

CERN Neutrino Project

26th November, 2013

M.Nessi


DG Neutrino Project mandate and recent P5-DG presentation

CERN Neutrino “Platform”

- enable large scale detector development and tests for neutrino detectors:
 - WA104 refurbish ICARUS T600
 - R&D on new Large LAr detector (“ICARUS++”)
 - R&D for air core muon detector
 - WA105 R&D on 2-phase LAr prototype
- study for a neutrino (test)beam in the North Area started
- Discussion with US (Fermilab) started concerning LBNE common efforts on detector AND accelerator topics

Needs global collaboration and long-term sustained efforts and support

MEMORANDUM

To : S. BERTOLUCCI, S. LETTOW, S. MYERS
From : R. HEUER 
cc : M. NESSI
Subject : CERN Neutrino Project

Following the events of the last few months and in line with the approved European Strategy, an initial project is starting at CERN, with the aim to provide an effective platform for future neutrino research activities at CERN and/or outside CERN.

The proposal SPSC-P-347 (ICARUS-NESSiE) and the expression of interest SPSC-E-007 (LAGUNA) have been conditionally approved by the August 2013 CERN Research Board with the CERN code WA104 and WA105 respectively. Conditionally implies that at this moment in time the construction of a short-baseline neutrino beam is not granted and the focus is mainly on detector technology development and qualification in test beams.

The initial LOI for a CERN neutrino facility should proceed towards concluding the detailed studies in early 2014, to allow a timely implementation, in case a positive decision would be taken in this direction.

The on going discussions and R&D plans with the US and the Japanese Colleagues should continue, in view of presenting to the CERN management a plan towards a major Intensity Frontier Facility, according to the European Strategy decision.

A CERN project is now created with the aim to foster collaboration with all partners mentioned above and to create an effective research platform, supported by CERN, for a future neutrino research activity involving European partners.

The above-mentioned CERN project will be coordinated Marzio Nessi, as CERN project coordinator who reports directly to the CERN Directorate.

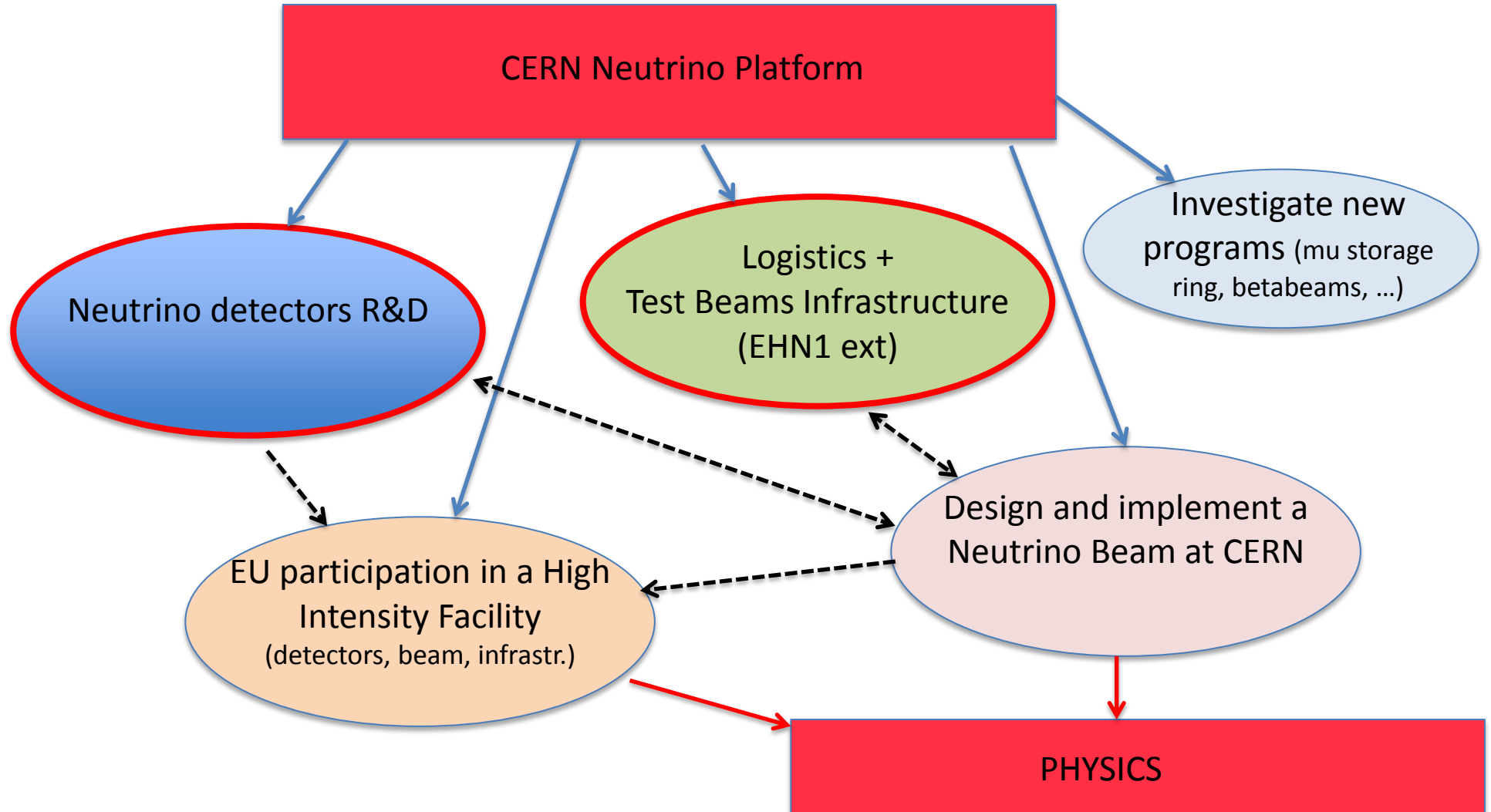
More recent Extended Directorate notes on the R&D short-term plans

short-term objectives:

- 1) Prepare and upgrade building 185 in Meyrin to host the facility for the refurbishment of the Icarus detector. This includes the infrastructures associated to the Icarus detector.
 - 2) Extend and equip the EHN1 experimental hall to receive single and two-phase LAr detector R&D installations. This includes the civil engineering, the charged particle test beams and the infrastructures associated with the detector R&D facility. The layout of this extension will be compatible with the present study for an eventual neutrino beam line in the North Area
 - 3) Launch an R&D programme for the development of technologies required for the creation of a modern neutrino beam line; the study will include targets, horns, reflectors, pulsed magnets and the related infrastructure systems for the target area. The studies will not be site specific and would allow for construction in the US, Japan or at CERN.
 - 4) Complete the civil engineering study of the current layout for a neutrino beam line in the North Experimental Area of the SPS; in particular, of the junction cavern with the extraction line from the SPS and of the extension of EHN1.
- 1) Publish the report of the studies already carried out.

CERN Neutrino Project

.....
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 Neutrino Platform

2014 -2018

Neutrino detectors R&D

MOUs preparation in progress

WA104: rebuild ICARUS T600 in bldg 185

WA104: R&D on a new Large LAr TPC (ICARUS T150)

WA104: R&D on an AIR core muon detector (NESSiE) or eventually integrate a solenoid in the main TPC

WA105: R&D on 2 phases large LAr TPC prototype

MIND : R&D on muon tracking detectors

USA : Start a common R&D effort with US groups and EU groups for a LBN type of experiment ?

CERN Neutrino Platform

2014 -2018

Neutrino detectors R&D

MOUs preparation in progress

CERN direct contribution under evaluation:

- all logistics aspects
- cryostats (membrane and new ICARUS type)
- cryogenics
- controls
- DAQ
- magnets and B-fields
- integration and assembly
- host for visiting collaborators (PJAS, fellows, students, scientific associates,..)
- special studies (feasibilities, particular techniques, ...)
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CERN Neutrino Platform

2014 -2016

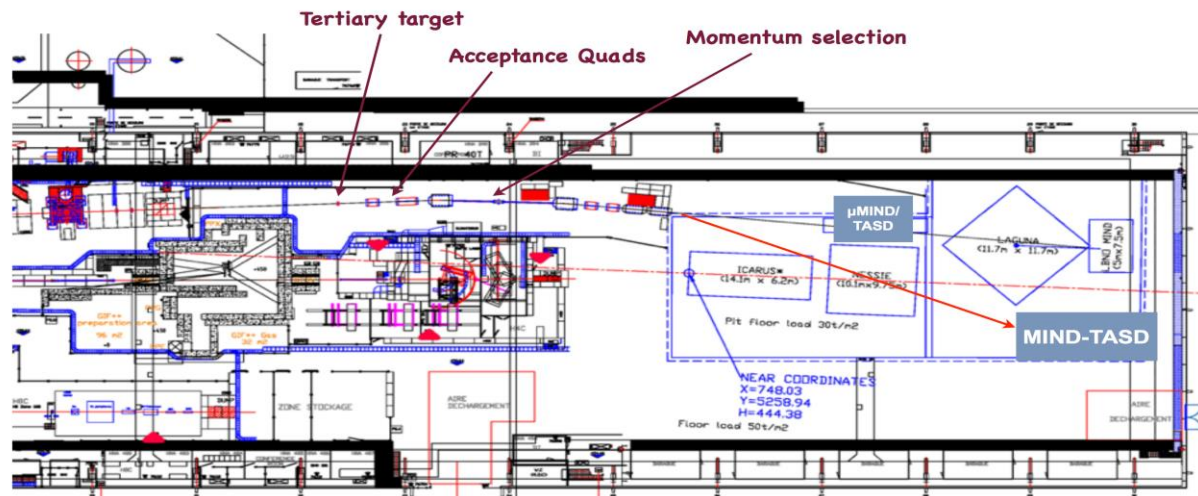
Logistics +
Test Beams Infrastructure
(EHN1 ext)



Bldg. 185 :

Hall empty by PH

EHN1 extension :



ν + charged beams for all experiments

MIND

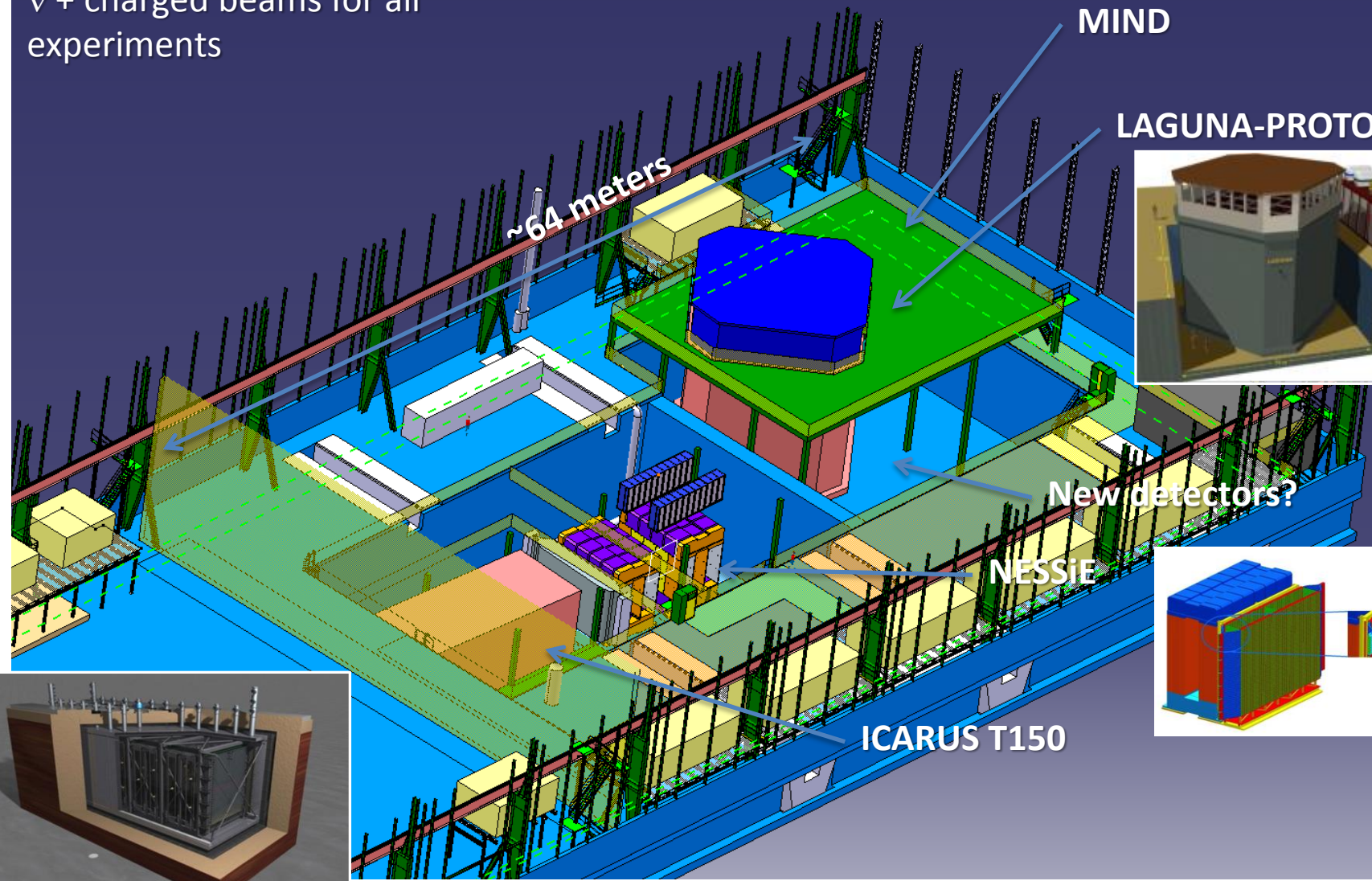
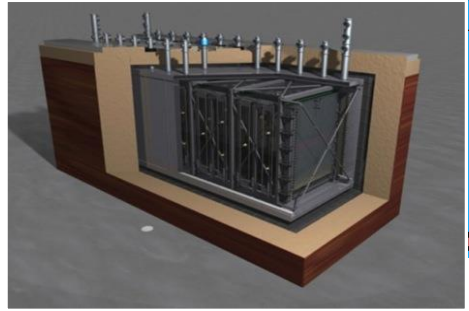
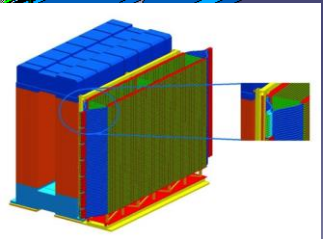
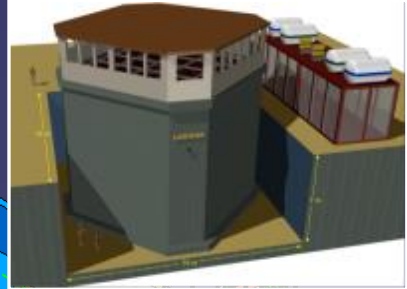
LAGUNA-PROTO

~64 meters

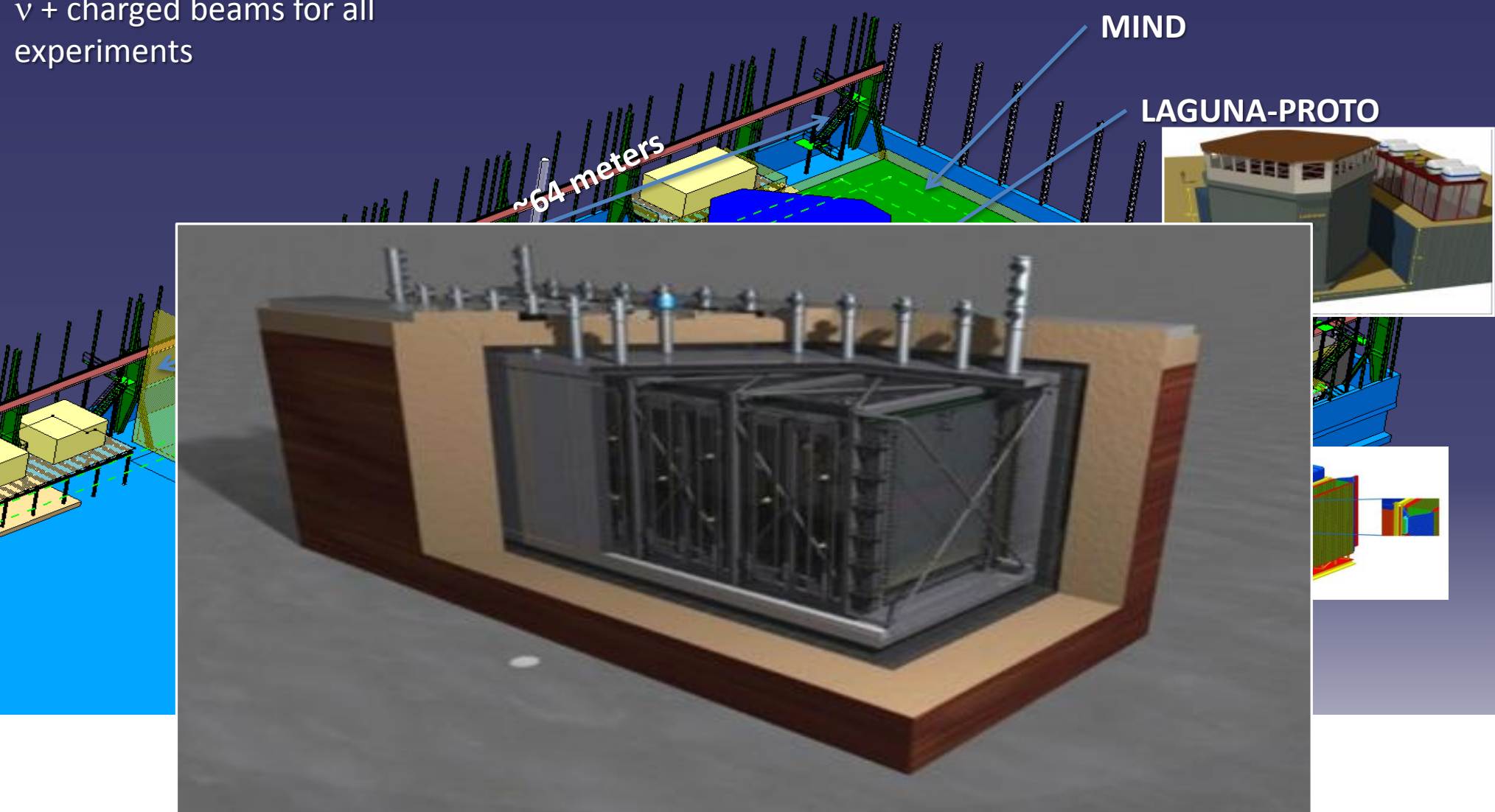
New detectors?

NESSIE

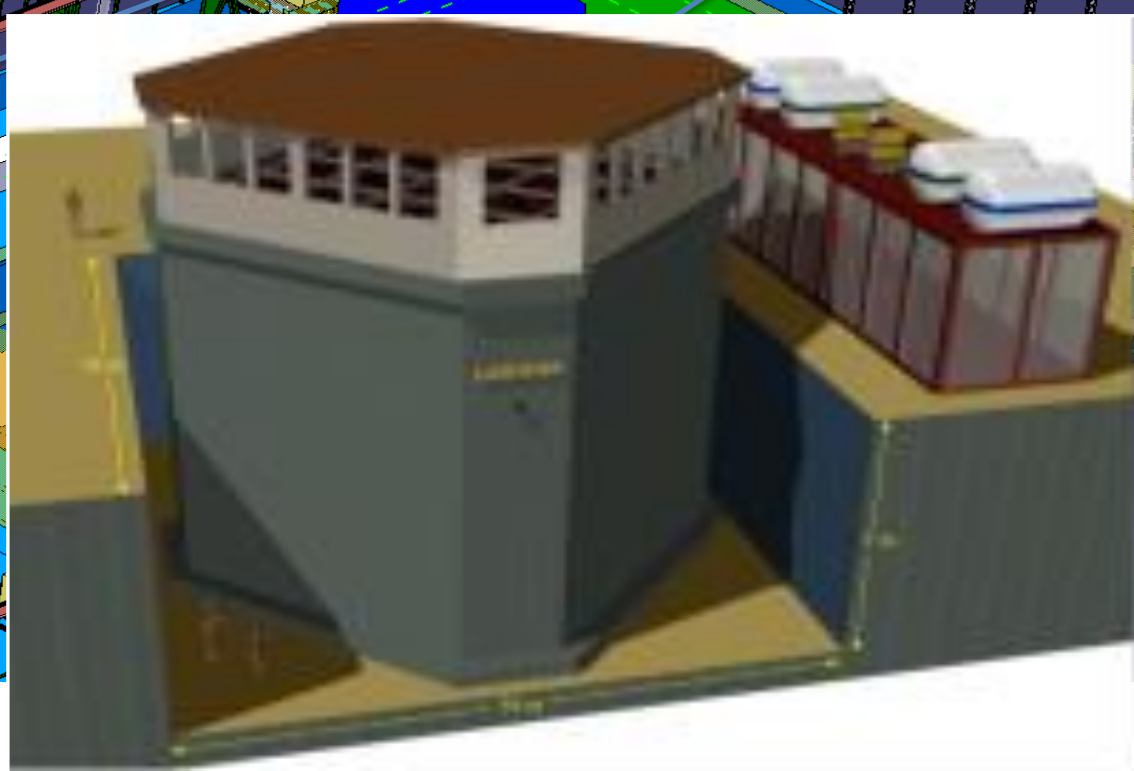
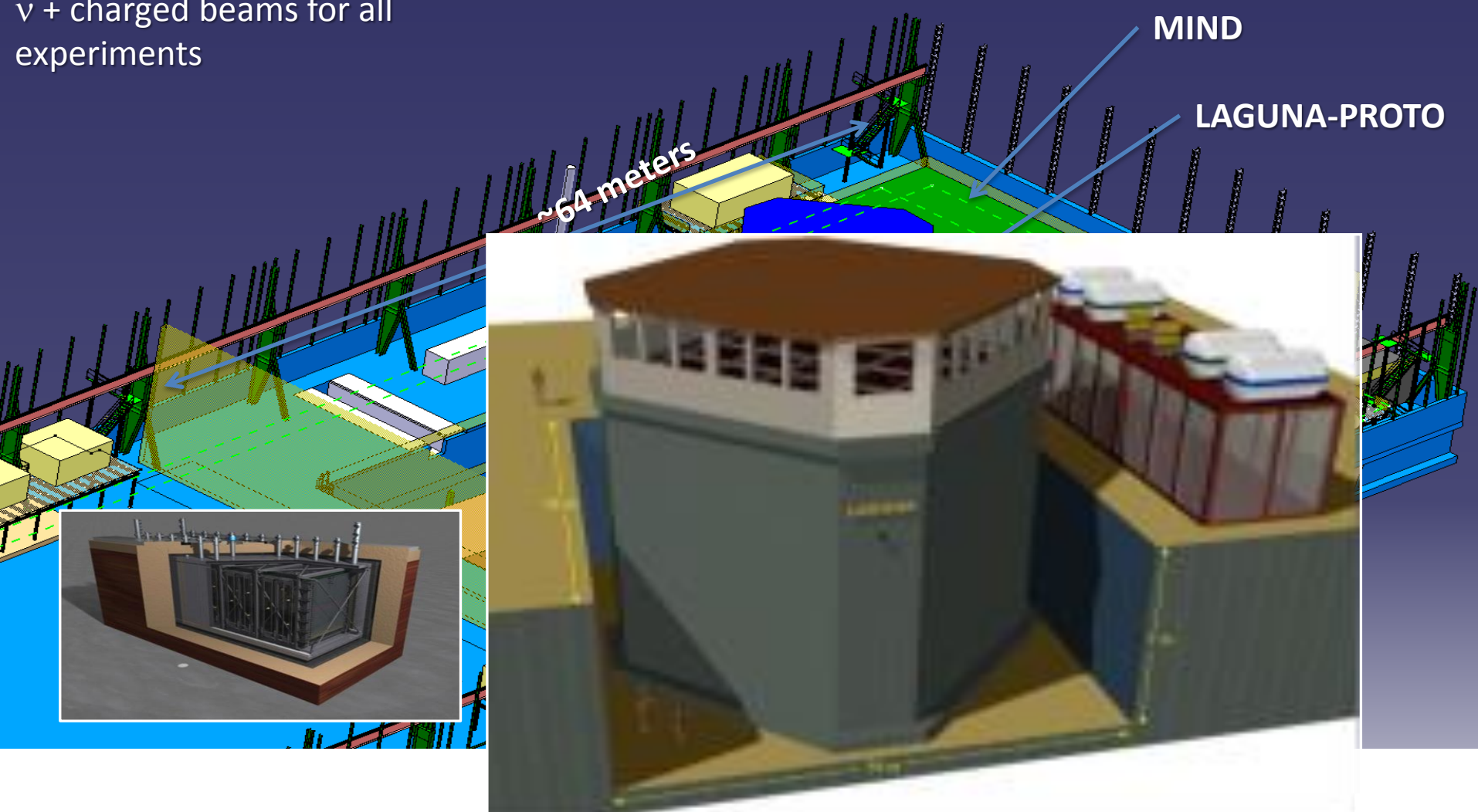
ICARUS T150

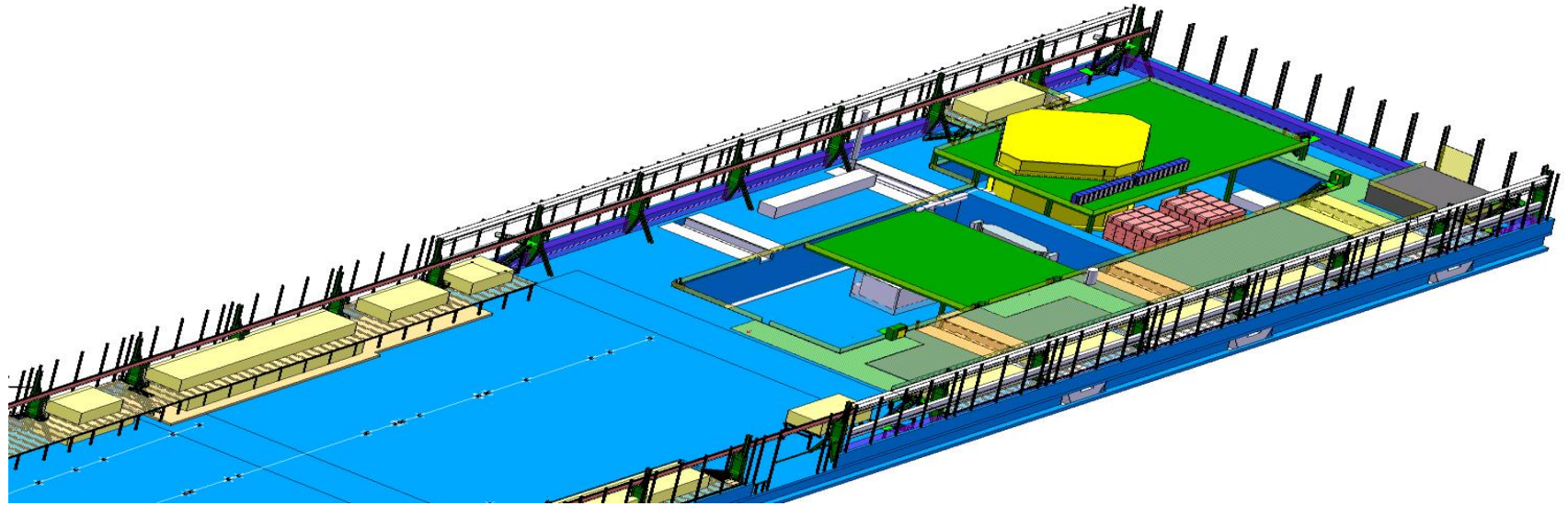


ν + charged beams for all experiments



ν + charged beams for all experiments





Ongoing activities with CERN participation:

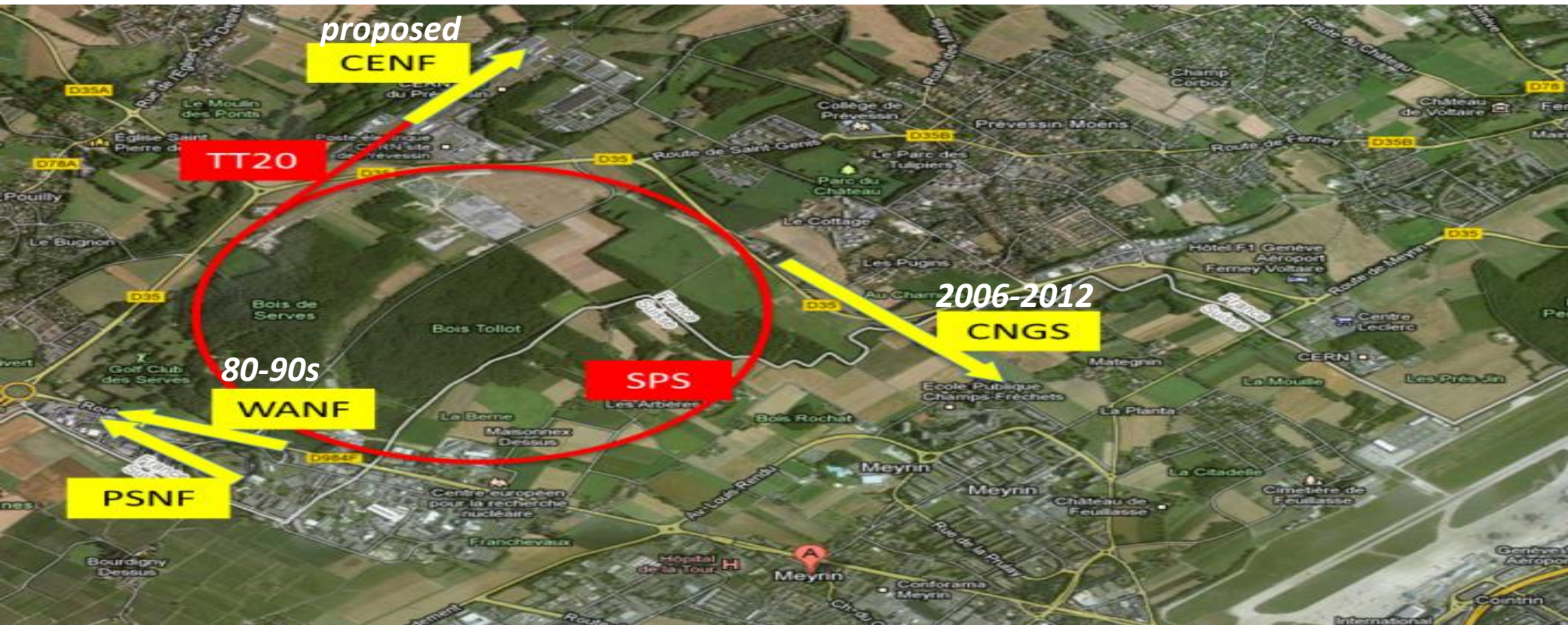
- ✓ Movement of ICARUS600 to CERN
- ✓ Preparation of b185 for ICARUS and b182 for LAGUNA
- ✓ Participation in the design, engineering and procurement of the new WA104 and WA105 cryostats
- ✓ Participation in the definition of a possible cryogenics project at CERN for WA104/5
- ✓ A feasibility study for a large superconducting magnet to be put around WA104, starting with the small WA104-ICARUS++ and/or participation in the air core magnet project of WA-104-NESSiE
- ✓ An detailed integration study for the EHN1 extension, ready for CE engineering detail design with input from technical groups
- ✓ Assignment to a selected CE firm, after the December FC of the design phase 1 and 2 of the EHN1 extension (IT-3947/GS). Specs must be ready the first week of December for the selected firm
- ✓ Detailed project definition for charged beams in the EHN1 extension
- ✓ Definition for all the above of the necessary safety and environmental studies
- ✓ Preparation of a budget request for all the above and finalization of the necessary MOUs with WA104 and WA105
- ✓ Initial discussions with the US groups on a possible common R&D

CERN Neutrino Platform

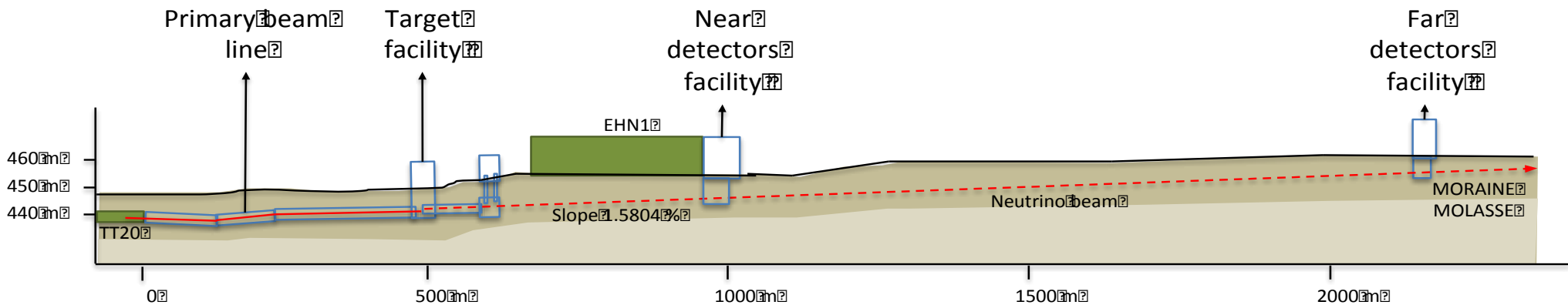
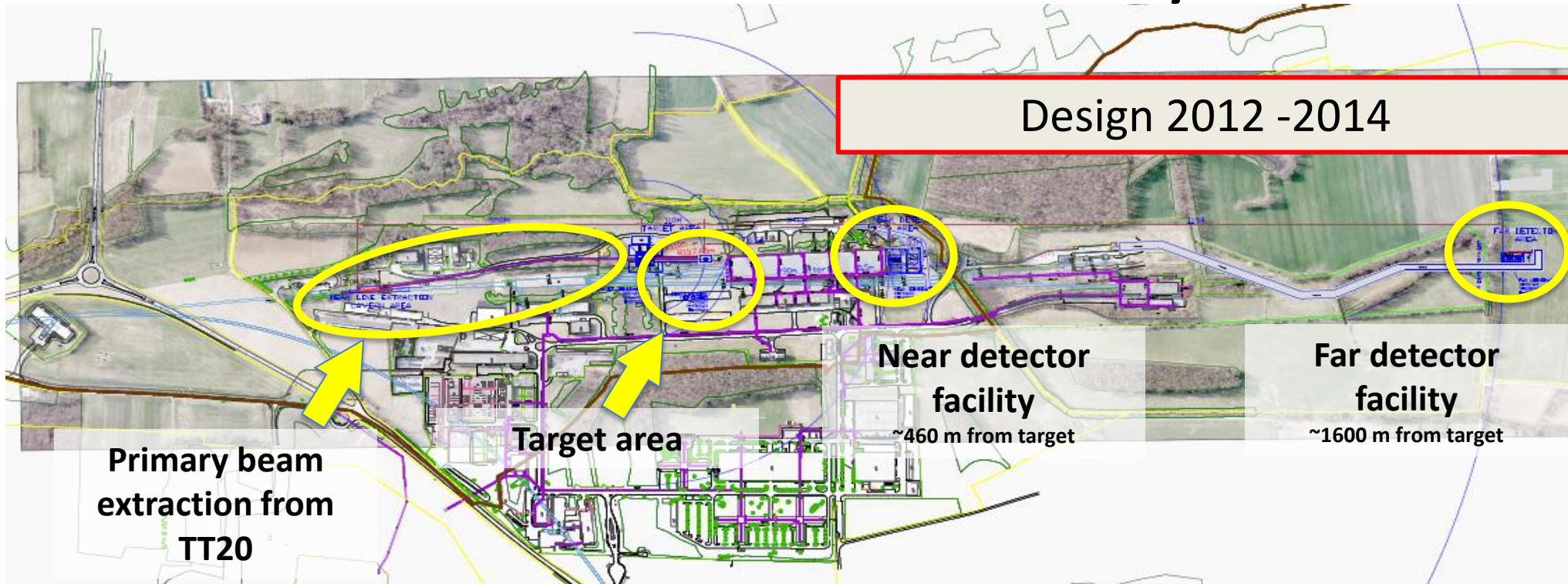
Design 2012 -2014

Eventually Construct 2015 -2018

Design and implement a Neutrino Beam at CERN



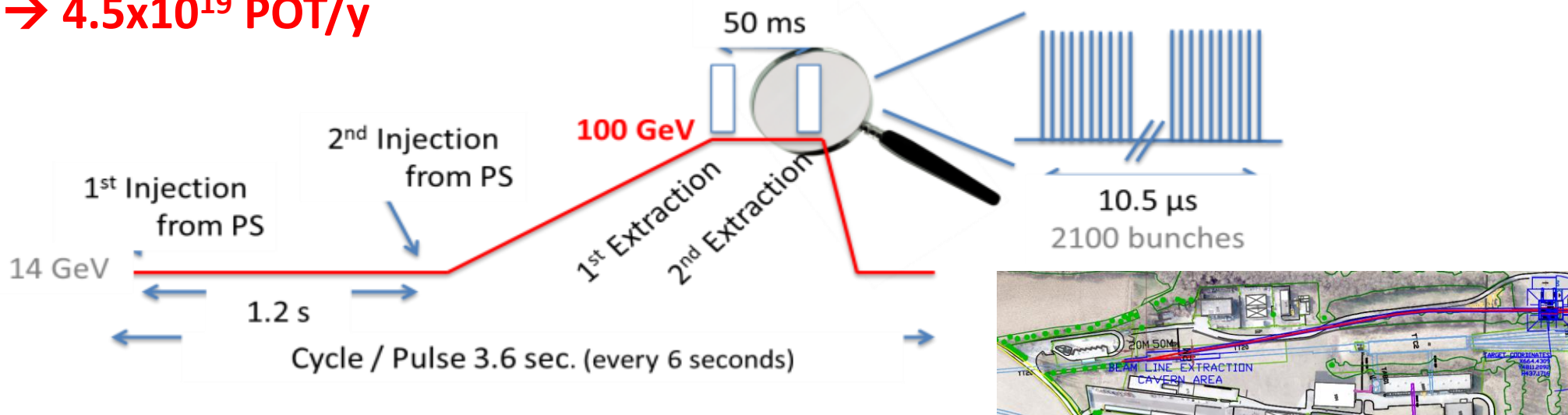
CERN Neutrino Facility



Primary proton beam characteristics

- Beam time structure similar to CNGS
- Primary beam momentum **100 GeV/c**
- Fast extraction: beam excitation via injection kicker in LSS1 and extraction in LSS2
- Novel solution tested for low intensities during recent beam tests
- ~ 720 kJ/pulse $\rightarrow \sim 200$ kW on target (max)

$\rightarrow 4.5 \times 10^{19}$ POT/y

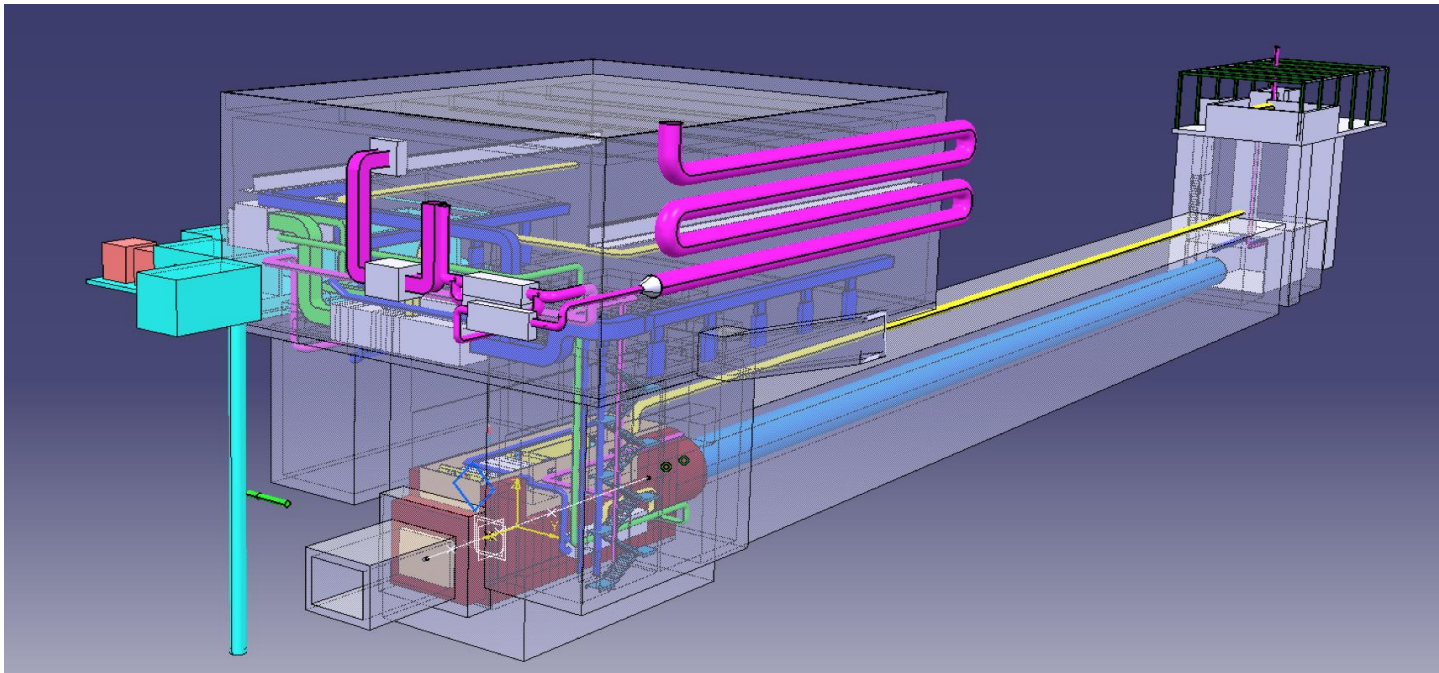


CERN Neutrino Platform

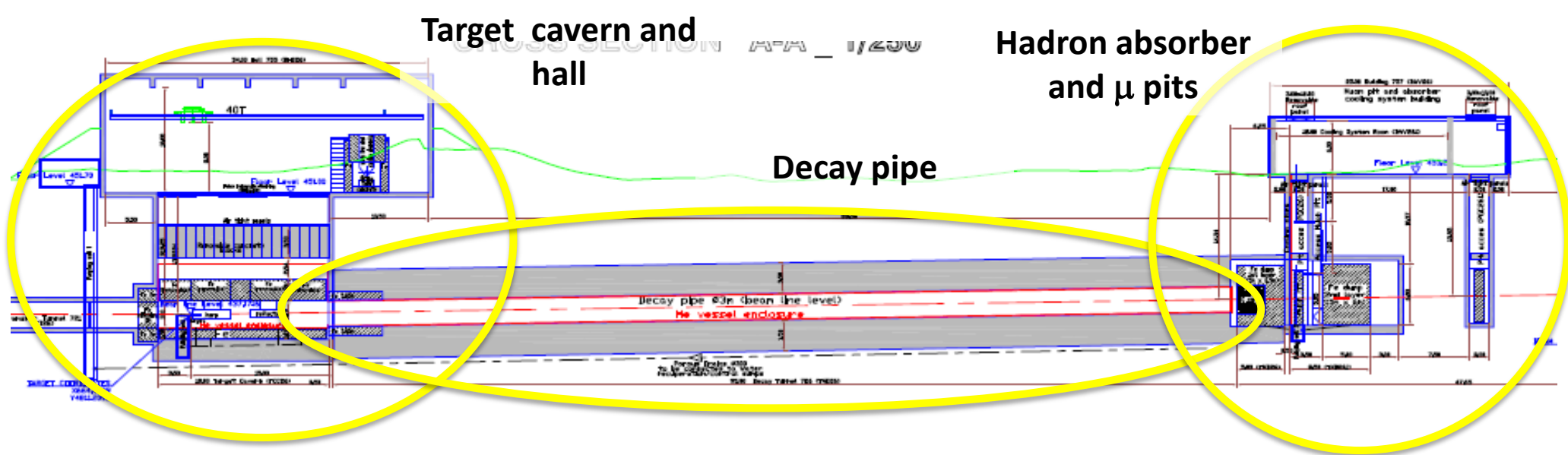
Design 2012 -2014

Eventually Construct 2015 -2018

Design and implement a
Neutrino Beam at CERN

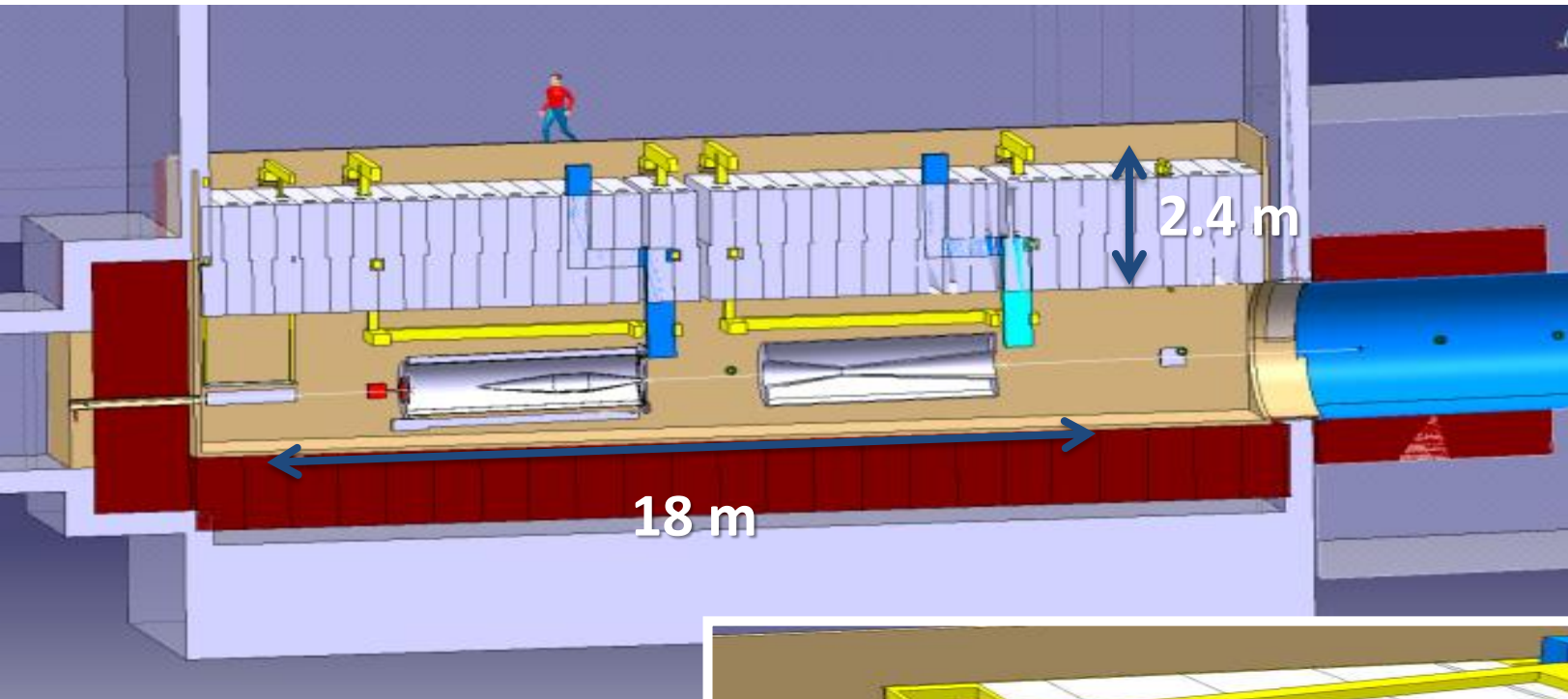


Target area, decay pipe and hadron absorber/dump

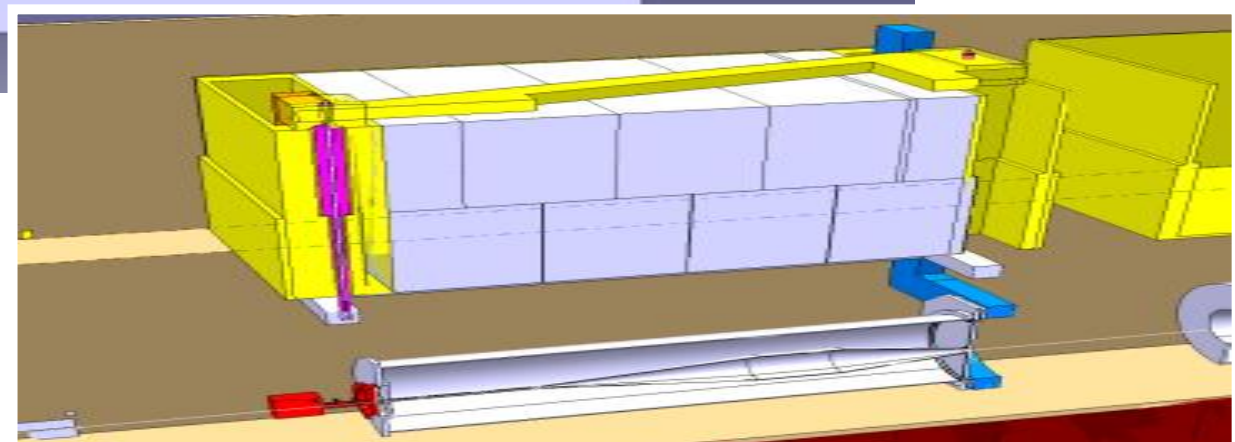


- Beam line under He, to avoid NO_x formation and to reduce air activation
- Angle, distance and depth optimised to keep dose rate in EHN1 $< 1 \mu\text{Sv/h}$
- Target shielding such that dose rate in target building area $< 15 \mu\text{Sv/h}$
- Air treatment and water recuperation
- Civil engineering drillings already performed

Secondary beam production



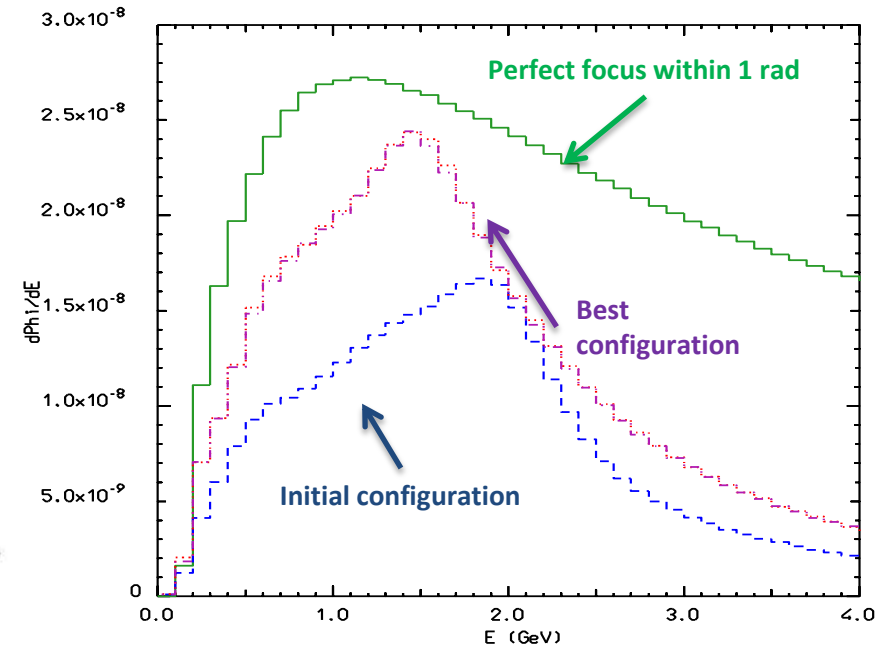
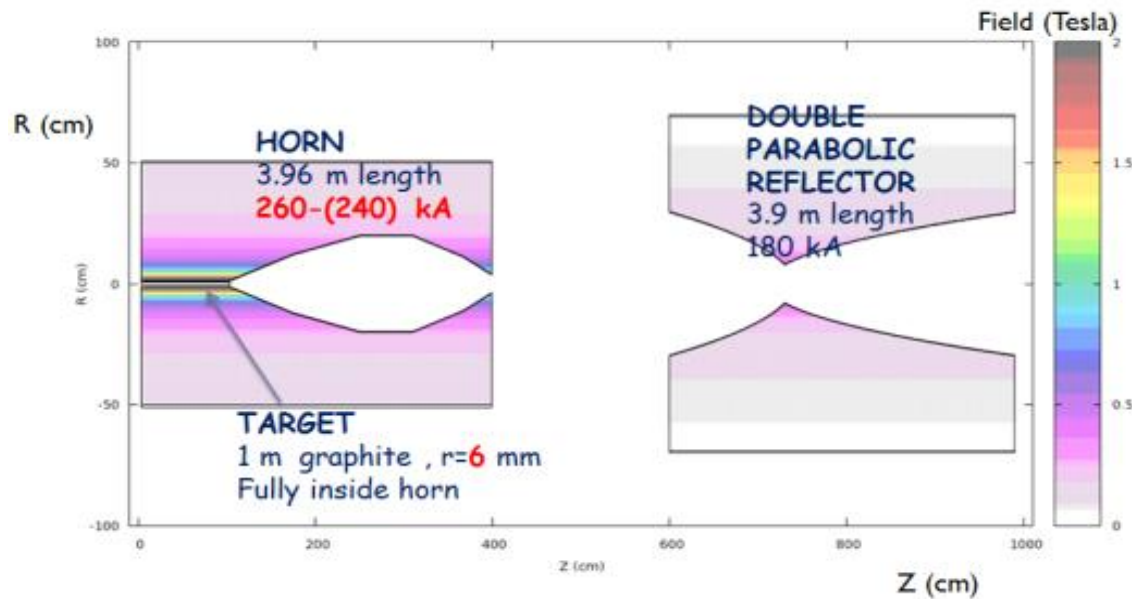
Integration of target trench, 3x3 m², matching DP diameters



Preliminary design of the support module, pure vertical movements

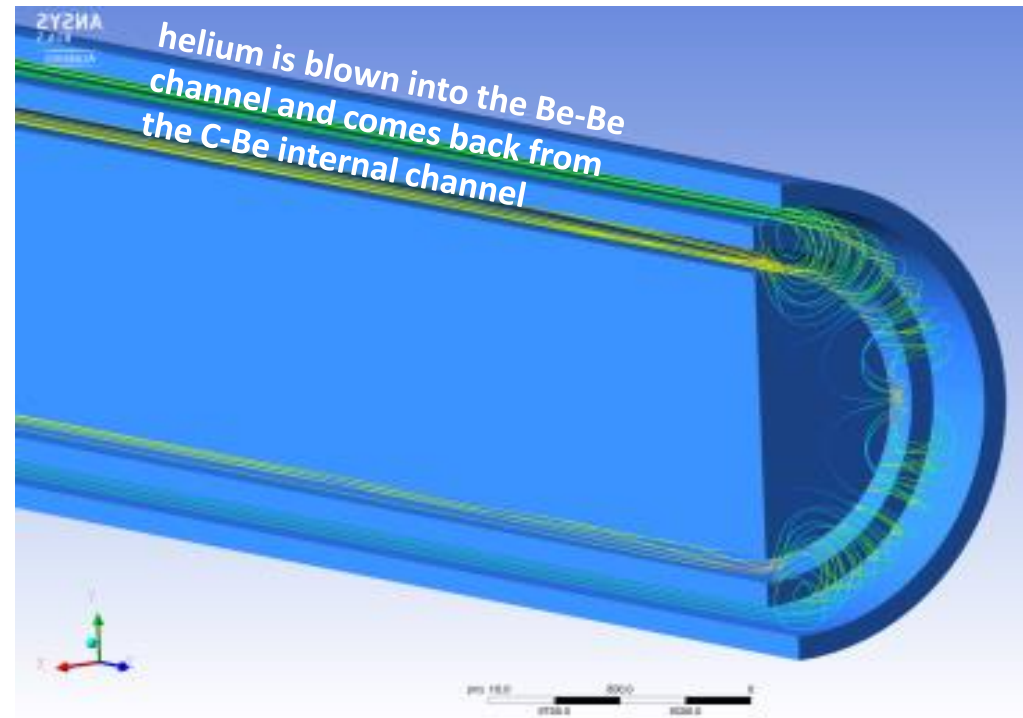
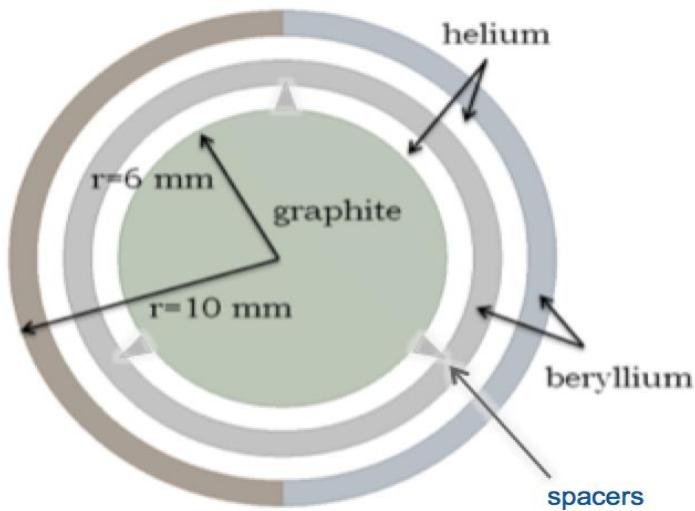
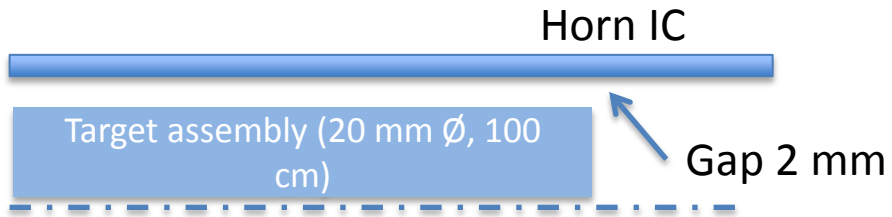
Neutrino beam optimisation

- FLUKA multi-parameter optimisation
- 5 GeV pion focusing – central ν_μ energy ~ 1.8 GeV
- Target inside horn, followed by reflector



- Far detector:
 - $\sim 1\text{M } \nu_\mu / \gamma$
 - $\sim 20\text{k } \nu_e / \gamma$

CENF target



- Aiming at simple solution which maximize pion output
- No contact allowed between target and horn

CERN Neutrino Platform

Design 2013 -2014

Design and implement a
Neutrino Beam at CERN

Primary and Secondary beam

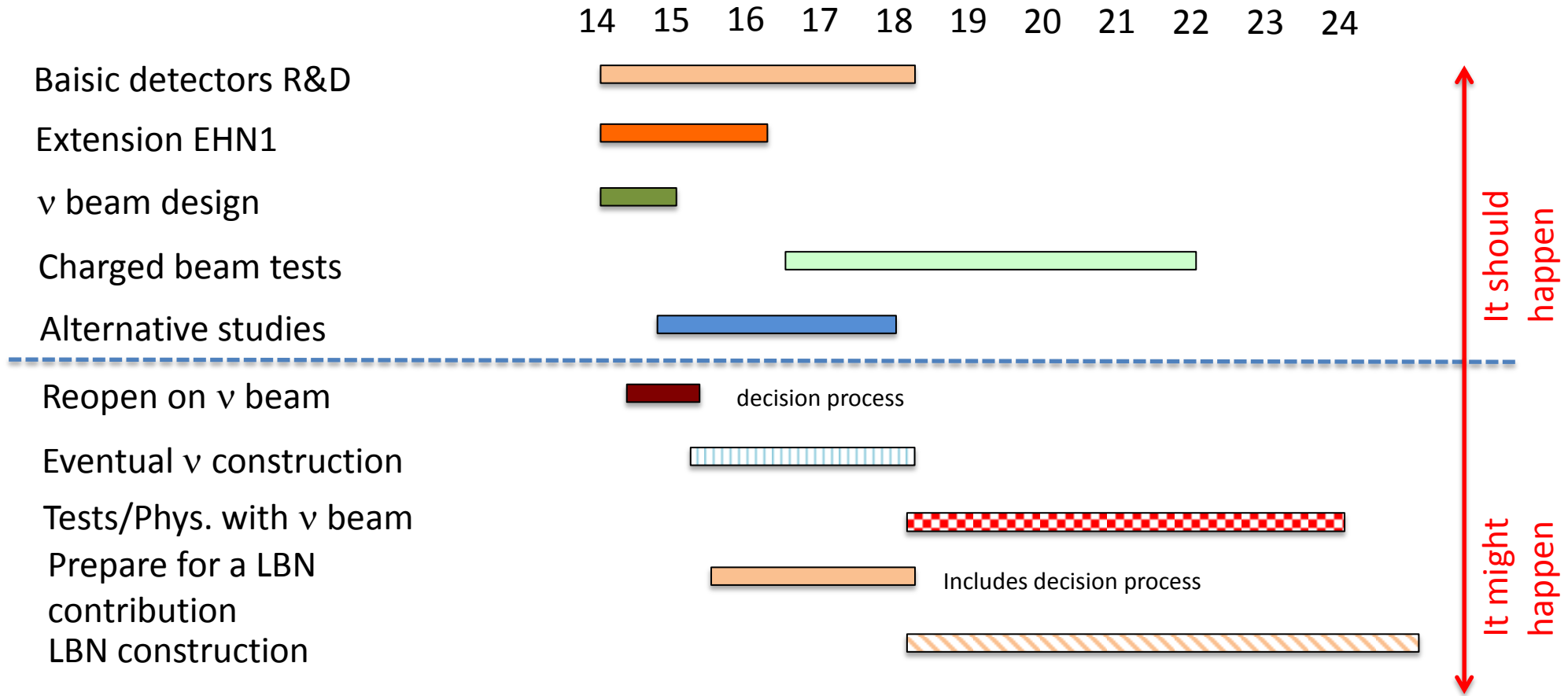
Ongoing/necessary design activities for a neutrino beam at CERN:

- ✓ Functional design of a secondary beam area (target area complex, decay pipe, hadron absorber, ...)
- ✓ Radioprotection, cranes and handling, cooling & ventilation, safety and power related issues for the secondary beam area
- ✓ Integration studies
- ✓ Detailed optimization and design of meson production target, horn and reflector, including detailed engineering
- ✓ Preliminary risks analysis (APR) study for secondary beam area
- ✓ CE detailed design via IT-3947/GS for secondary beam areas
- ✓ Functional and geometrical design of the primary beam (TT26)
- ✓ Detailed cost estimation of the secondary beam line
- ✓ Environmental impact study for the secondary beams
- ✓ Possible cooperation with FNAL on the design of the LBNE secondary beam

- ✓ Prepare CE specs for junction cavern with existing SPS TT20 beam line
- ✓ Prepare CE specs for Primary beam tunnel (~600m)
- ✓ Optimize beam optics and power consumption through new beam elements (pulsed, super-ferric, cryo, ??)

CERN Neutrino Platform

Time profile and sequence of operations and decisions



Summary:

- ✓ CERN offers a platform for Neutrino detectors R&D
- ✓ CERN will support this platform in an active way and will help WA104, WA105 and others in this initial phase
- ✓ CERN will construct a large neutrino test area (EHN1 extension) with charged beams capabilities, available in 2016 (and compatible with a future neutrino beam)
- ✓ CERN will continue the detailed studies towards a neutrino short baseline at CERN in particular for the secondary beam facility
- ✓ CERN will assist the EU neutrino community in their long term common plans