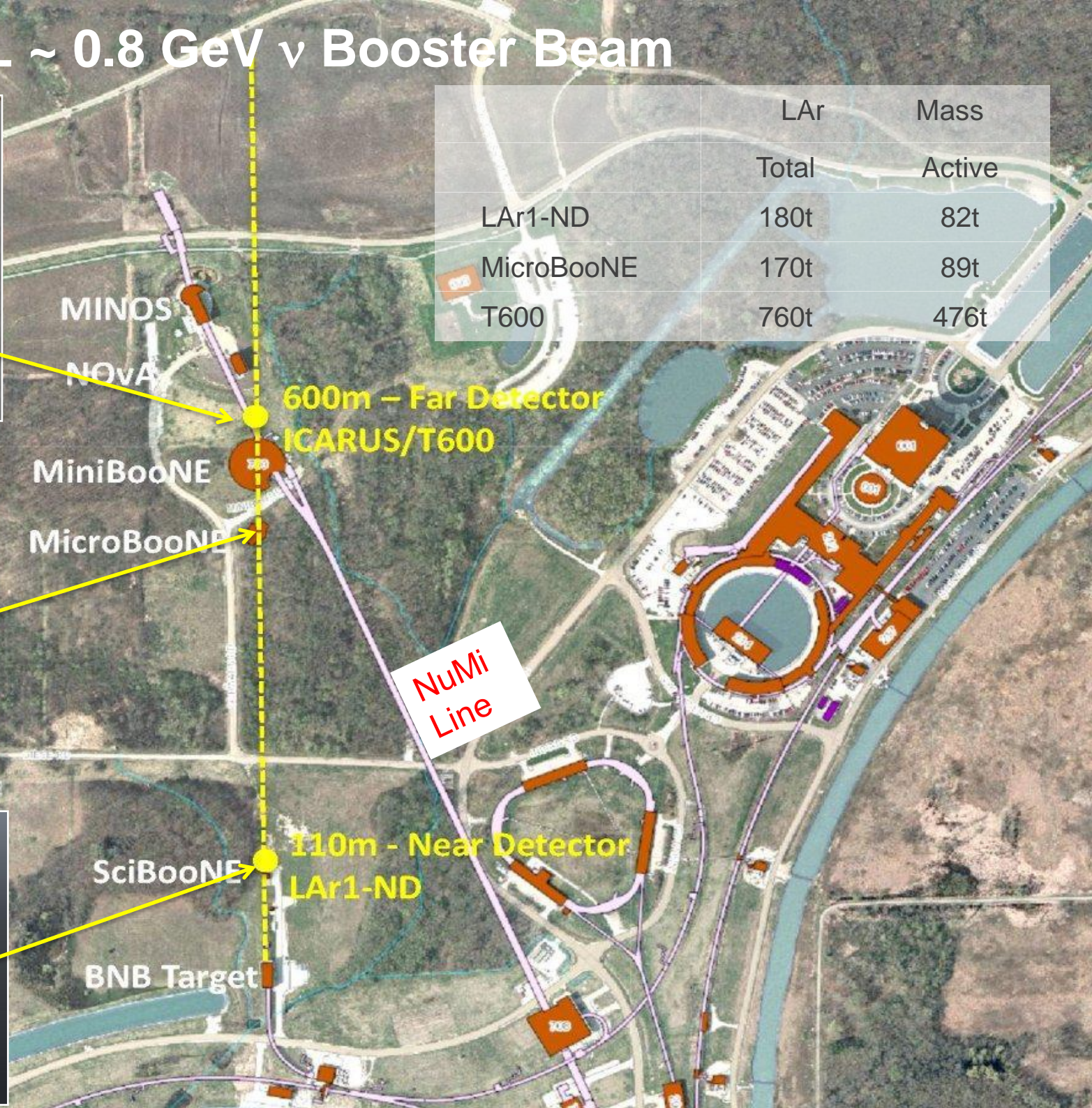
ICARUS
T600



MicroBooNE



LAr1-ND



	LAr	Mass
	Total	Active
LAr1-ND	180t	82t
MicroBooNE	170t	89t
T600	760t	476t

NuMi
Line

600m - Far Detector
ICARUS/T600

110m - Near Detector
LAr1-ND

MINOS
NOVA

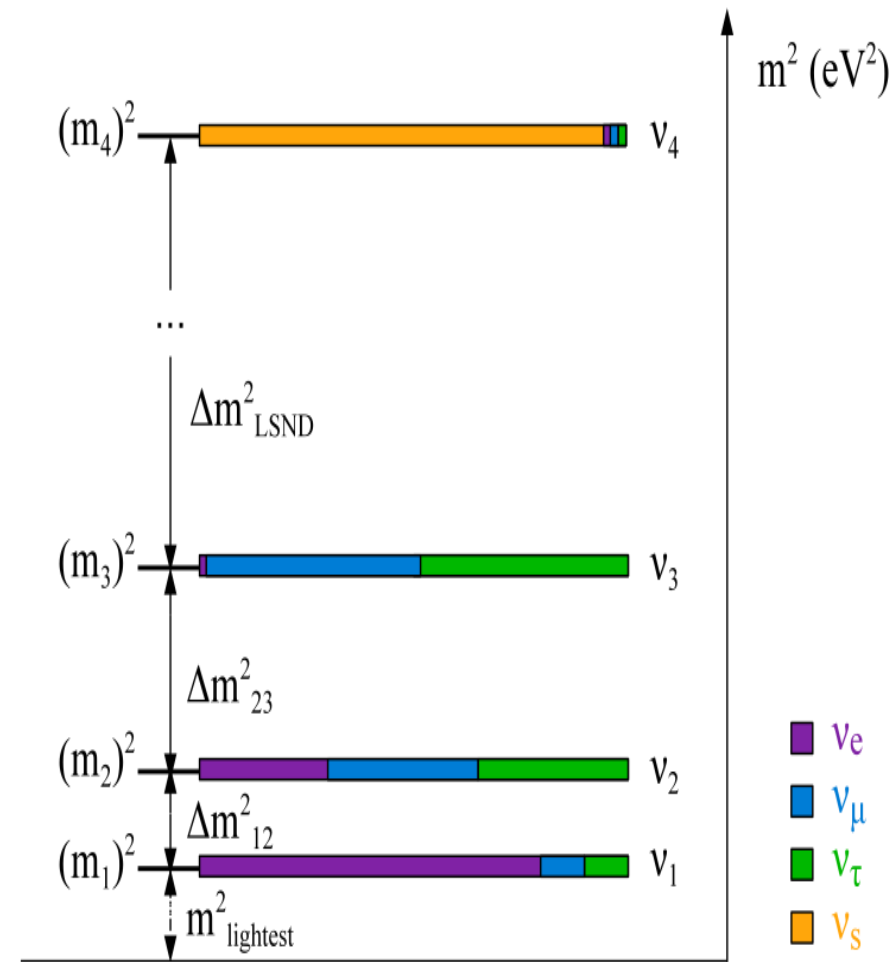
MiniBooNE
MicroBooNE

SciBooNE
BNB Target

SBL Physics Program

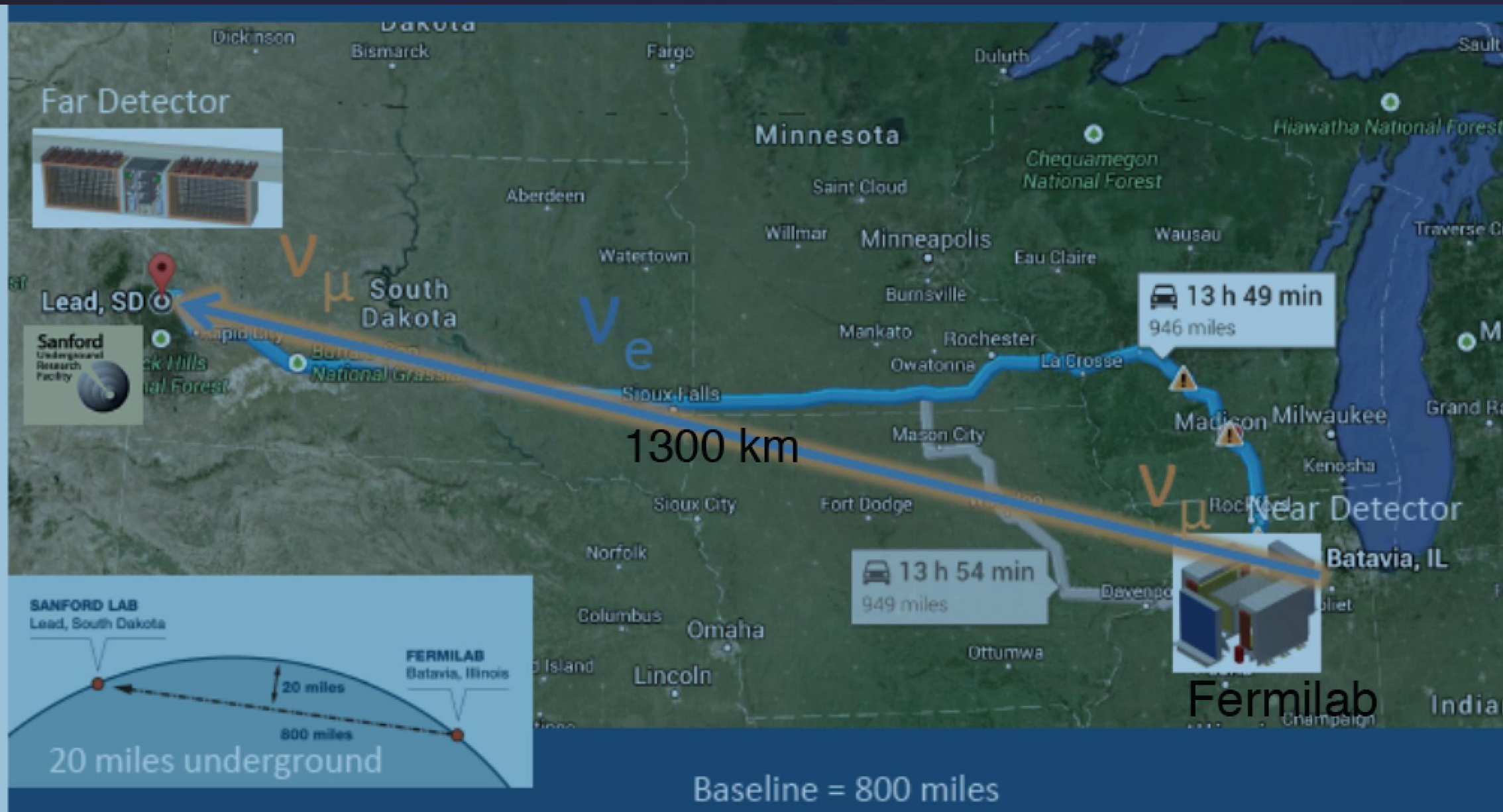
- A Multi-detector program will address the unexplained anomalies which together could be hinting at new physics (steriles?)
 - *MicroBooNE will address MiniBooNE low energy excess but is not designed to explore the complete sterile neutrino oscillation parameter space on its own*
 - *Plans to have all 3 detectors in operation in 2018 (LOI submitted, proposal in January 2015)*

Experiment	Type	Channel	Significance
LSND	DAR	$\bar{\nu}_\mu \rightarrow \bar{\nu}_e$ CC	3.8σ
MiniBooNE	SBL accelerator	$\nu_\mu \rightarrow \nu_e$ CC	3.4σ
MiniBooNE	SBL accelerator	$\bar{\nu}_\mu \rightarrow \bar{\nu}_e$ CC	2.8σ
GALLEX/SAGE	Source - e capture	ν_e disappearance	2.8σ
Reactors	Beta-decay	$\bar{\nu}_e$ disappearance	3.0σ



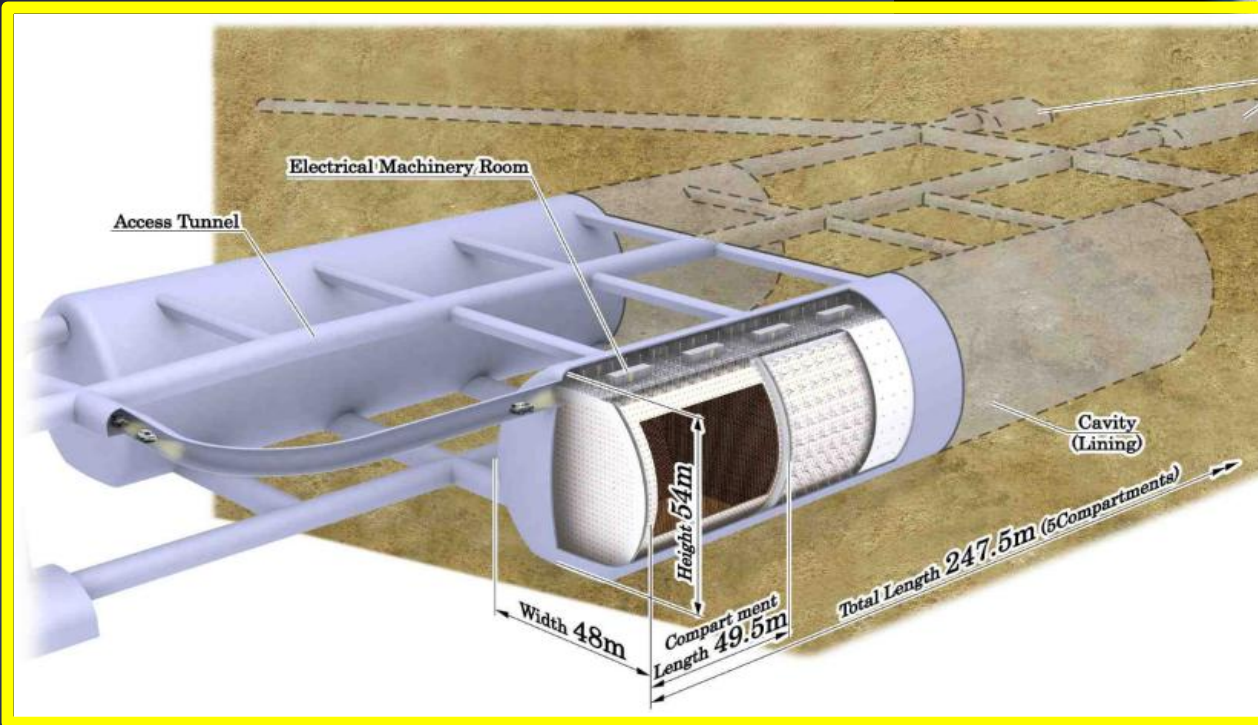
K. N. Abazajian et al. "Light Sterile Neutrinos: A Whitepaper", arXiv:1204.5379 [hep-ph], (2012)

The LAr Long Baseline Facility (LBNF)



Hyper-Kamiokande plan in Japan

$L=295\text{km}$ $OA=2.5\text{deg}$

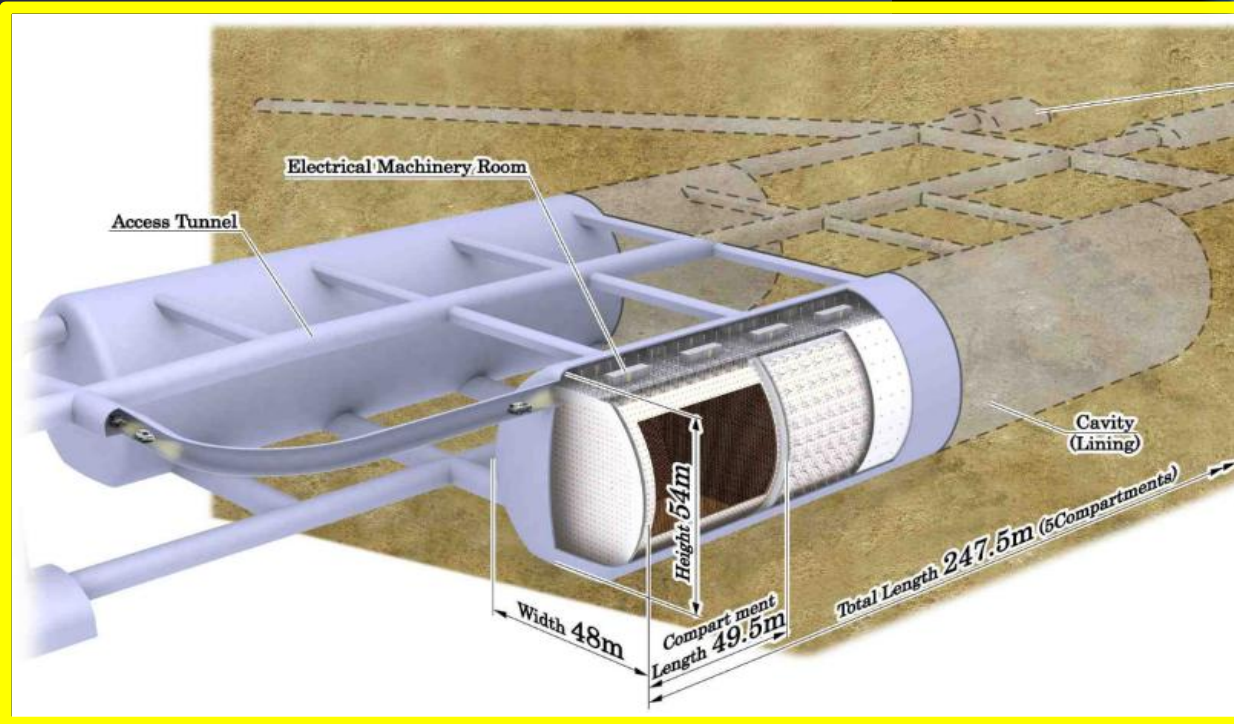


LoI: The Hyper-Kamiokande Experiment arXiv:1109.3262v1

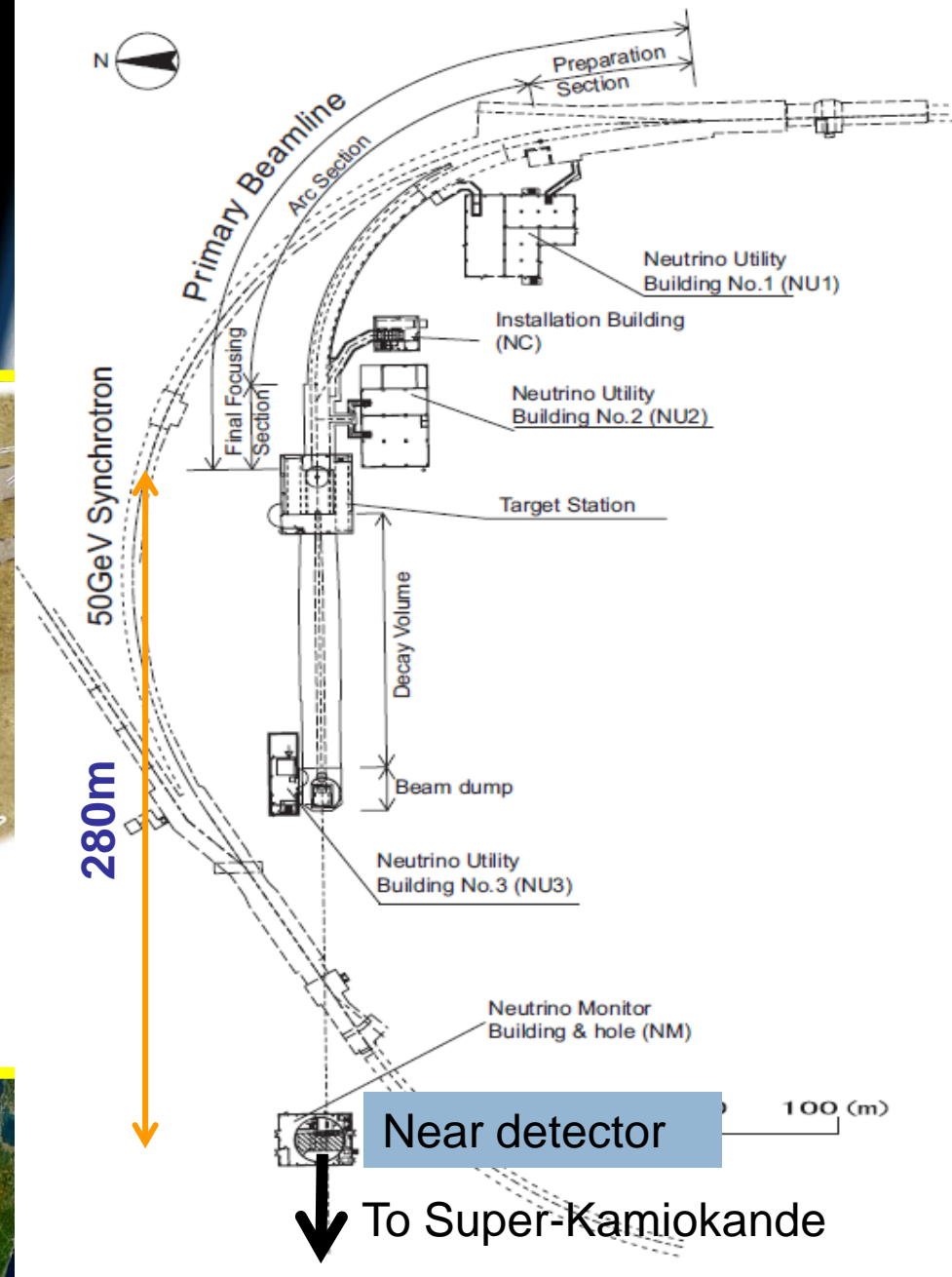
The beam is from J-PARC

Hyper-Kamiokande

$L=295\text{km}$ $OA=2.5\text{deg}$



LoI: The Hyper-Kamiokande Experiment arXiv:1109.3262v1



The beam is from J-PARC

Scientific Priorities

- ➔ CP violation in the neutrino sector
- ➔ CP phase measurement regardless of its value
- ➔ Neutrino Mass Hierarchy determination
- ➔ Determination of θ_{23} octant and precision parameter measurements
- ➔ Precision tests of 3-flavor neutrino model.
- ➔ Atmospheric neutrino measurements (confirmation of mass ordering with independent data)
- ➔ Proton decay
- ➔ Supernova burst neutrinos

Next event

From: "Nigel S. Lockyer" lockyer@fnal.gov

Dear Colleagues,

This message is to remind you that there are two identical open meetings (everyone welcome) to communicate the Letter of Intent to the scientific community. They will take place as follows:

December 5, 2014 CERN (Council Chambers) 1 pm-6 pm local time

December 12, 2014 Fermilab (1 West) 10 am- 3 pm local time

The agenda for the open meetings is as follows

Welcome and Background Introduction (Nigel Lockyer) 15+15 min

The Fermilab Facility -- what it entails (Jim Strait) 30+15 min

Summary of the Letter of Intent (LOI) for LBNF (Rob Roser and Ken Long) 30+15 min

International Governance Working Group Report (Joe Lykken)-- 15 +15 min

Coffee Break 30 minutes

Panel Discussion with seeded questions as well as extended Q&A with audience (2 hours)

PLEASE register for the meetings at: <https://indico.fnal.gov/conferenceDisplay.py?confId=9127>

To support the LOI: <https://indico.fnal.gov/conferenceDisplay.py?confId=9090>

Finally -- please reserve January 22-24 2015 for the first proto-collaboration meeting of the entire community: **Location to be determined**

We encourage you to share this message with any of your colleagues that may be interested.

How does CERN fit in all this?

- ✓ As a support structure for all these activities, where CERN expertise can be a VALUE
- ✓ As the support Laboratory for all European Groups interested in a collaborative effort
- ✓ As a unique R&D and tests facility of detectors and components (hardware and software)
- ✓ As a research group active at these facilities

→ NEUTRINO PLATFORM

NEUTRINO CERN PLATFORM

- Detectors Activities
- Beam Lines Activities
- Cryogenics Activities
- Nord Area EHN1 extension
- Recent events
- Next 2 months !

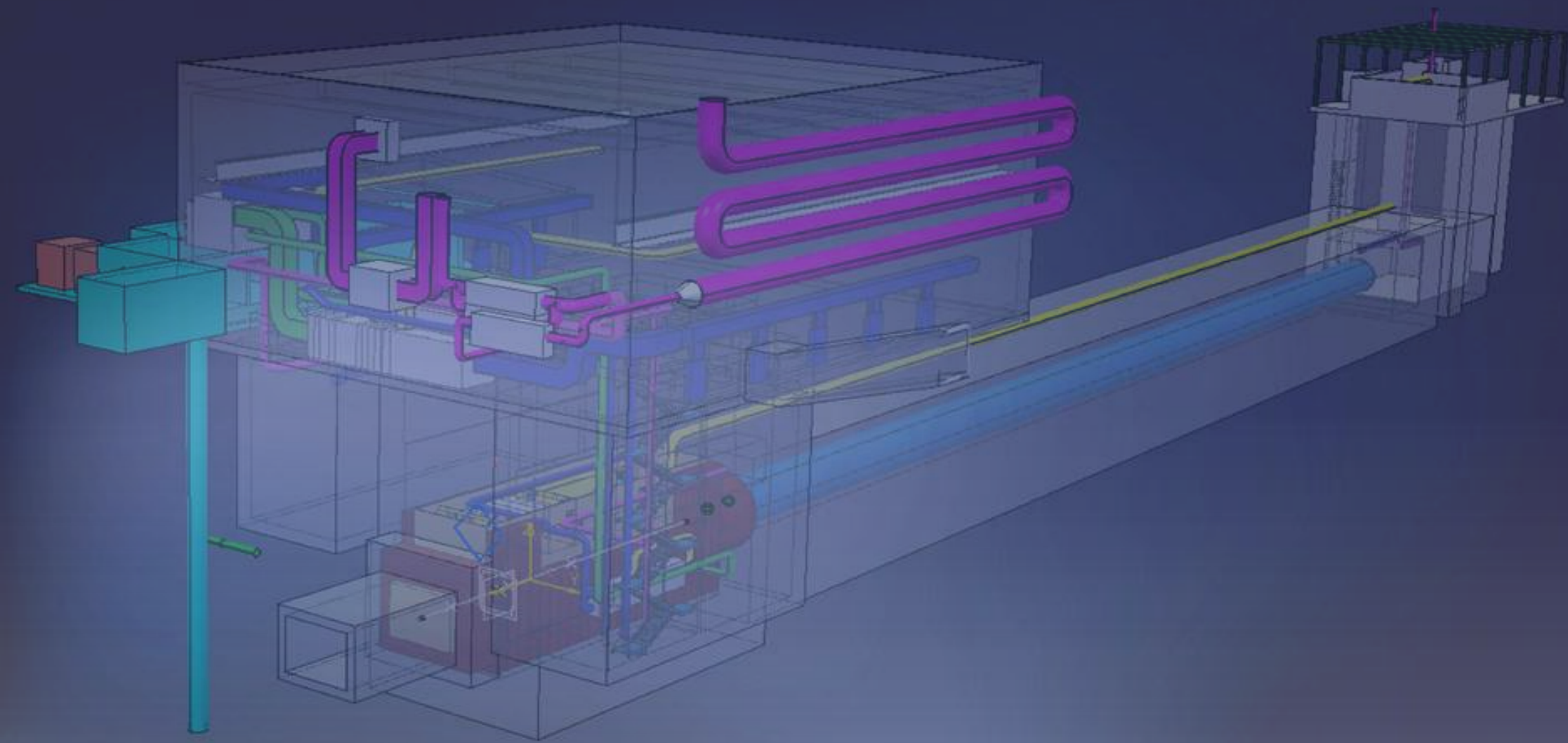
Detector Projects presently under consideration

SPSC

- *WA104 ICARUS detector overhauling*
- *WA105 construction and test of 2 large prototypes/demonstrators*
- *WA104 NESSiE R&D and test of a new generation of muon spectrometers*
- *Baby MIND : demonstrator and test of a new muon tracking detector (T2K, ND-HKK?)*
- ***LBNF test of a TPC module***

- *ArgonCube : prototypes of a new generation of highly modular TPCs*
- *HKK : R&D and test of detector components (EU)*
- *Construction and test of a new magnetized TPC (future ND ?)*
- *Participation in the design and construction of LAR1-ND cryostat and cryo plant*
- *...*

Neutrino Beam lines activities

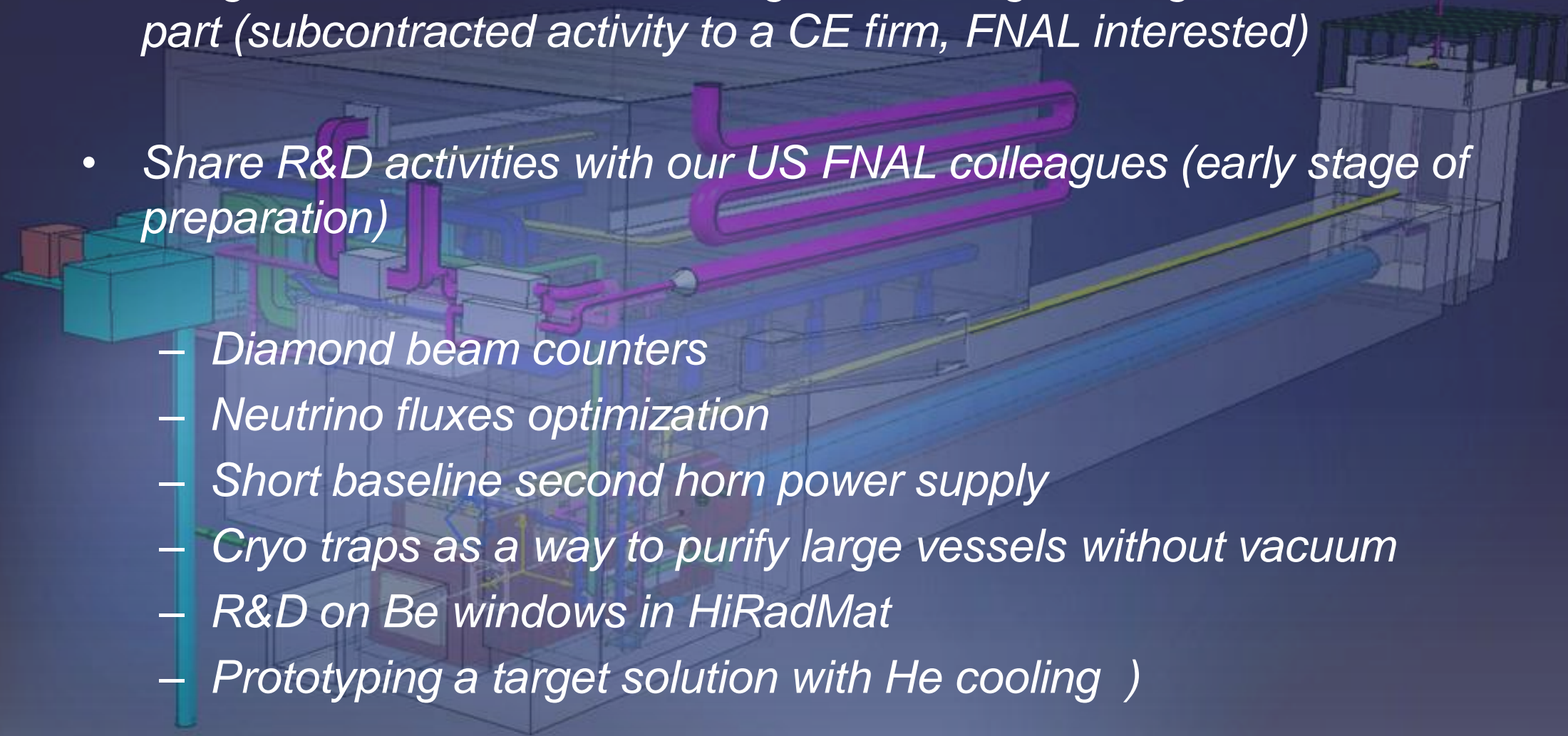


Neutrino Beam lines activities

- *Bring the CENF functional design at the engineering level for the CE part (subcontracted activity to a CE firm, FNAL interested)*

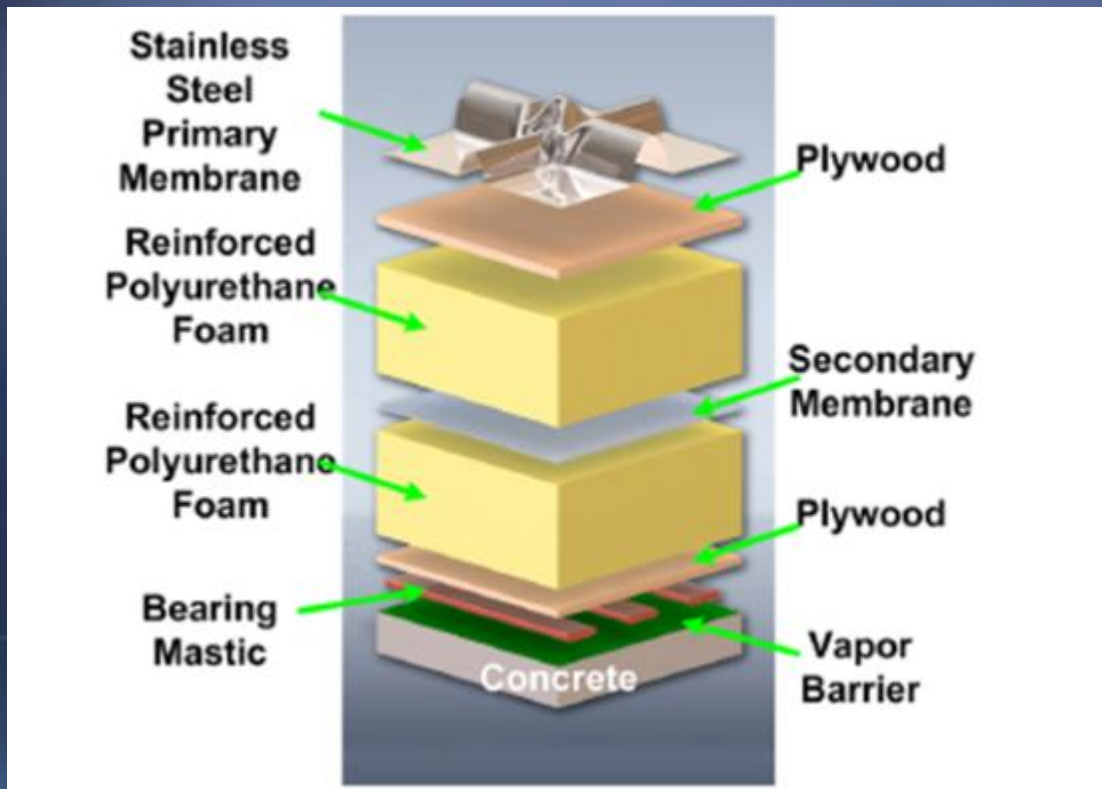
- *Share R&D activities with our US FNAL colleagues (early stage of preparation)*

- *Diamond beam counters*
- *Neutrino fluxes optimization*
- *Short baseline second horn power supply*
- *Cryo traps as a way to purify large vessels without vacuum*
- *R&D on Be windows in HiRadMat*
- *Prototyping a target solution with He cooling)*
- *.....*



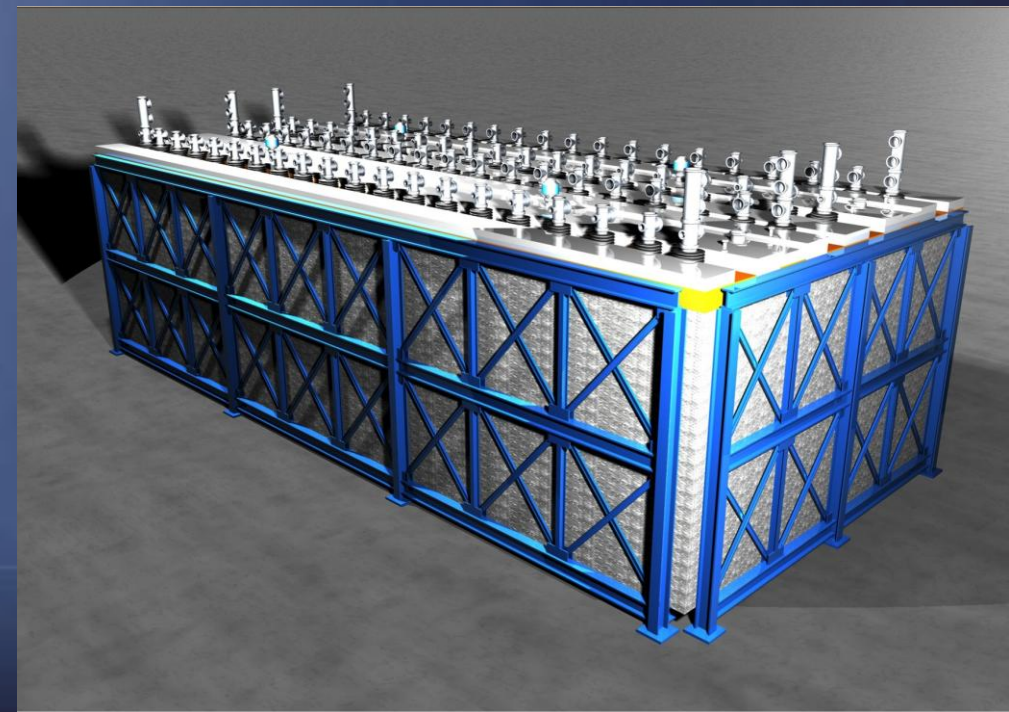
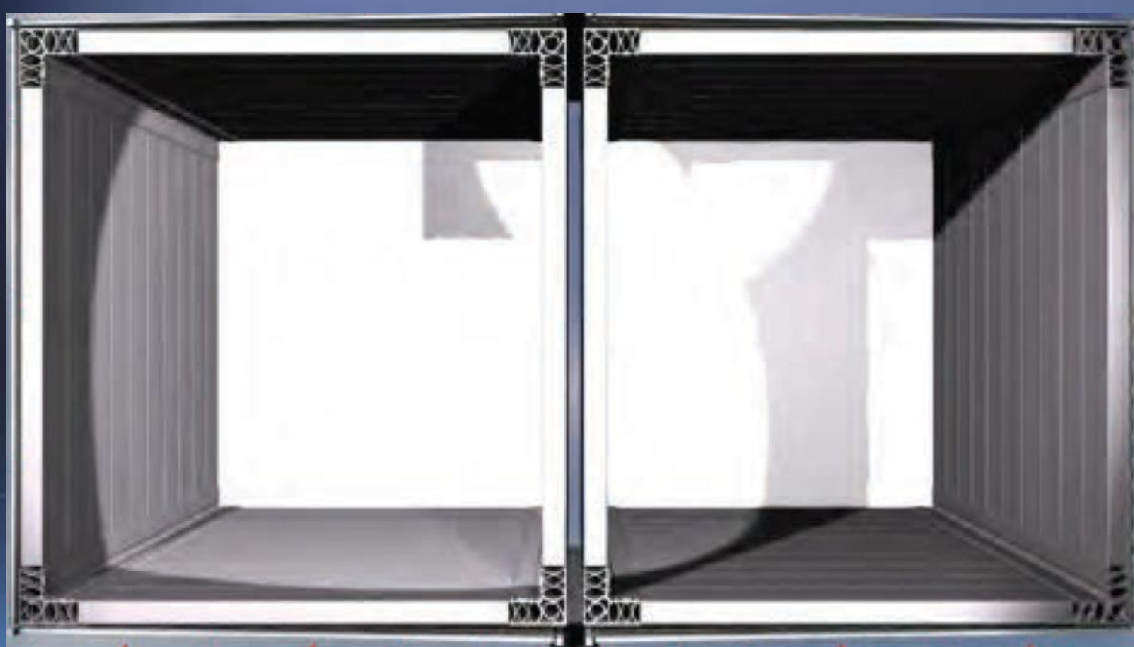
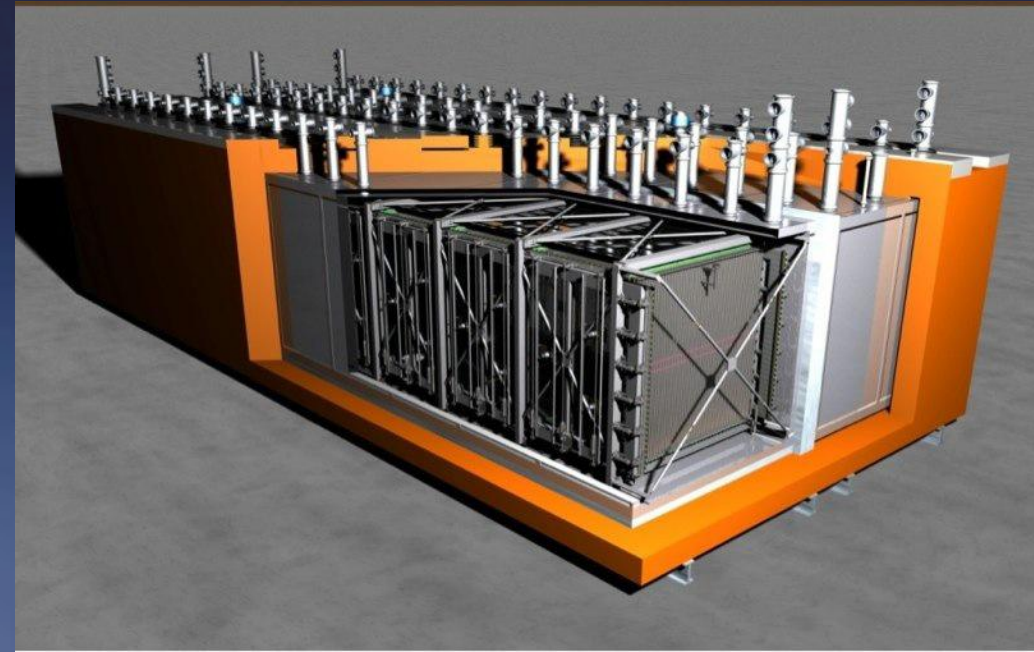
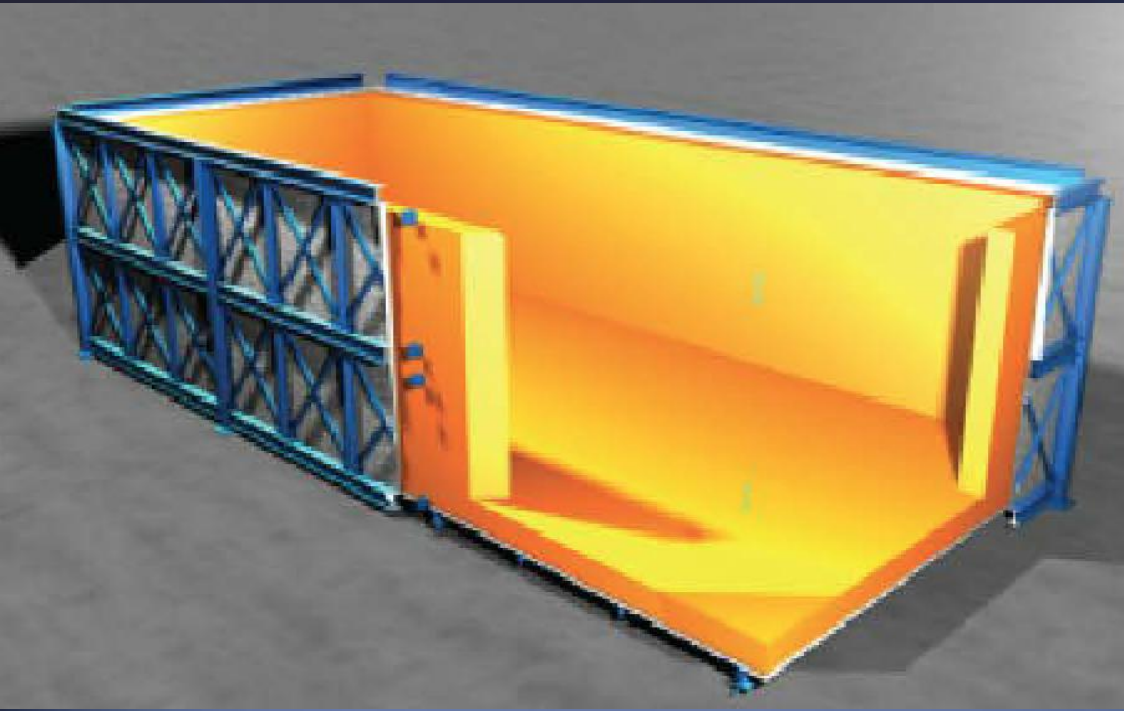
Cryogenics activities

- We are re-creating a LAr cryogenics group which should serve the needs of the community at large (in cooperation with FNAL)
- Existing Cryolab, augmented by 2 staff + 3 PJAS
- 5 large cryostats and related cryogenics under scrutiny and construction !

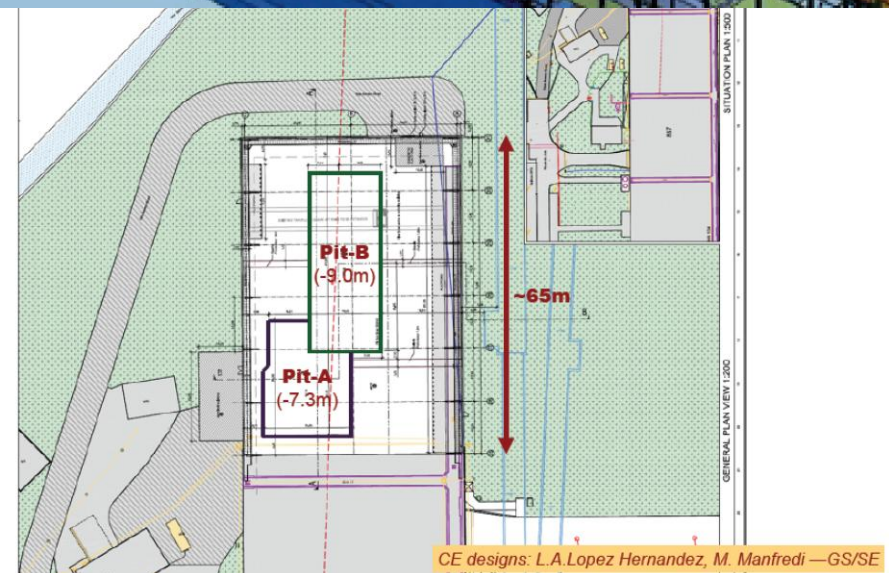
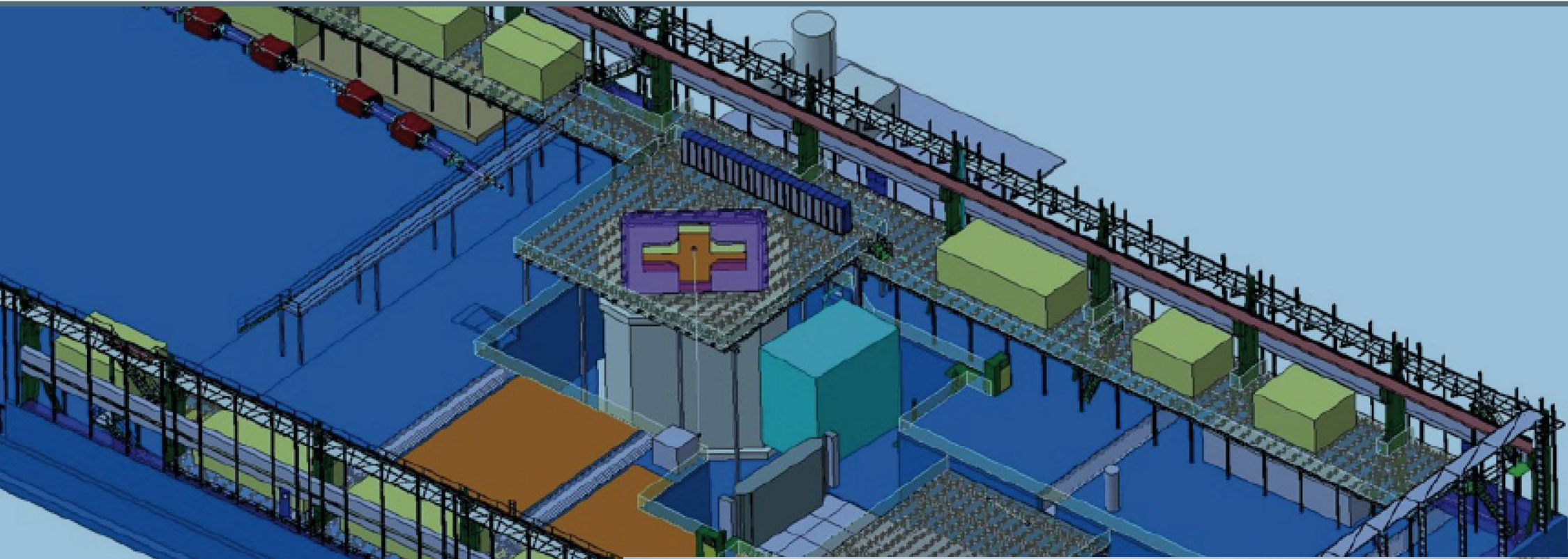


New technology : membrane cryostats

ICARUS Cryostat



EHN1 extension



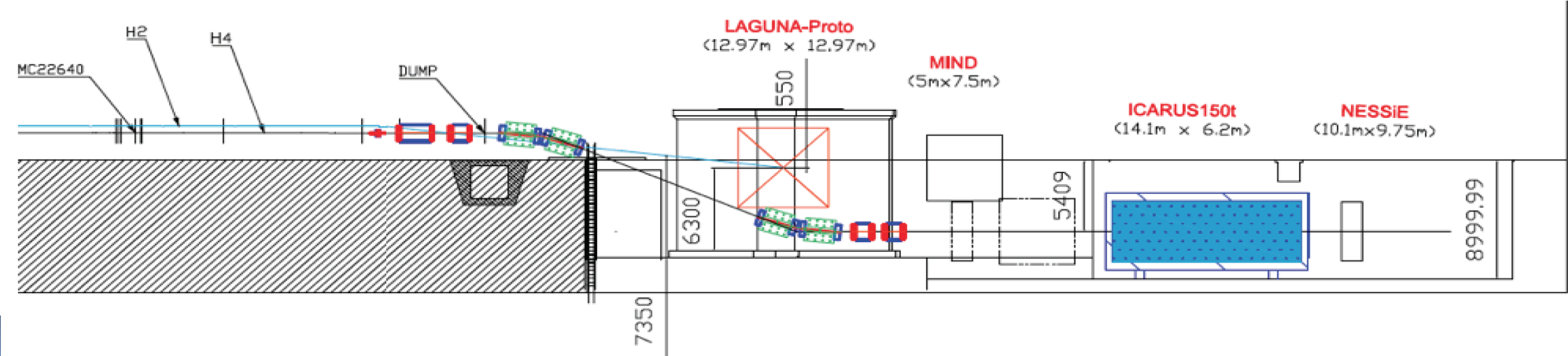
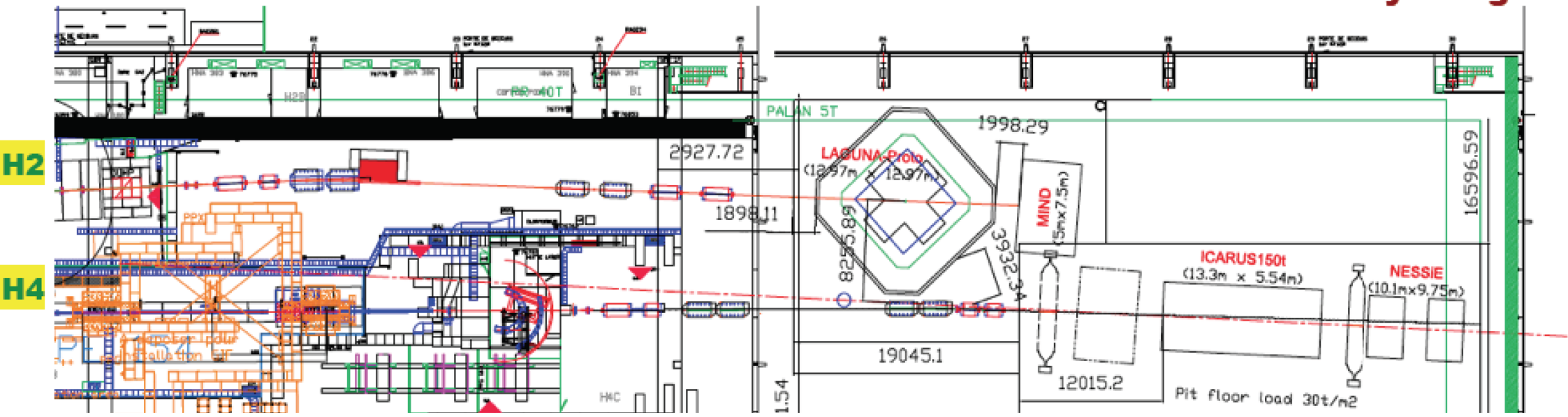
CE designs: L.A.Lopez Hernandez, M. Manfredi —GS/SE



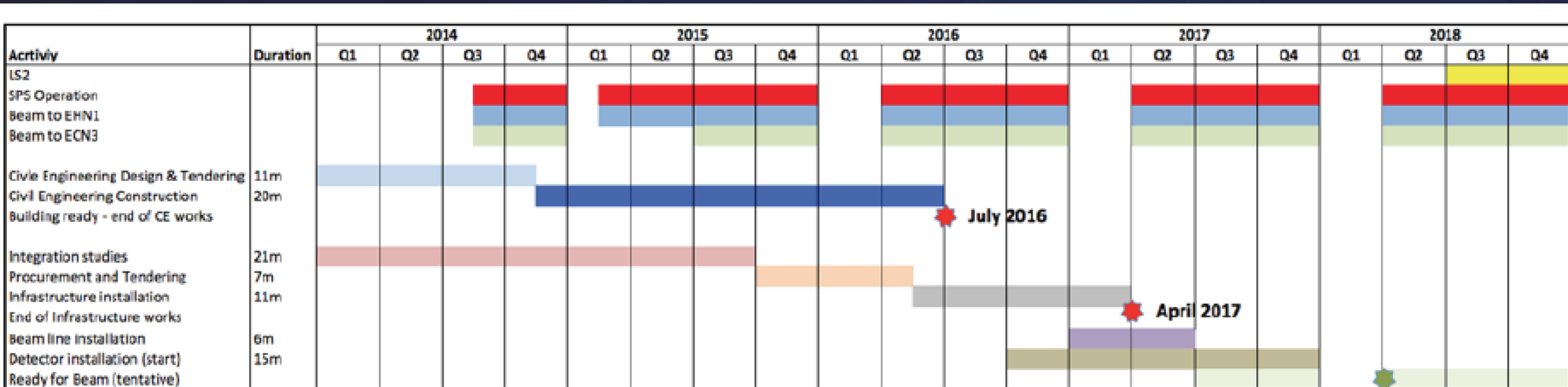
Charged tertiary beams

- H2 extension: 1-20 GeV/c, hadrons (π^\pm , μ^\pm , p - mixed beam), electrons(e^\pm)
- H4 extension: 1-5(7) GeV/c, hadrons (π^\pm , μ^\pm , p - mixed beam), electrons(e^\pm)
- ▶ interest to go lower, down to 0.2 GeV beams for LBN TPC test

Preliminary designs!



EHN1 extension : CE contract ready, wait for green light from next FC



► Activities beyond CE construction are still tentative

► Construction expected to start in 2014

- profit from the window without beam in ECN3 to finish the excavation and construction nearby TT85

► Target dates:

- CE works completed : **July 2016**
- Infrastructure completed : **April 2017**
- Experiments ready for beam for **2017/2018 SPS run**

WA104 : ICARUS detector overhauling

ICARUS Collaboration with INFN and CERN help

- *Move the detector from the GS Laboratory to CERN*
- *Prepare at CERN all the necessary infrastructure (clean rooms, cryogenics, ...)*
- *Reshape the detector with new components (more PMTs, new cathode?, new inner cabling, new electronics, ..)*
- *Construct a new generation of cryostats*
- *Reshape, maintain and modernize the cryo plant*
- *Reassemble the 2 T300 detectors inside their cryostats*
- *Construct a new outer vessel*
- *Make it ready for shipment to FNAL*

ICARUS Detector at Gran Sasso being dismantled



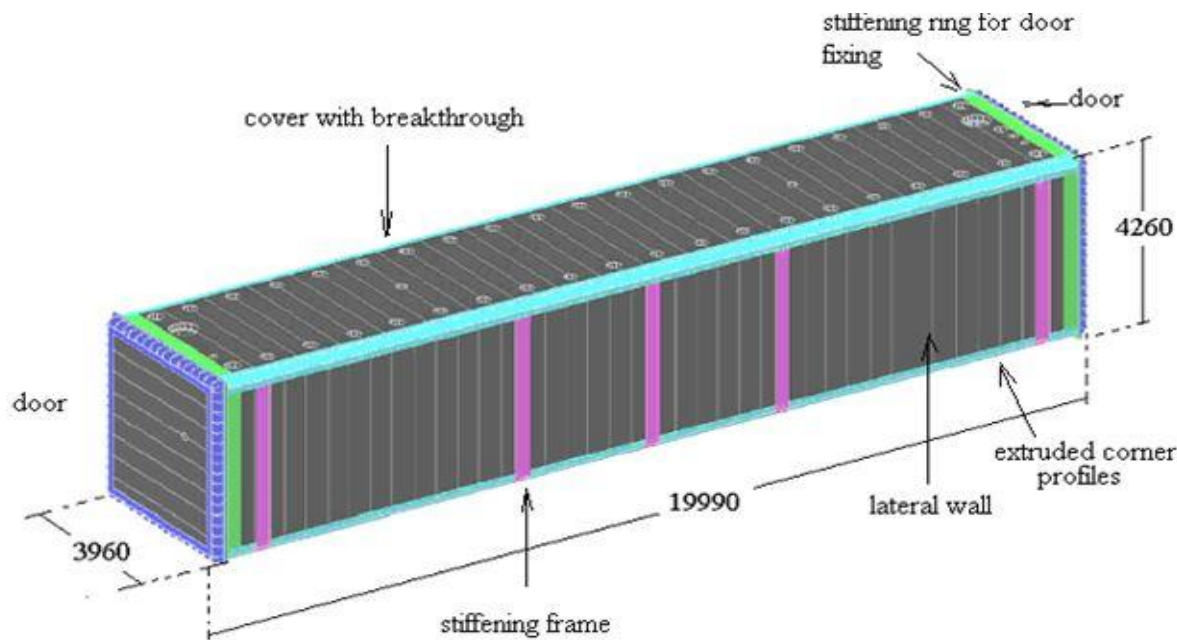
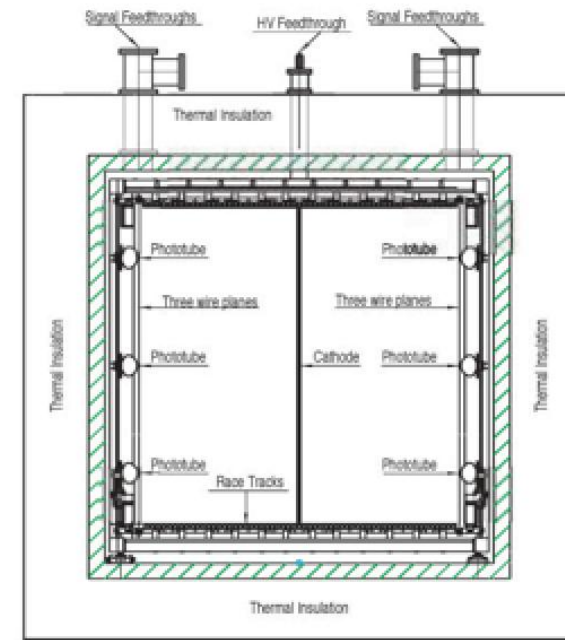
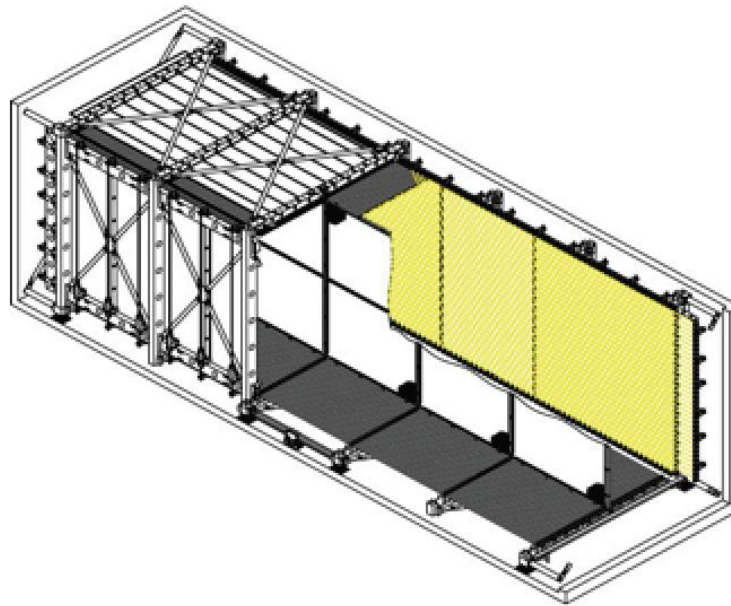
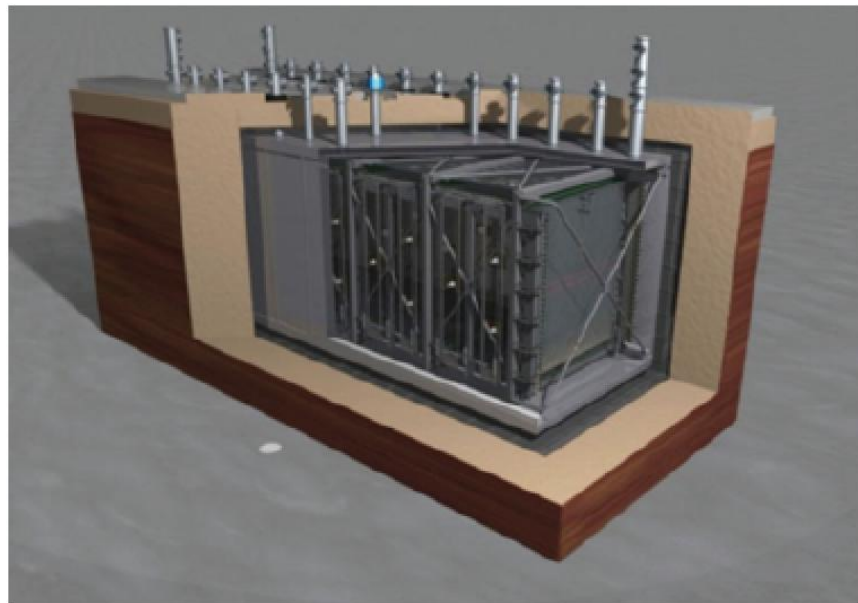
and moved to CERN (10 days trip)



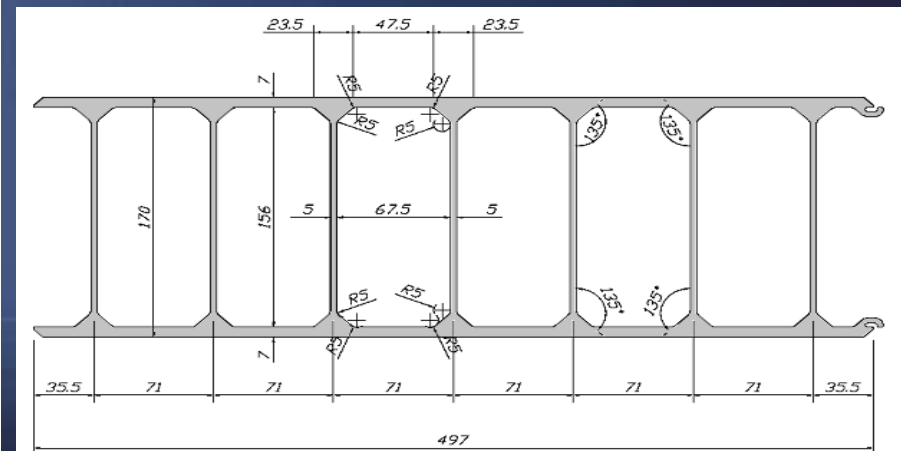
ICARUS Detector arrived at CERN (T300) yesterday



ICARUS new cryostats

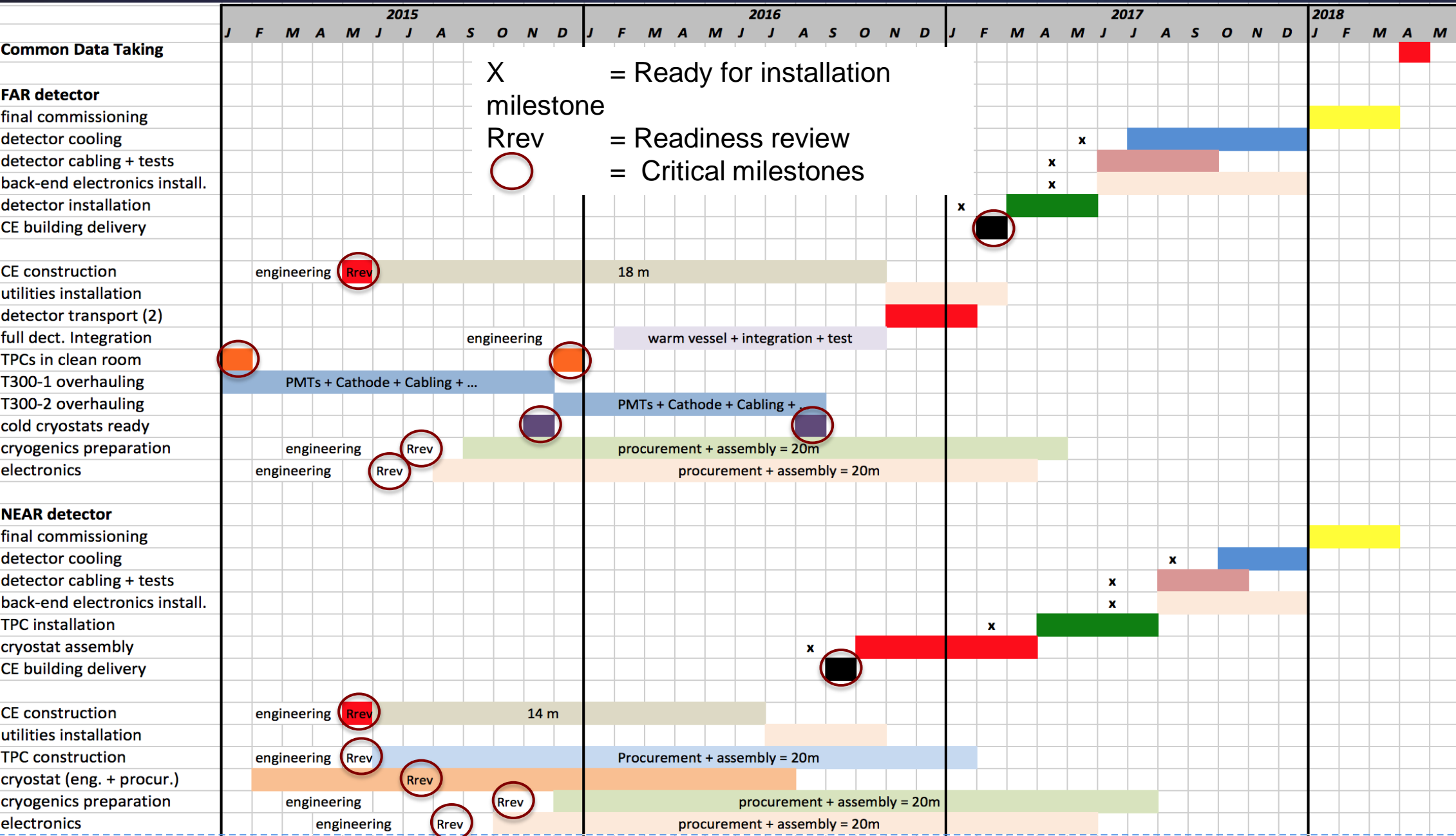


Aluminium extruded panels



Short Baseline @FNAL (Schedule)

with INFN and CERN involvement



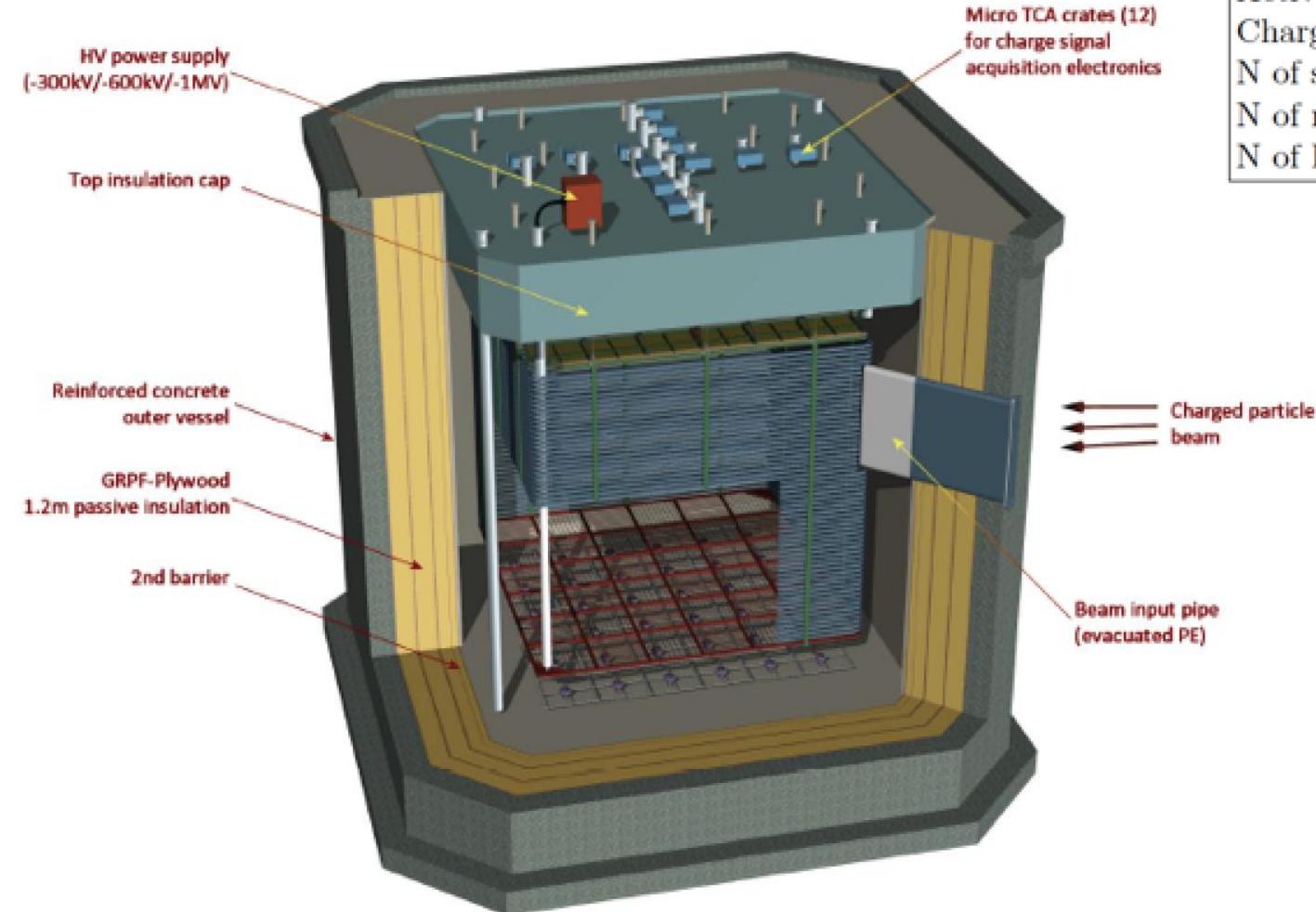
WA105 : LAGUNA detector Demonstrator

LAGUNA Collaboration with CERN help

- *Prepare at CERN all the necessary infrastructure (clean rooms, cryogenics, ...)*
- *Construct a new generation of cryostats based on membrane technology*
- *Provide all the necessary cryogenics*
- *Construct and test 2 prototypes of a 2-phases LAr TPC*
 - *3 x 1 x 1 m³*
 - *6 x 6 x 6 m³*
- *Charged beam tests at the SPS with full readout capabilities*

WA105 large demonstrator (2 phases LAr TPC)

Liquid argon density	T/m ³	1.38
Liquid argon volume height	m	7.6
Active liquid argon height	m	5.99
Hydrostatic pressure at the bottom	bar	1.03
Inner vessel size (WxLxH)	m ³	8.3 × 8.3 × 8.1
Inner vessel base surface	m ²	67.6
Total liquid argon volume	m ³	509.6
Total liquid argon mass	t	705
Active LAr area	m ²	36
Charge readout module (0.5 x0.5 m ²)		36
N of signal feedthrough		12
N of readout channels		7680
N of PMT		36

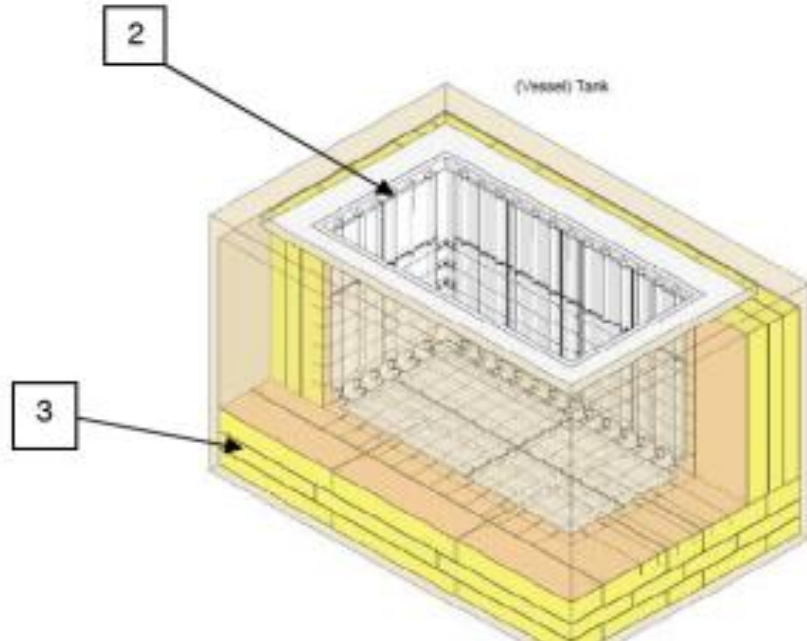
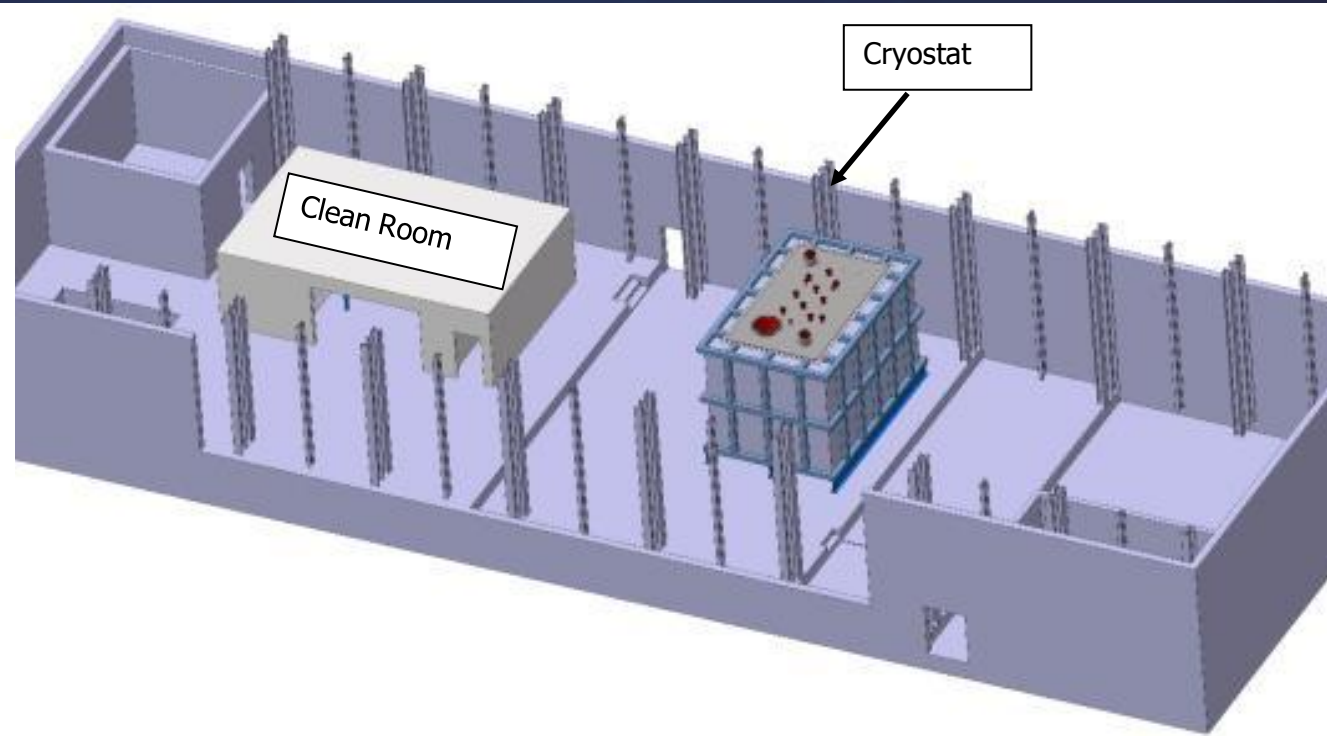
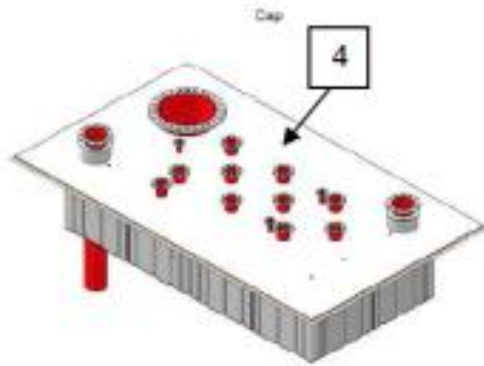


External dimensions:

12.5(w) * ~12.5(l) * ~11.2(h) m

First membrane cryostat under construction (ready in spring 2015, 17 m³ LAr, b182)

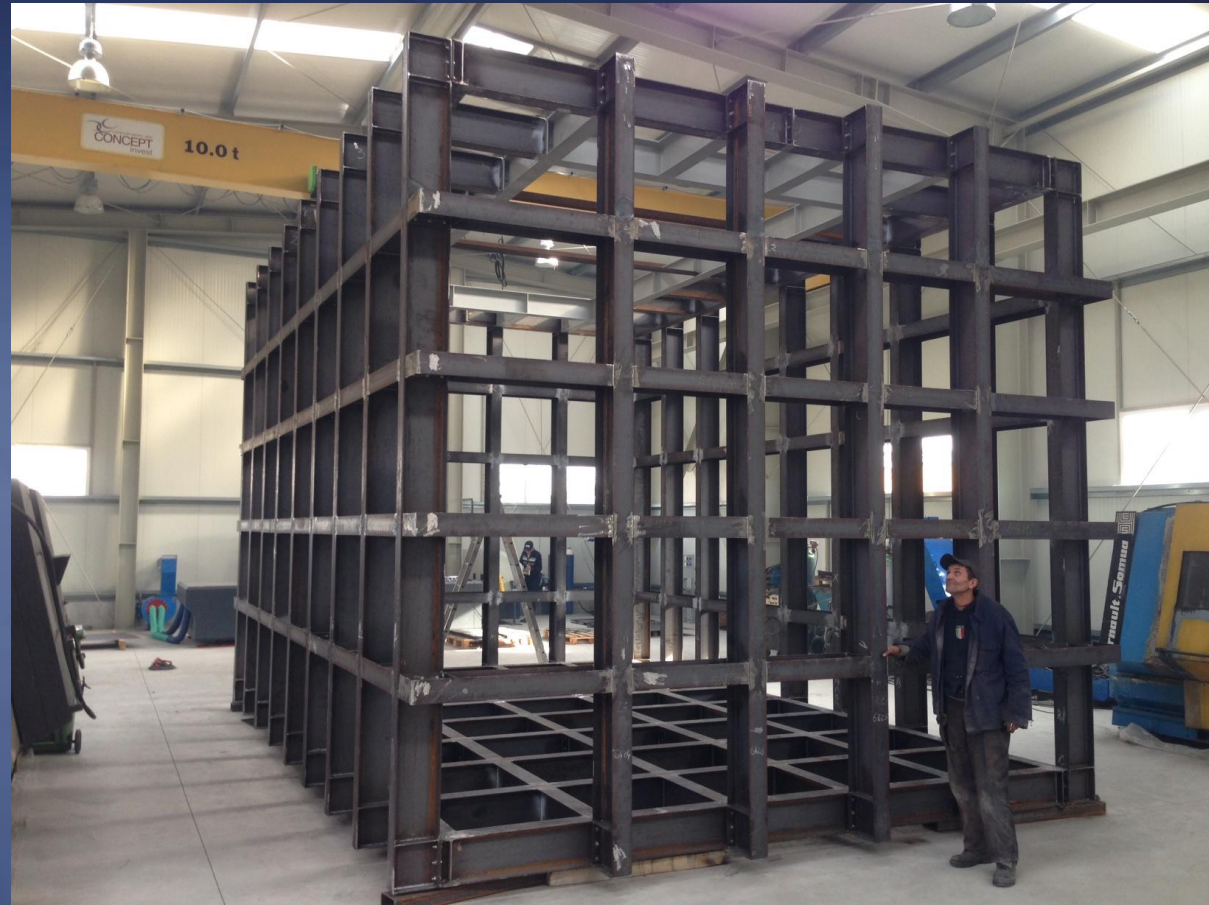
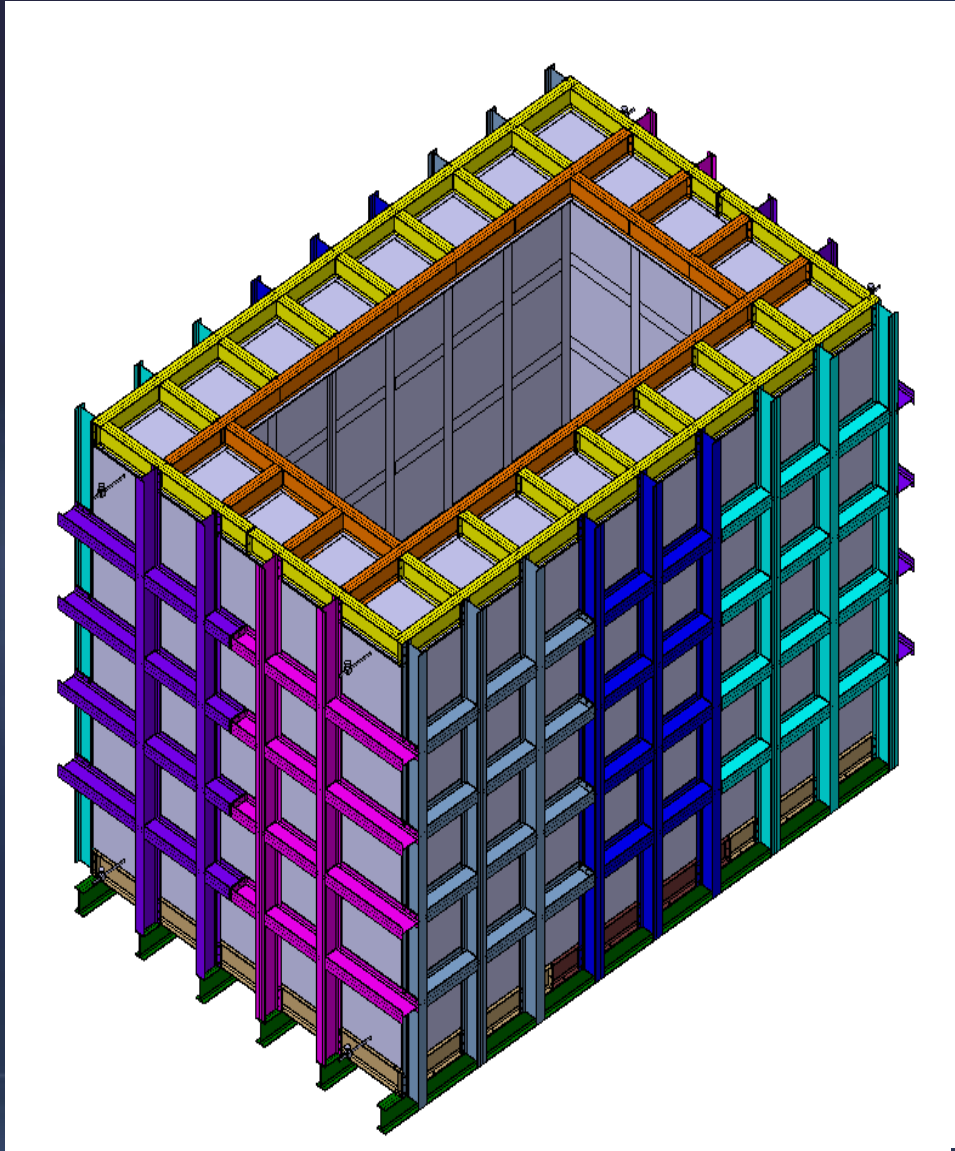
General View



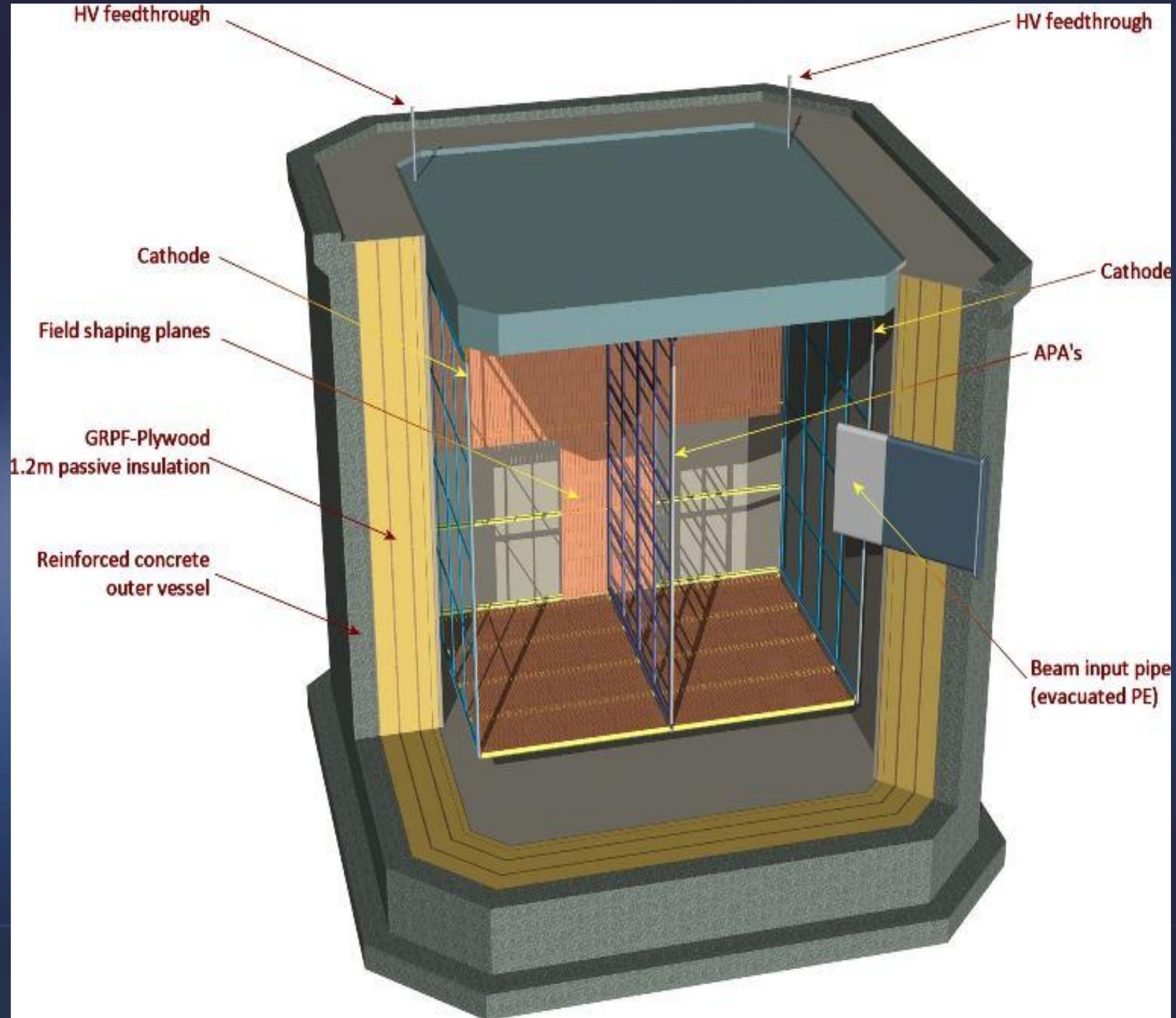
3.0 * 4.8 * 3.9 m³

Inner dimensions: height*length*width

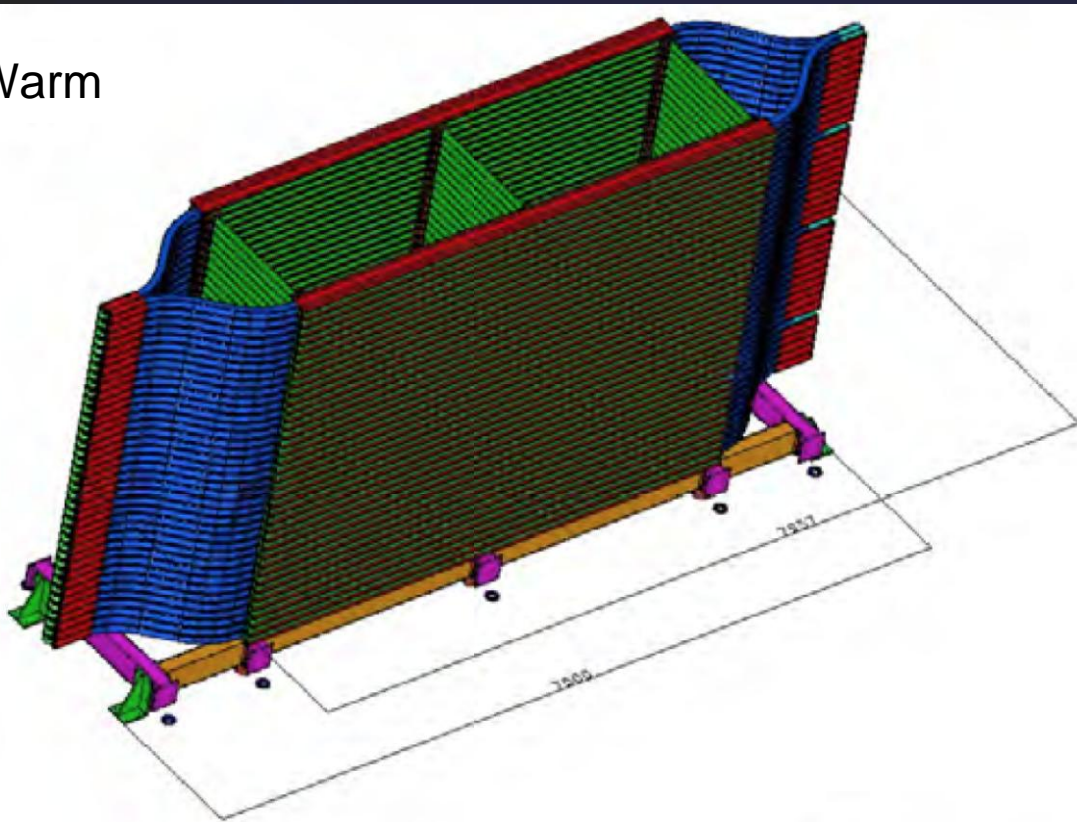
First membrane cryostat under construction (ready in spring 2015, 17 m³ LAr)



LBNF modules test



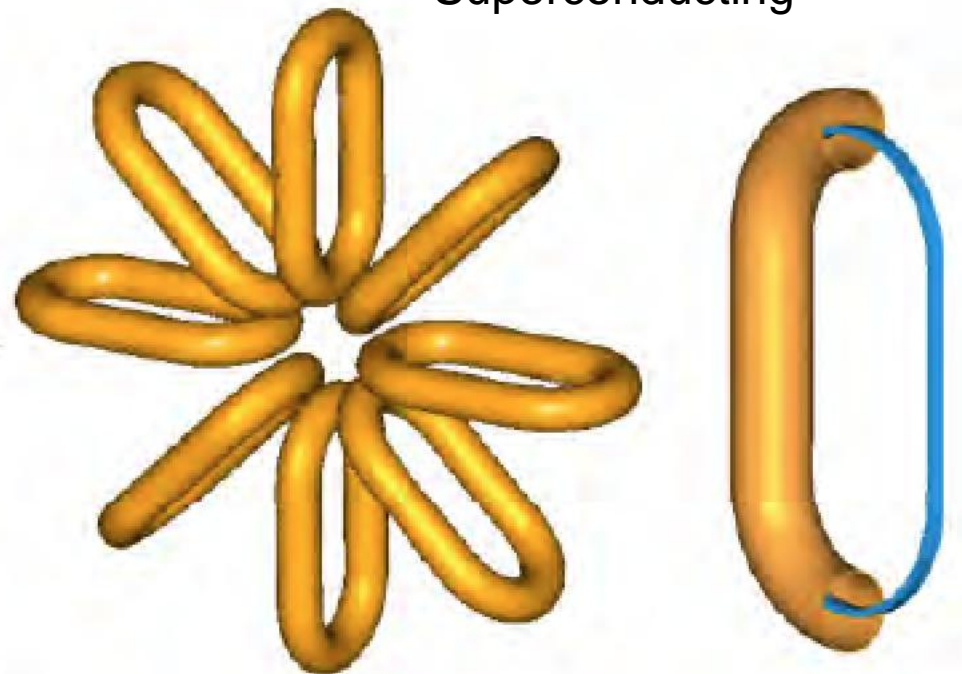
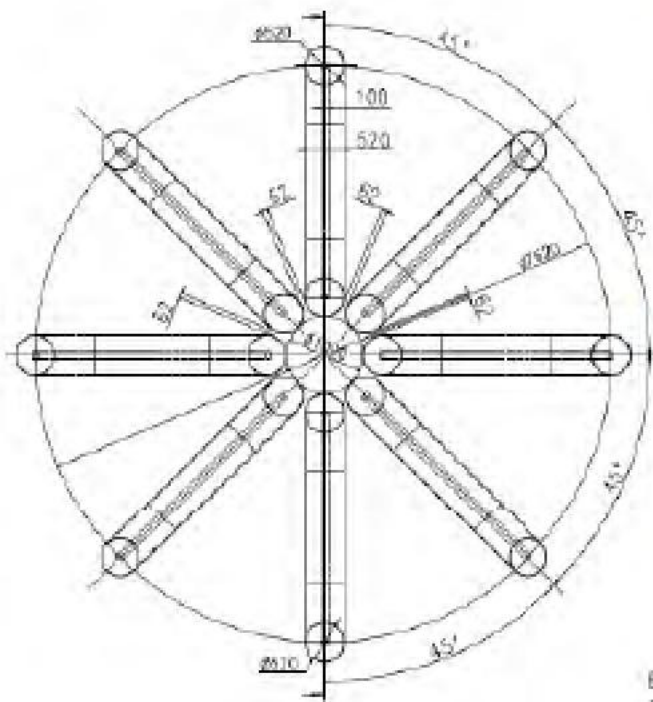
Warm



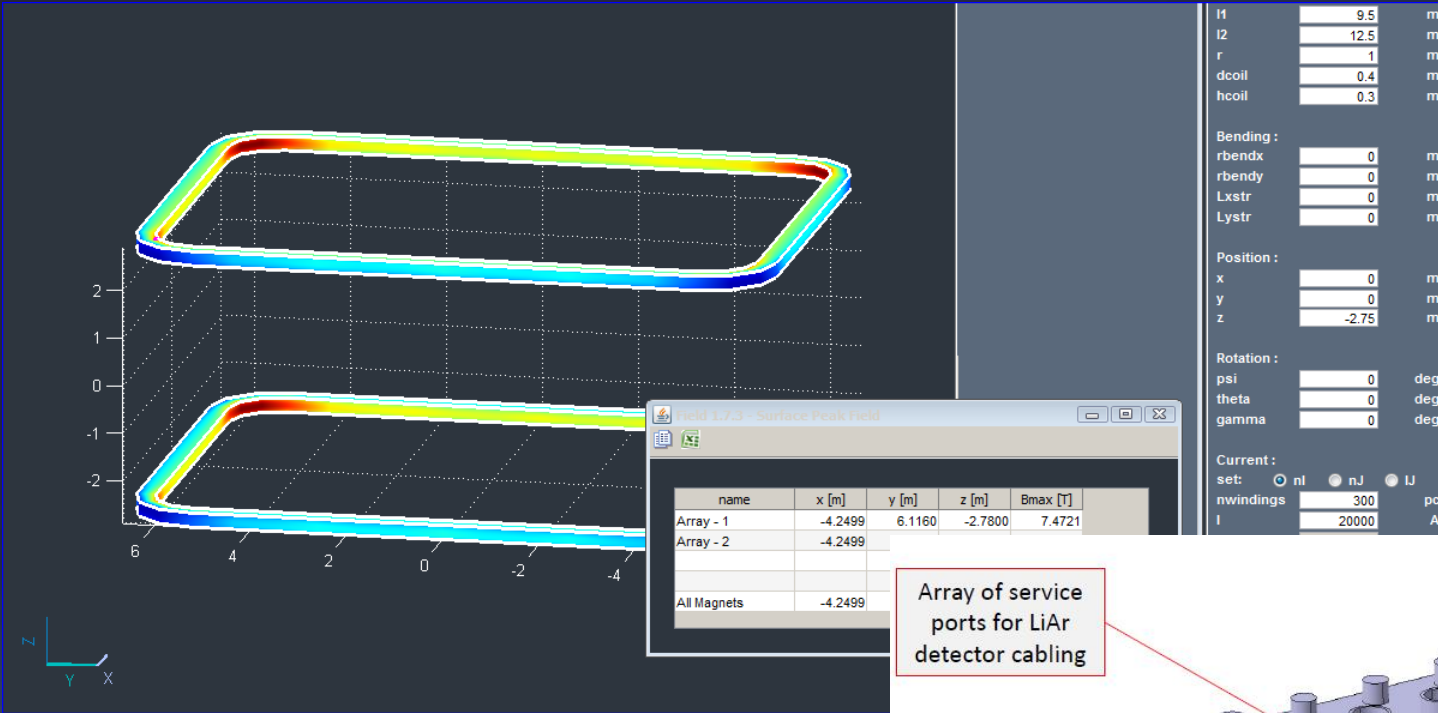
Air core magnets R&D

NESSiE Collaboration

Superconducting



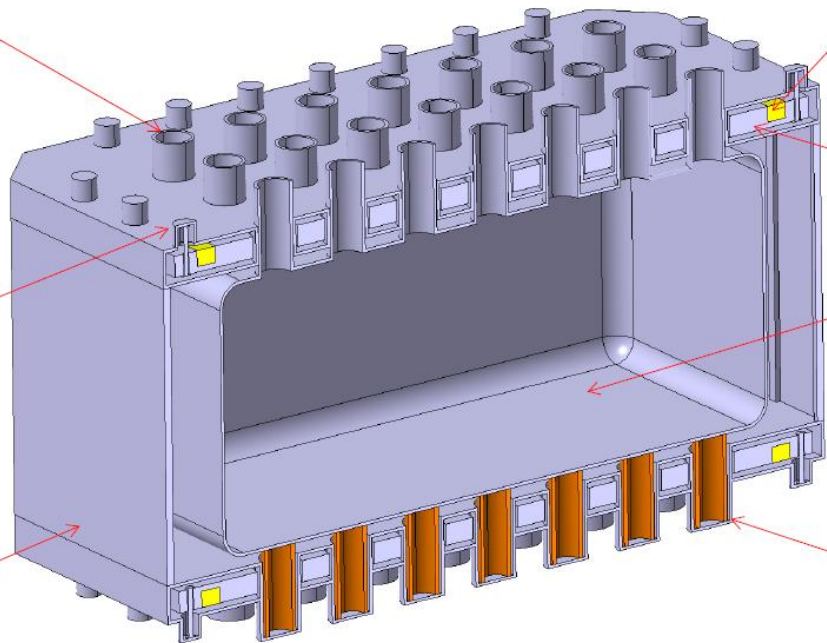
A fully magnetized TPC ?



Array of service ports for LiAr detector cabling

Line of Tie rod ports with vacuum seal for taking coil weight and Lorentz force

Vessel wall with reinforcement ribs takes the 30MN Lorentz force + 10MN vacuum load



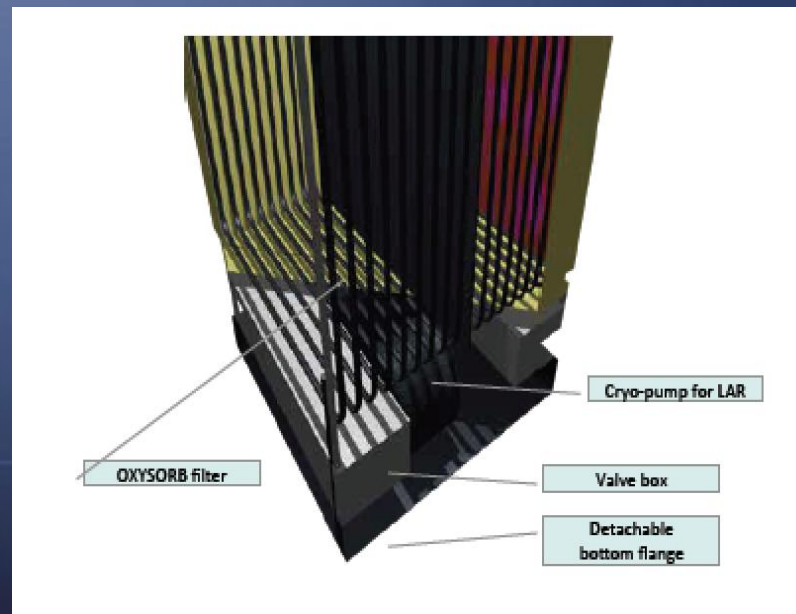
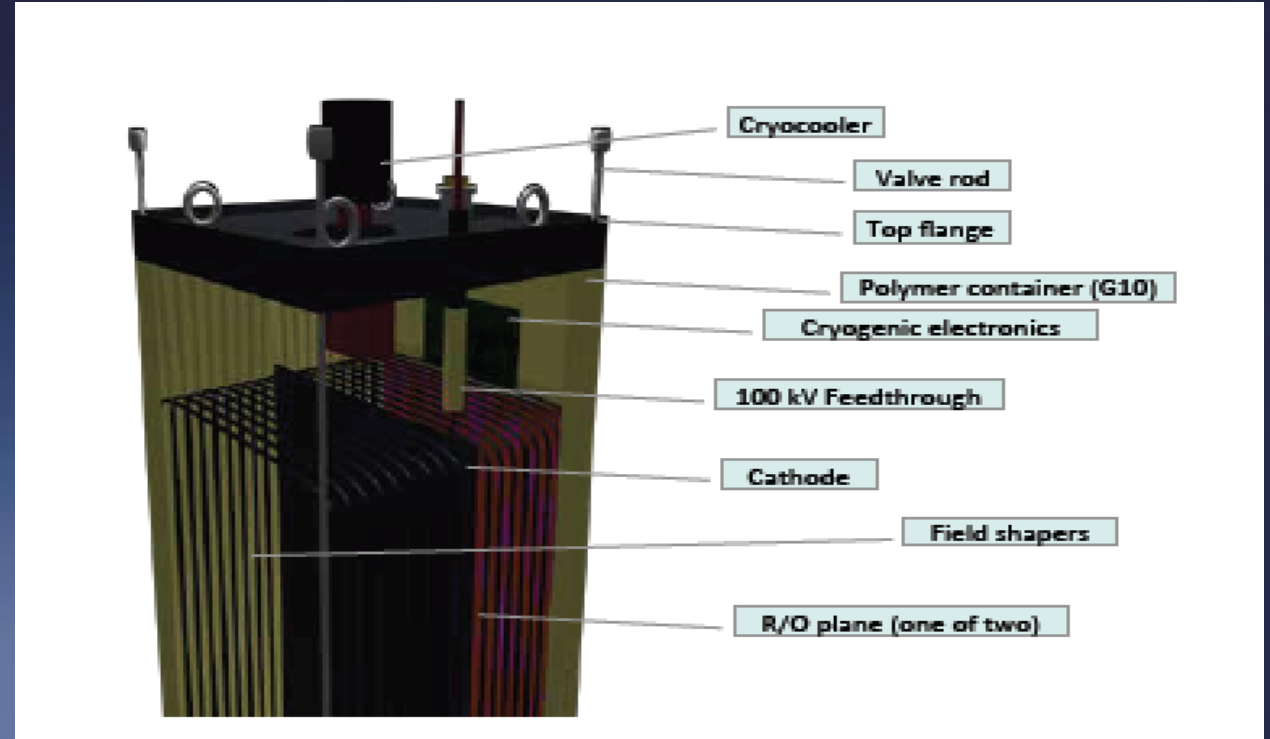
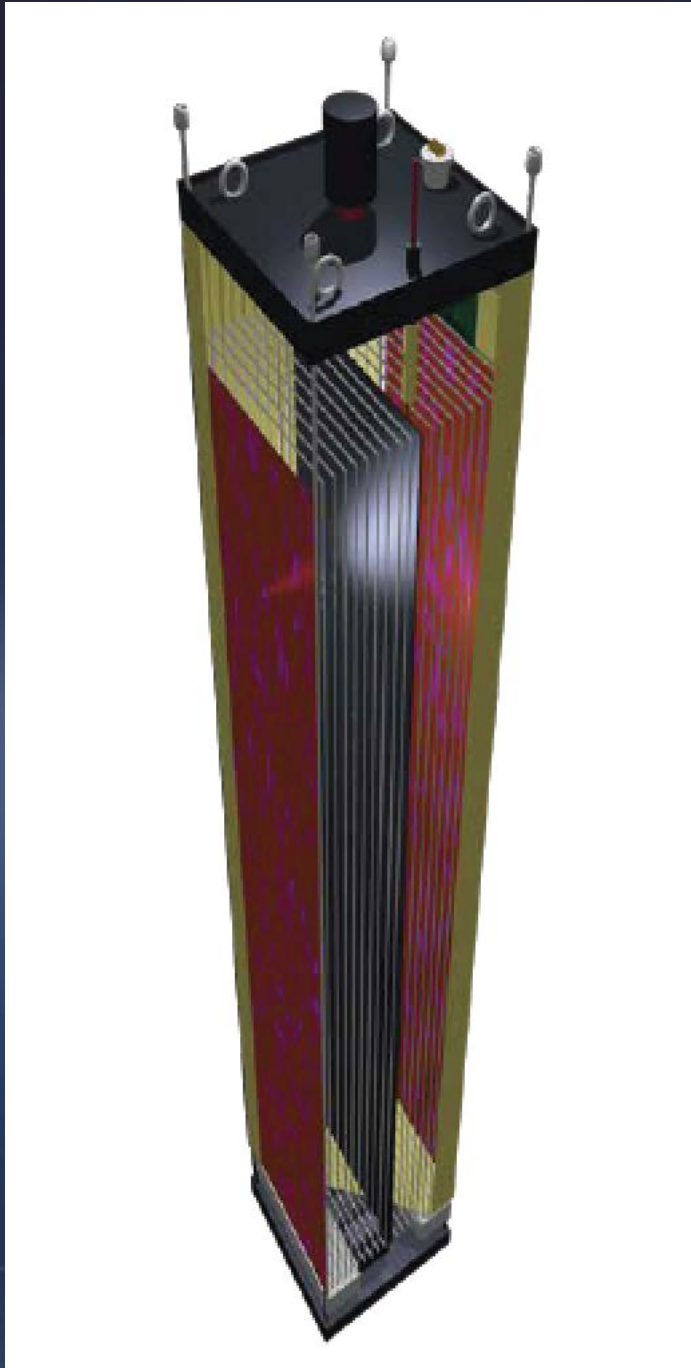
Racetrack Coil

Coil casing

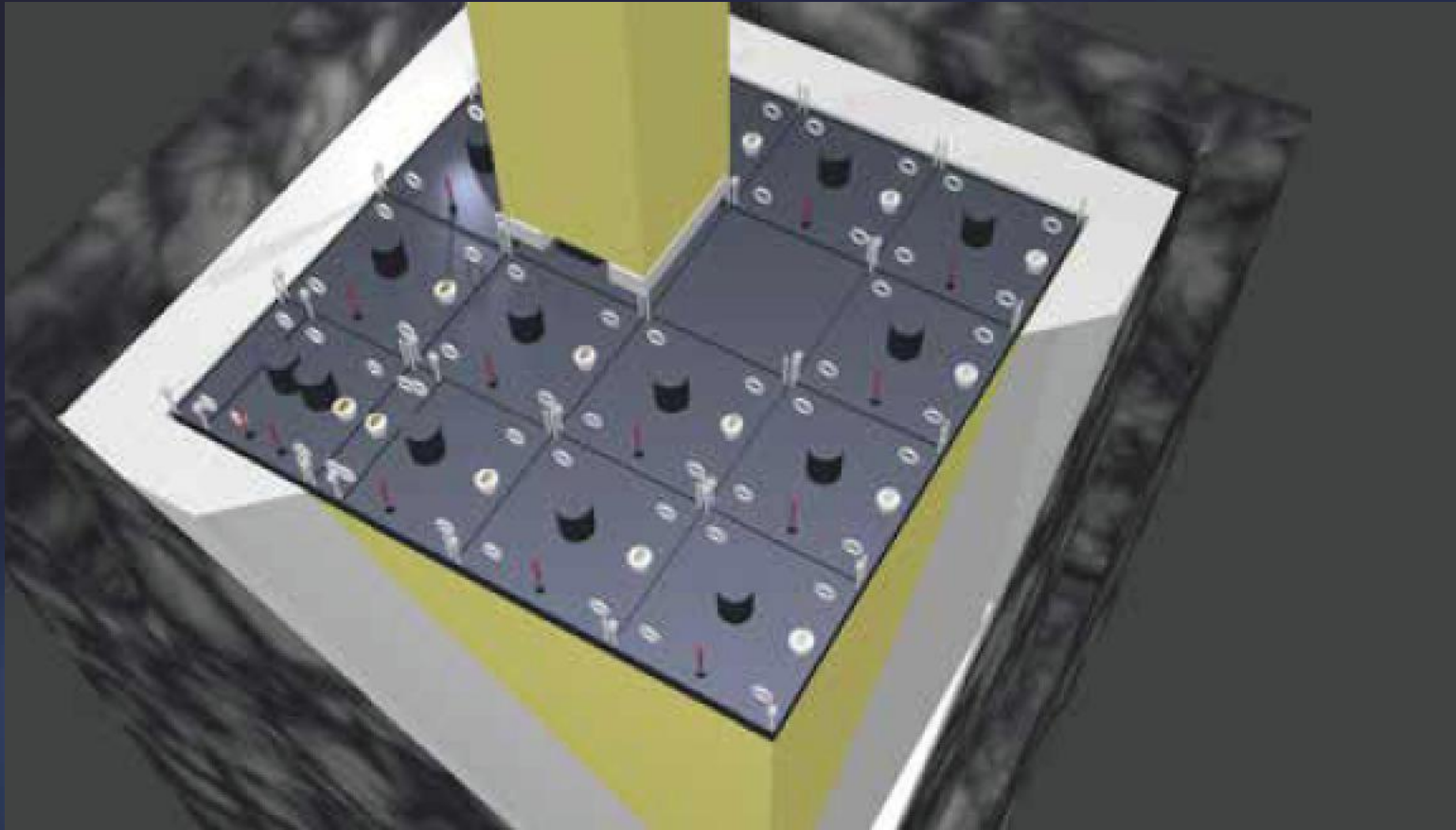
500 m³ LiAr 83 K;
900 t liquid + vessel,
1000t total

Array of support tubes for 1000t including vacuum seals;
Heat load 300-83 K

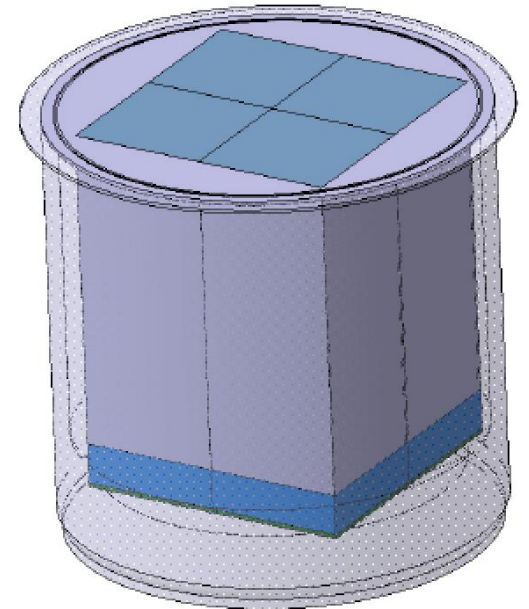
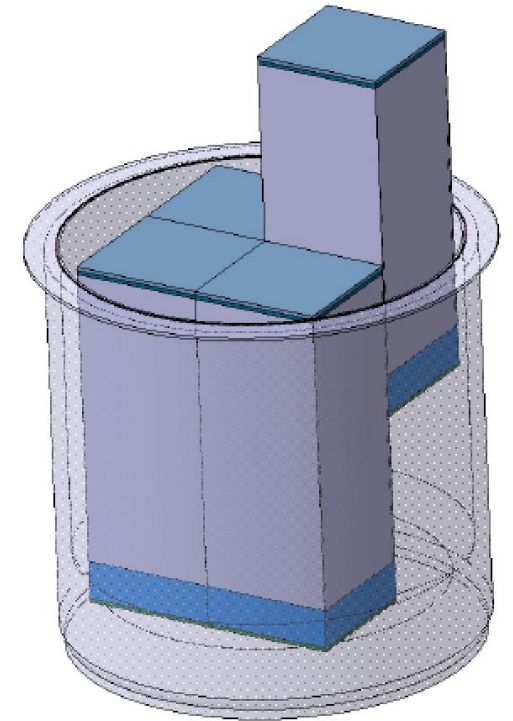
A very modular TPC ?



A very modular TPC ?



Each module 2m x 2m x (5 or 10) m



Next few weeks

- 5th December : LBNF kickoff meeting at CERN
- By Xmas both ICARUS TPCs at CERN
- December FC request for EHN1 extension, then CE activities will start
- 21th December submission to FNAL PAC of the Short Baseline Proposal
- 22nd December submission to the SPSC of a new R&D LOI (ArgonCube)

Summary:

- ✓ CERN offers a platform for Neutrino detectors R&D. This platform is now part of the CERN MTP. We will support this platform in an active way and will help WA104, WA105 and all others proposals
- ✓ CERN will construct a large neutrino test area (EHN1 extension) with charged beams capabilities, available in 2017
- ✓ CERN will assist the EU neutrino community in their long term common plans. For the moment CERN is not committing to any neutrino beam at CERN, in view of an agreed road map between all partners
- ✓ In the short term, CERN is helping in getting a Short Baseline operational at FNAL with an agreed physics program ... and later a Long Baseline