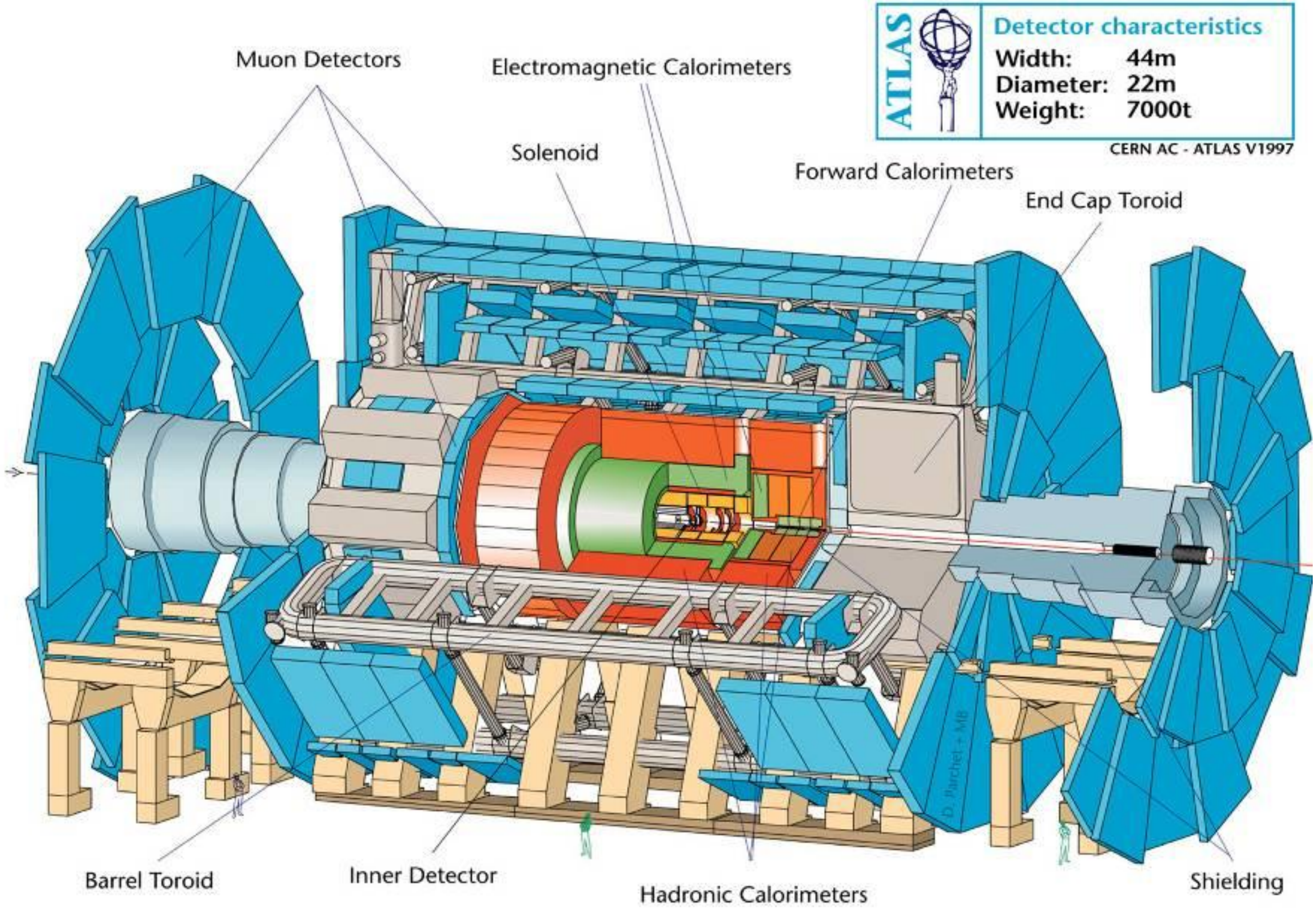
BULGARIAN ENGINEERING TEACHERS PROGRAMME

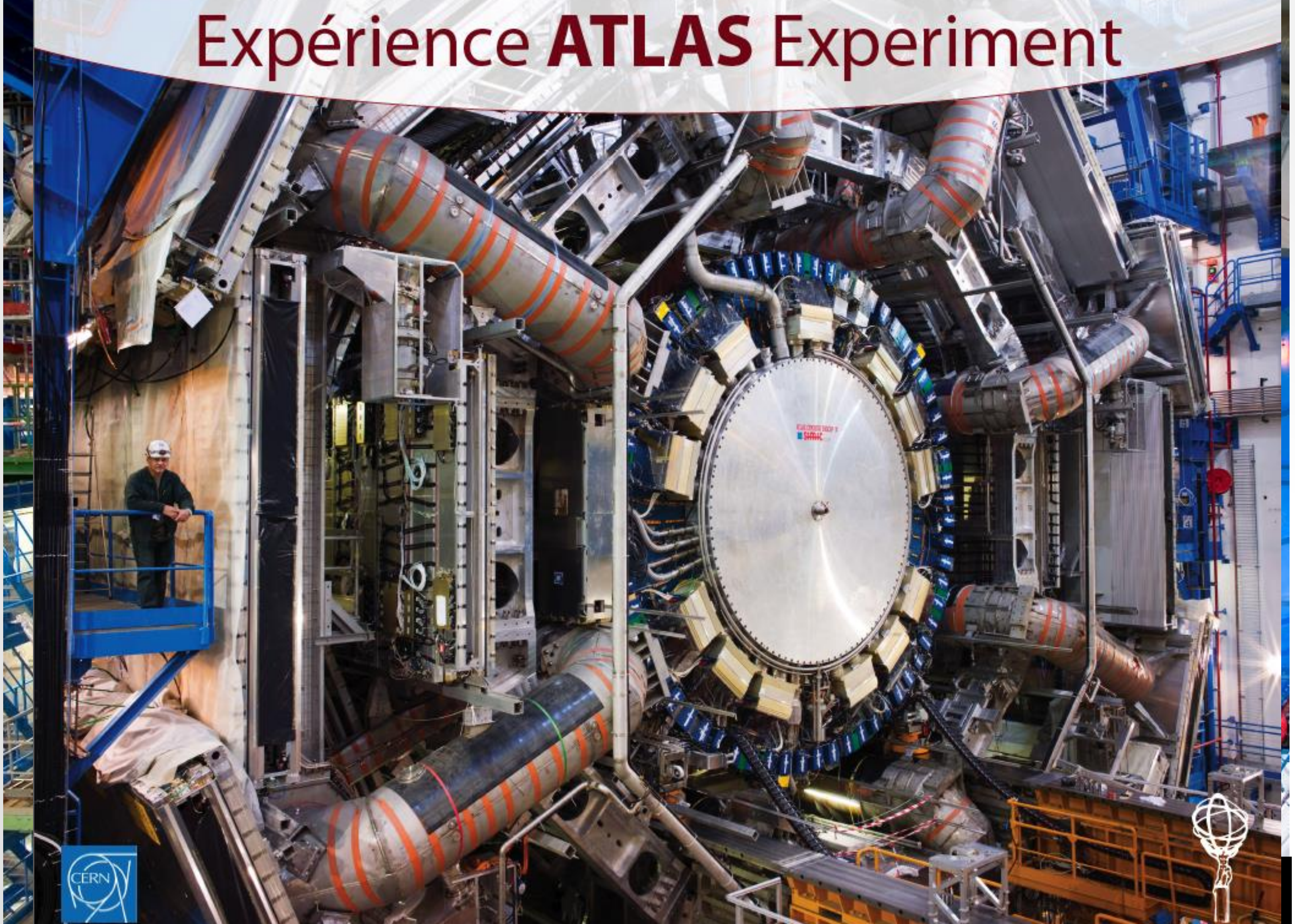
DETECTOR SITES AND SYSTEMS FOR REMOTE PERSONAL SUPERVISION

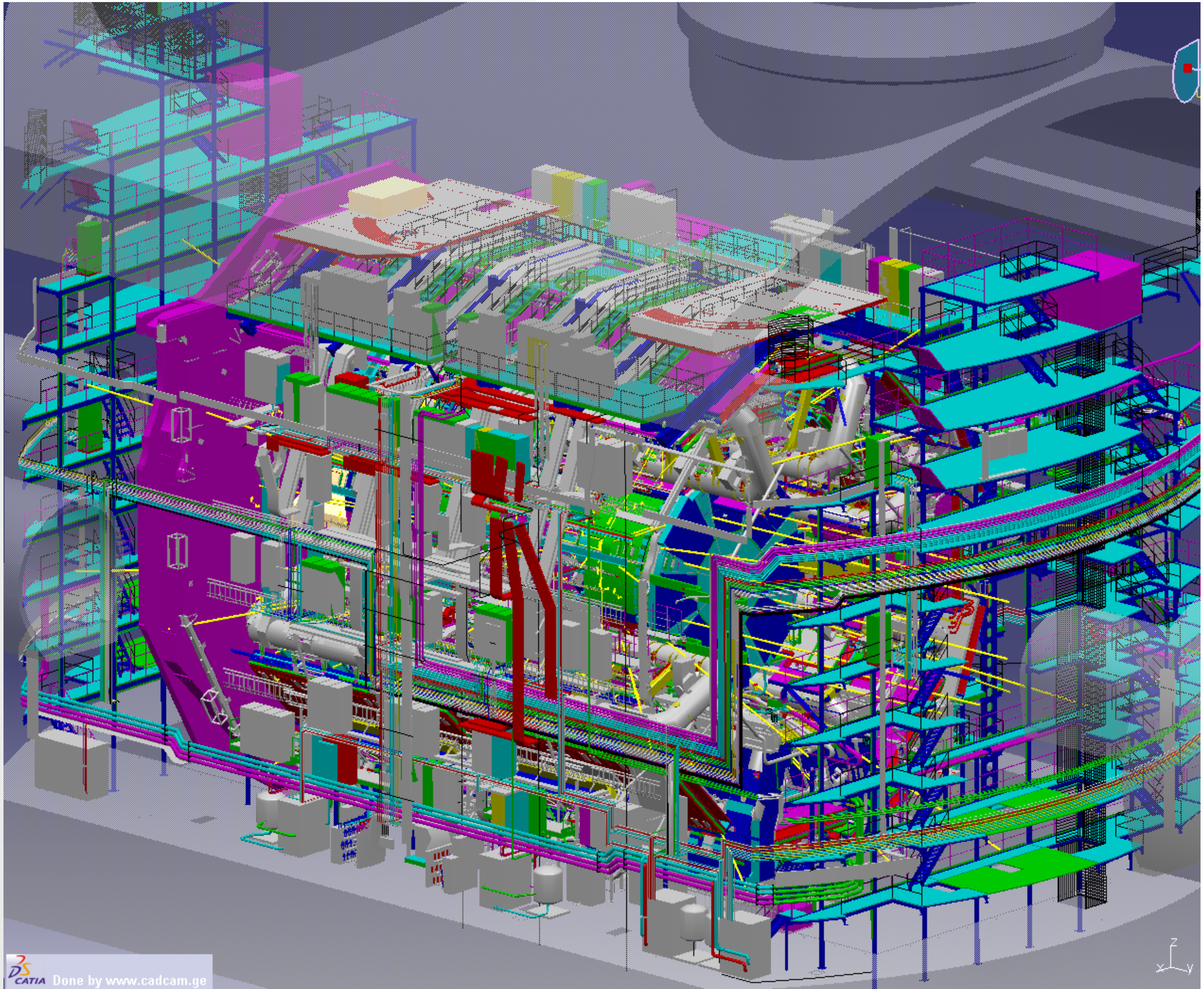
DIMITAR MLADENOV

CERN

ATLAS


Muon Detectors
Electromagnetic Calorimeters
ATLAS
Detector characteristics
Width: 44m
Diameter: 22m
Weight: 7000t
CERN AC - ATLAS V1997
Solenoid
Forward Calorimeters
End Cap Toroid
Barrel Toroid
Inner Detector
Hadronic Calorimeters
Shielding


Expérience ATLAS Experiment
CERN


CATIA
Done by www.cadcam.ge

ASSEMBLY OF THE BIG WHEELS SECTORS

- Assembly work of the 104 sectors

- Team of around 50 engineers and technicians from different nationalities
(Israel, Pakistan, France, Russia, USA, China, Japan, etc.)

- Safety.
    - work analysis
    - safety control
    - scaffoldings/nacelles/personal.

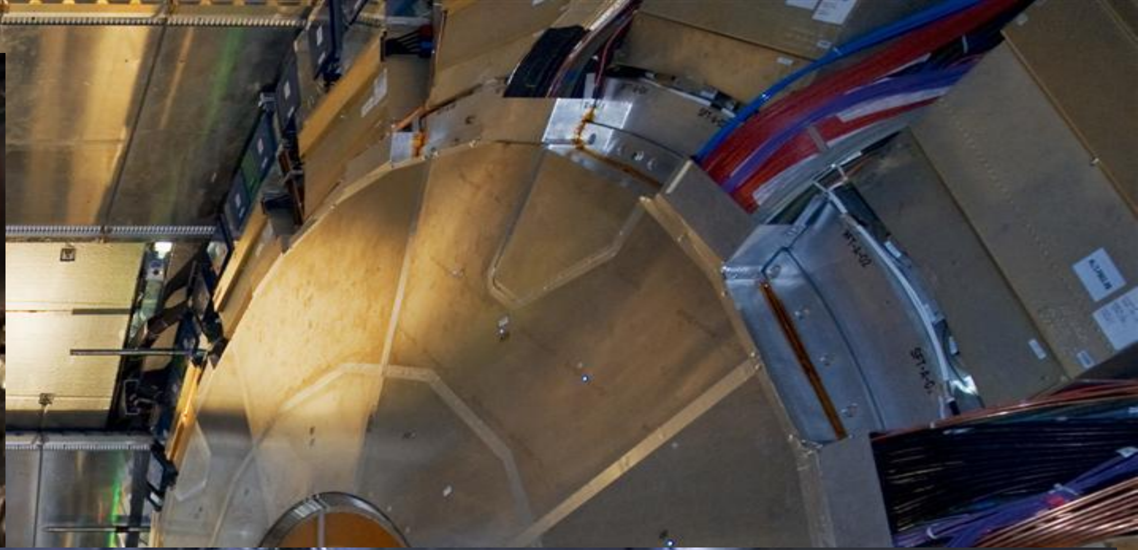
- Huge personal rotation:
    - welcome/sent off
    - integration
    - professional and safety training
    - link person between:
        - teams in the assembly hall
        - the assembly hall and the design office

Safety!

Hundred meters of platforms, ladders, holes, etc.

Scaffoldings

Confined spaces

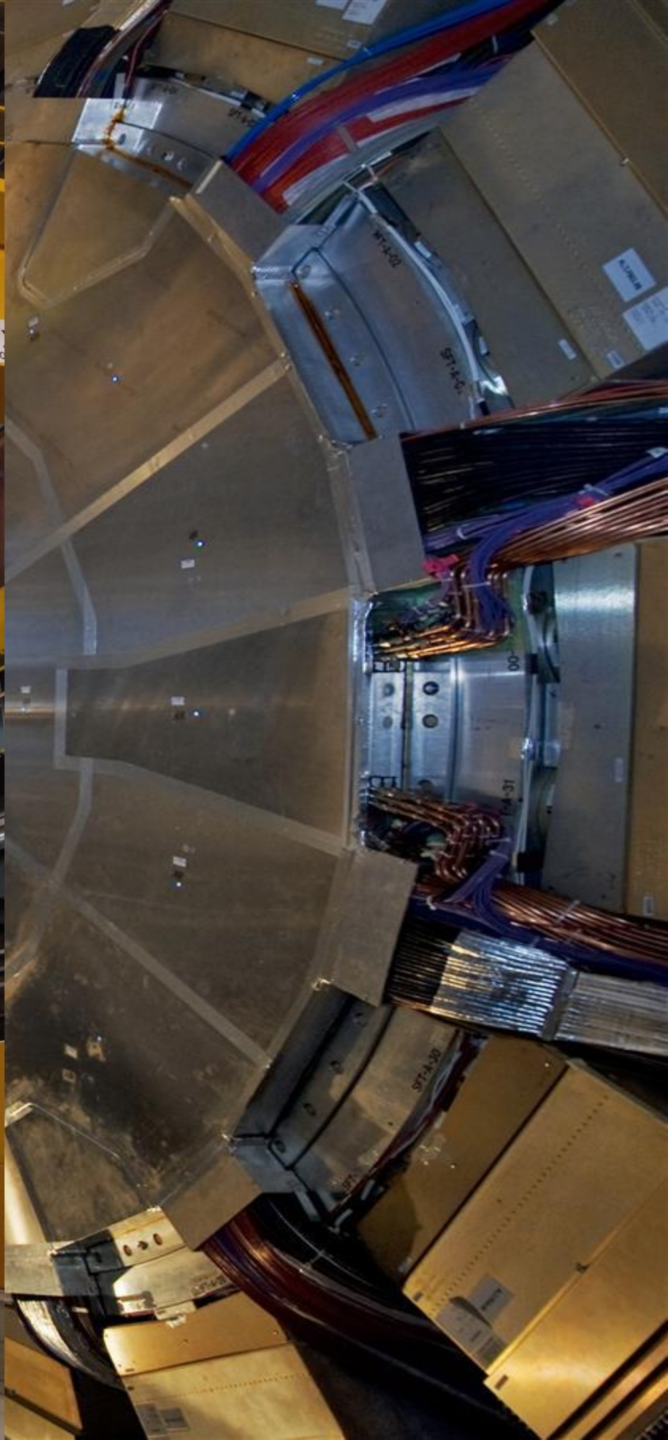


Lightening changing and not always optimum ...

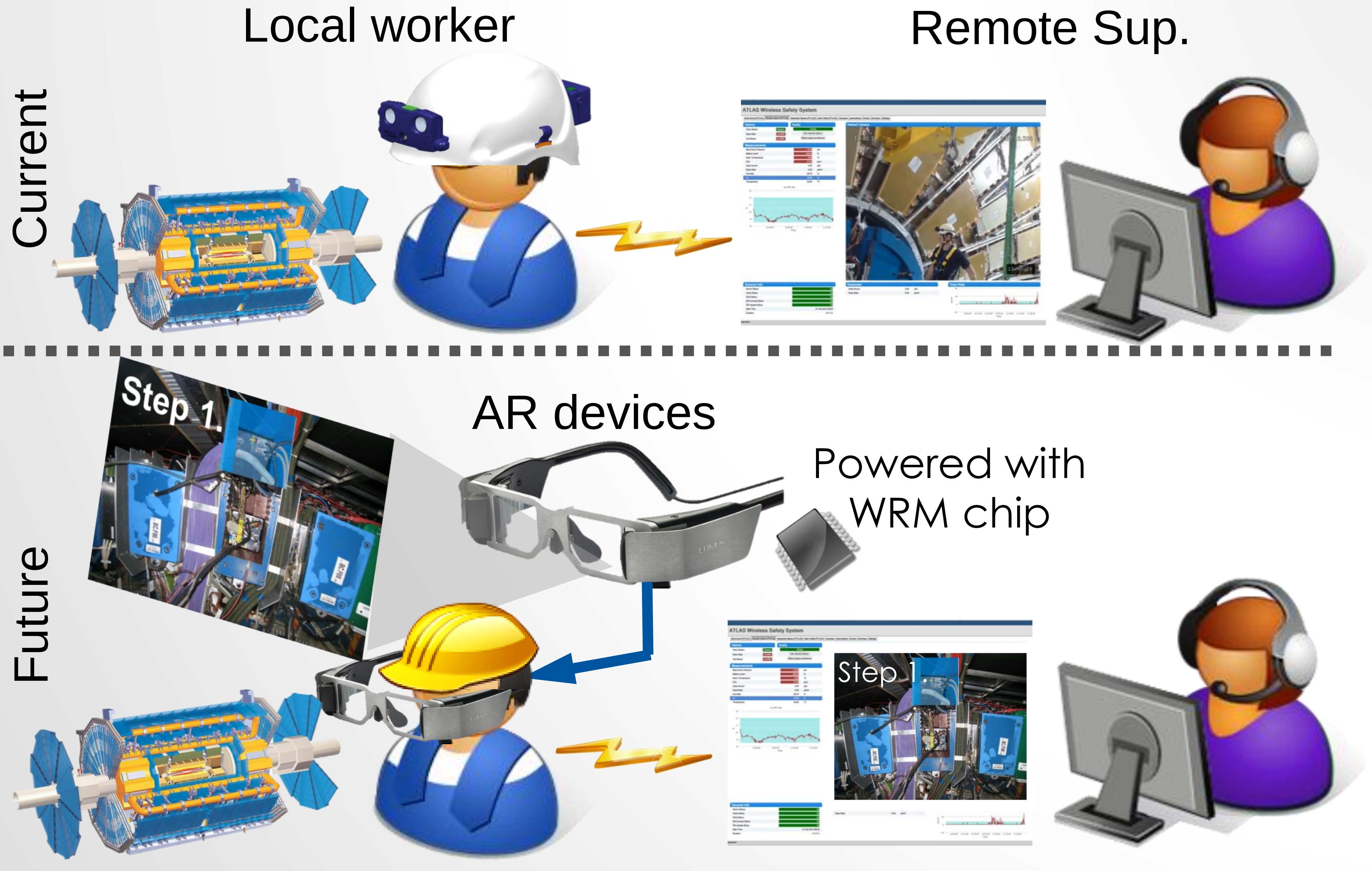
The activities are very different
from very detailed detector expertise work
… to heavy loads transport

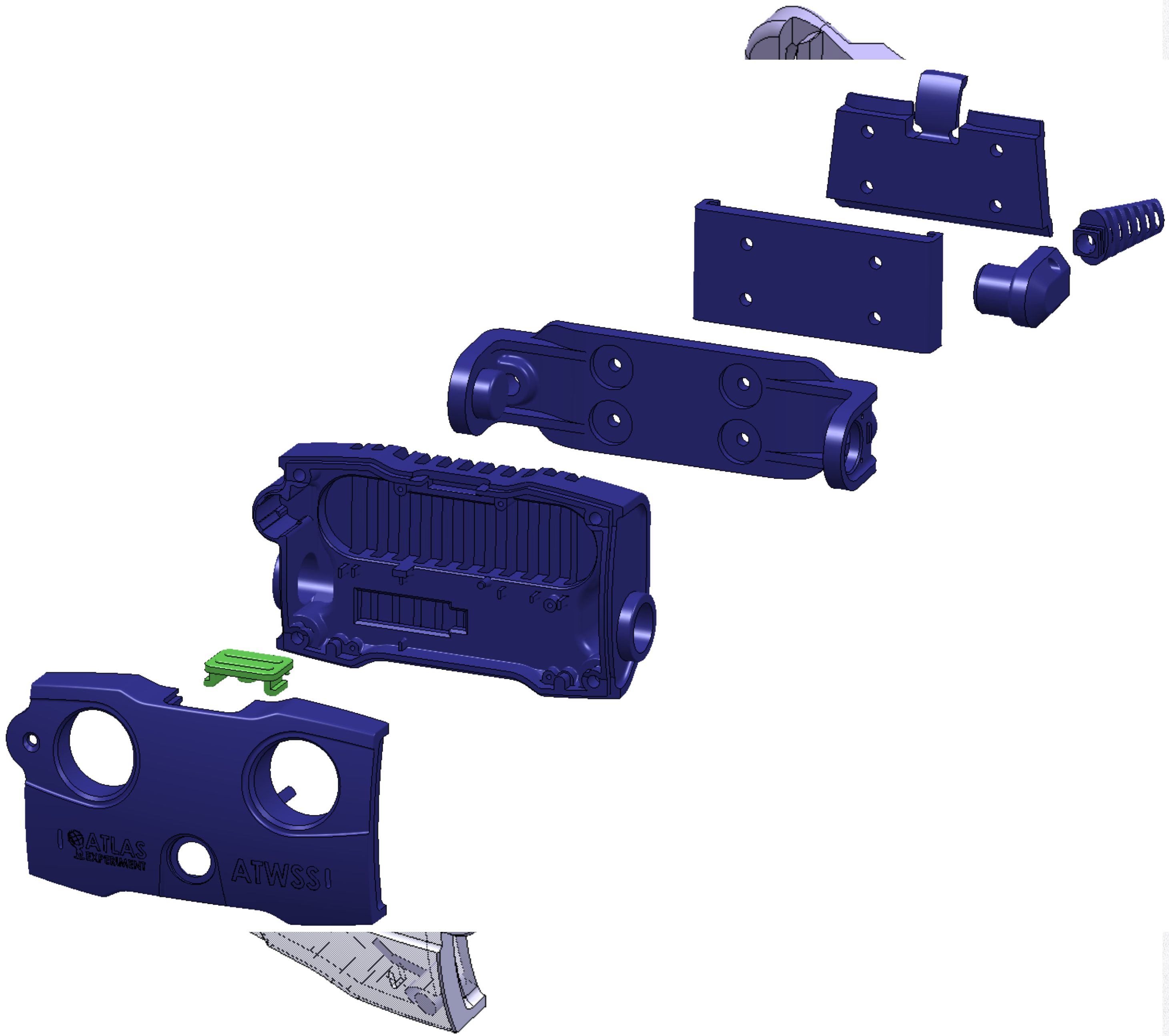

EA.F02
EA.F01
EA.F64
ANL34
ANL05

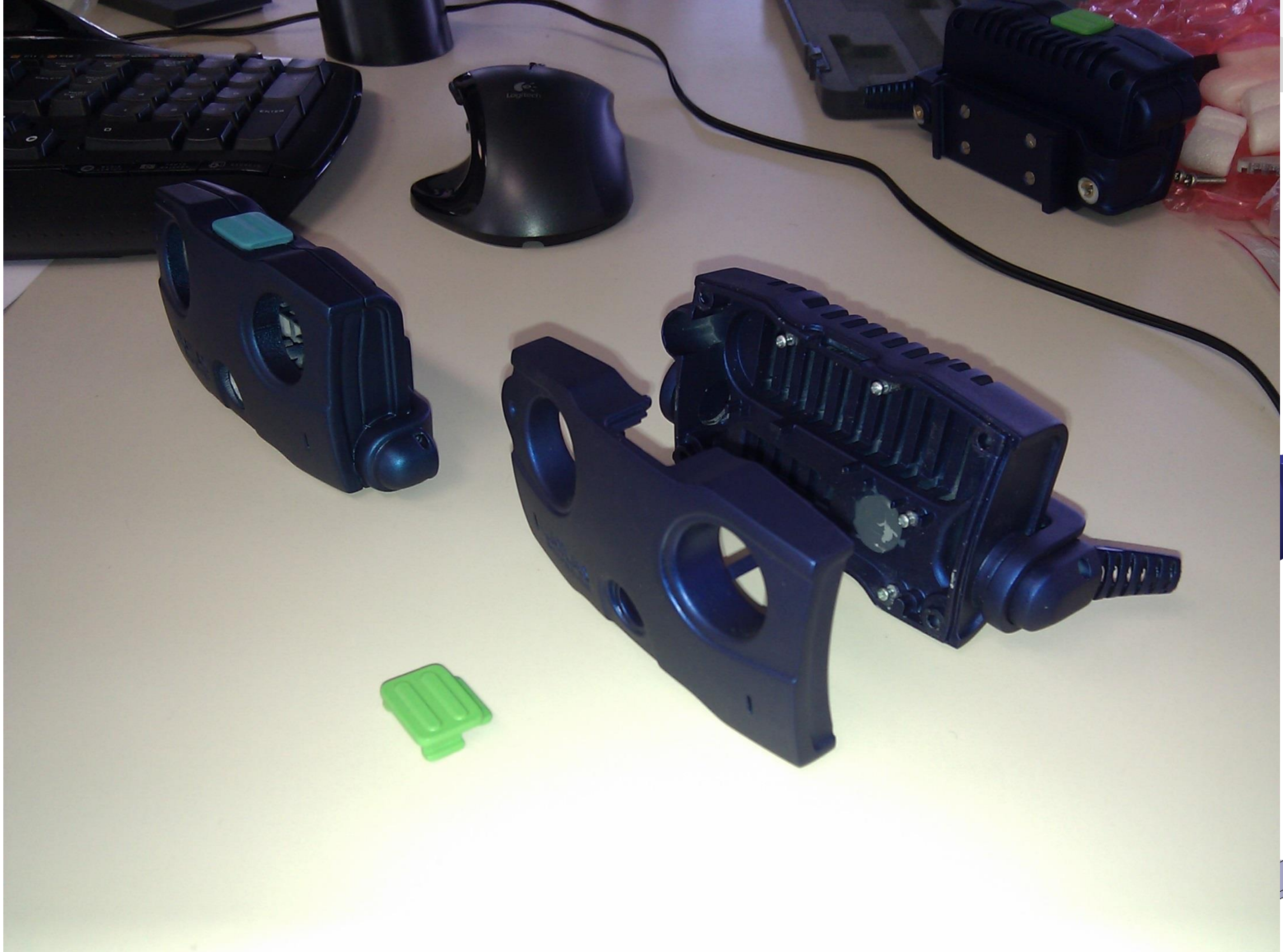

BRUNNHUBER
KRANTECHNIK
BRUNNHUBER
KRANE GMBH



OVERVIEW OF PERSONNEL SAFETY SYSTEM




ATLAS
EXPERIMENT
ATWSS


Status of the ATWPSS system development

✓Several prototypes configurations already developed and tested in the ATLAS experimental cavern.

✓Head Mounted Display from LUMUS

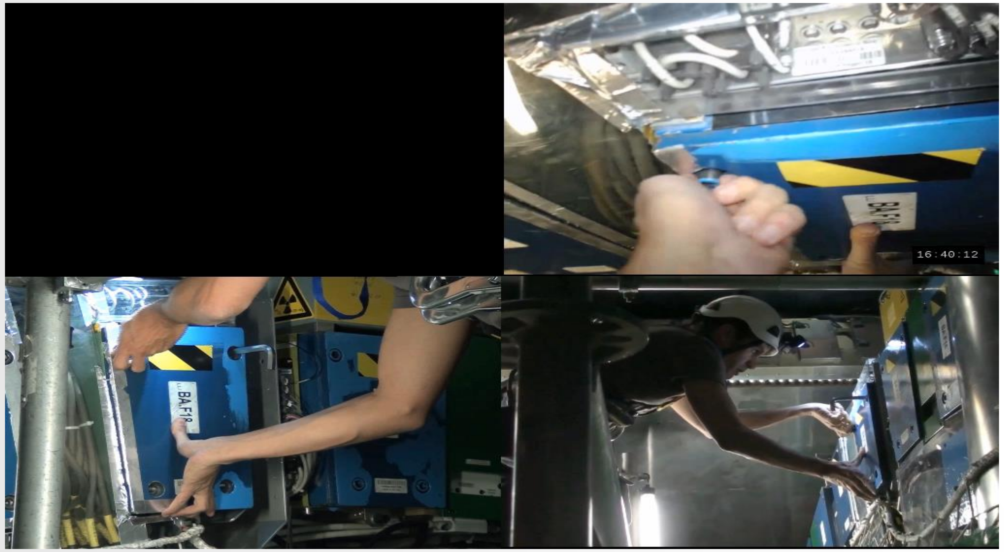
GOOGLE glasses

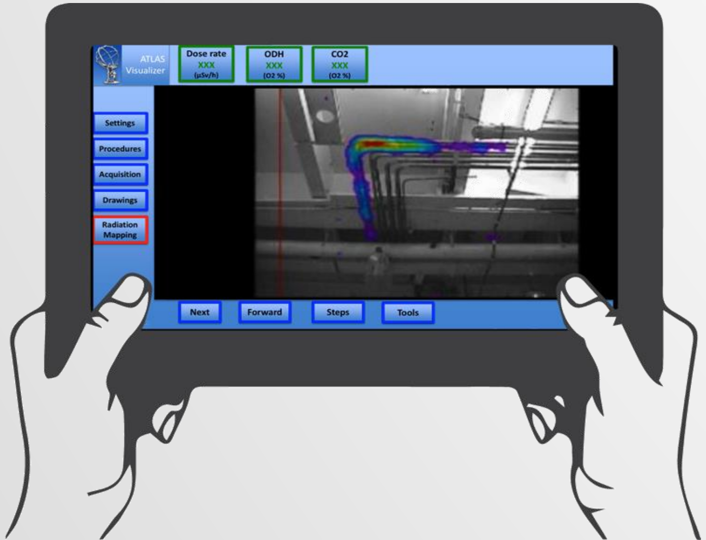
5 ATWPSS systems are currently in use

We have already saved radiation doses !

HOW?

We provide Augmented and Virtual Reality information to workers: procedure of work, radiation environment





Video 1

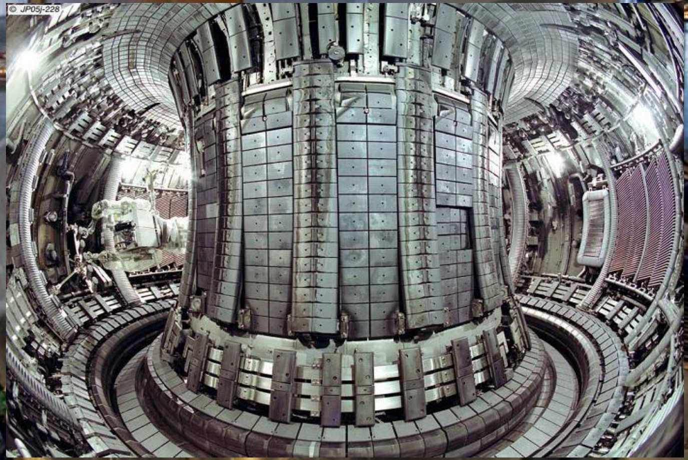
Video 2

We are currently looking the best way to approach the problem

The strategy ...

1. In collaboration within CERN: LHC Machine, EN department, ISOLDE, .. determine the most suitable company to assist us in the process

2. In parallel, we are looking for some possible EU funding to develop / adapt technologies for the "CERN cases"

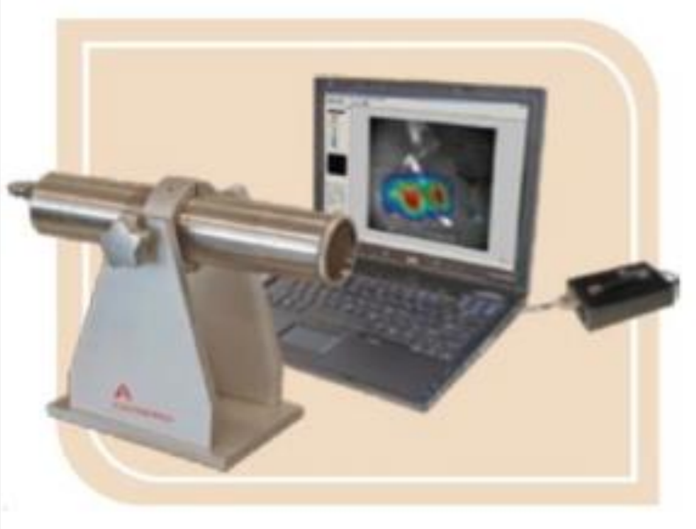


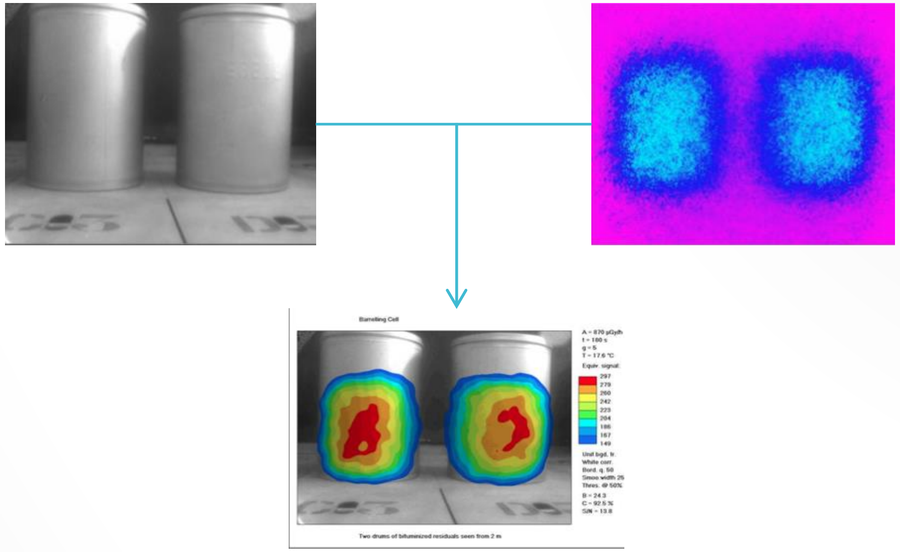
3. Start a prototype in building 180 very soon (within a year) to test the technologies and get experience

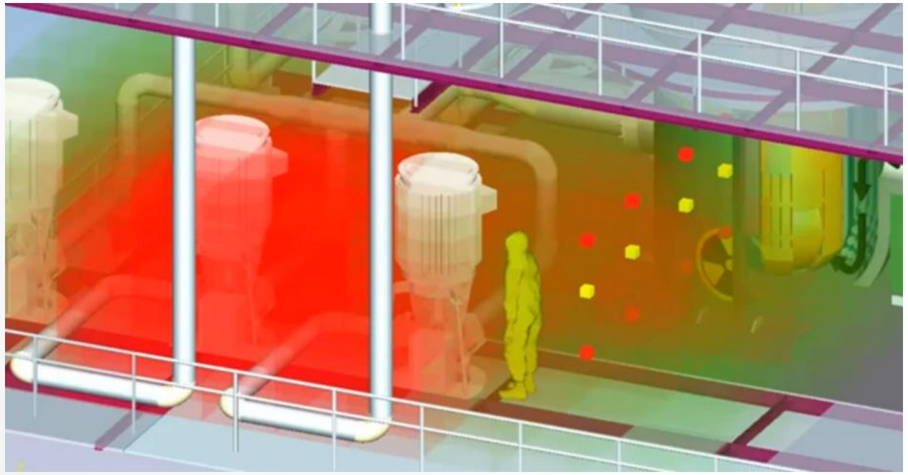
Video 1

Video 2

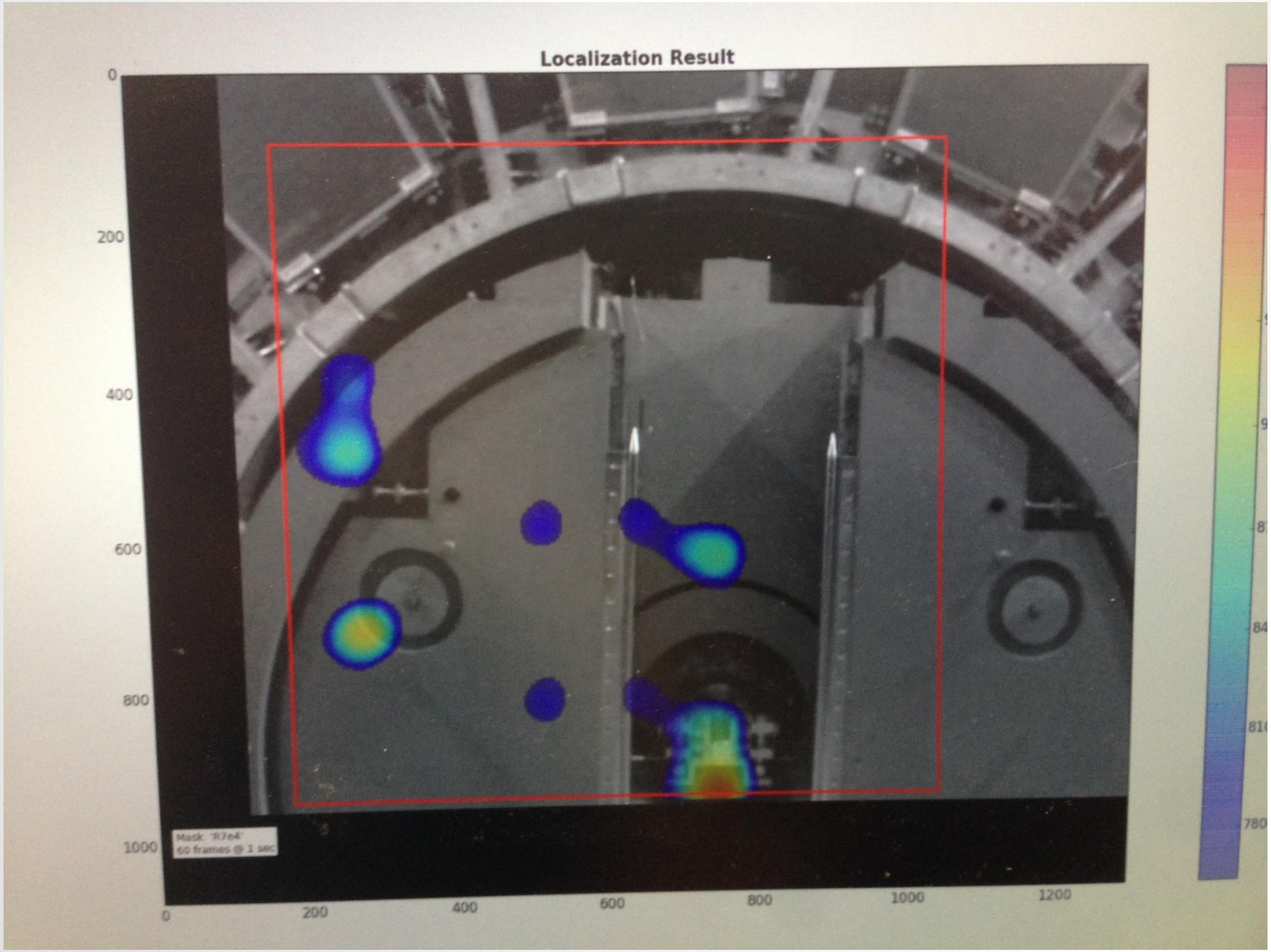
GAMMA IMAGING CAMERA



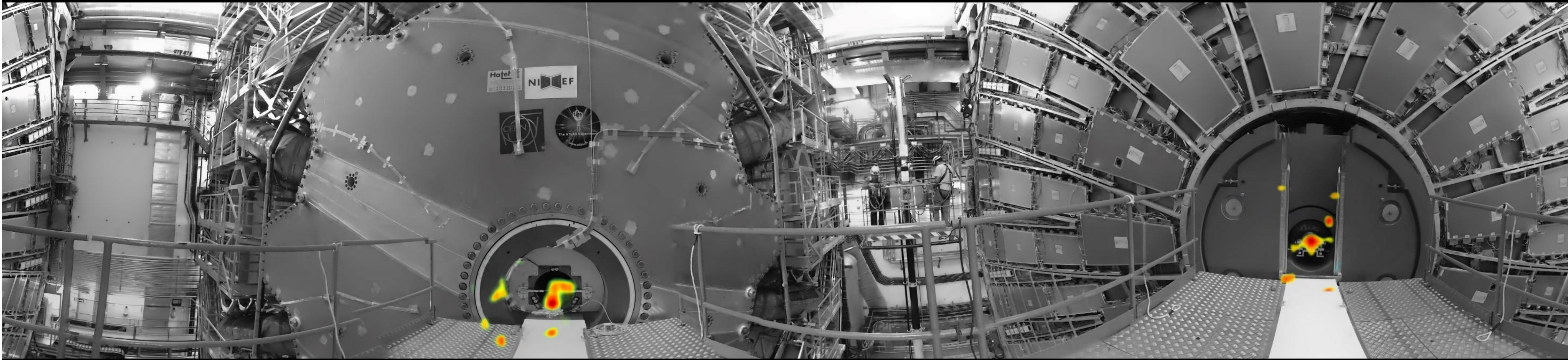




ALARA planning using Jack and Microsoft Kinect

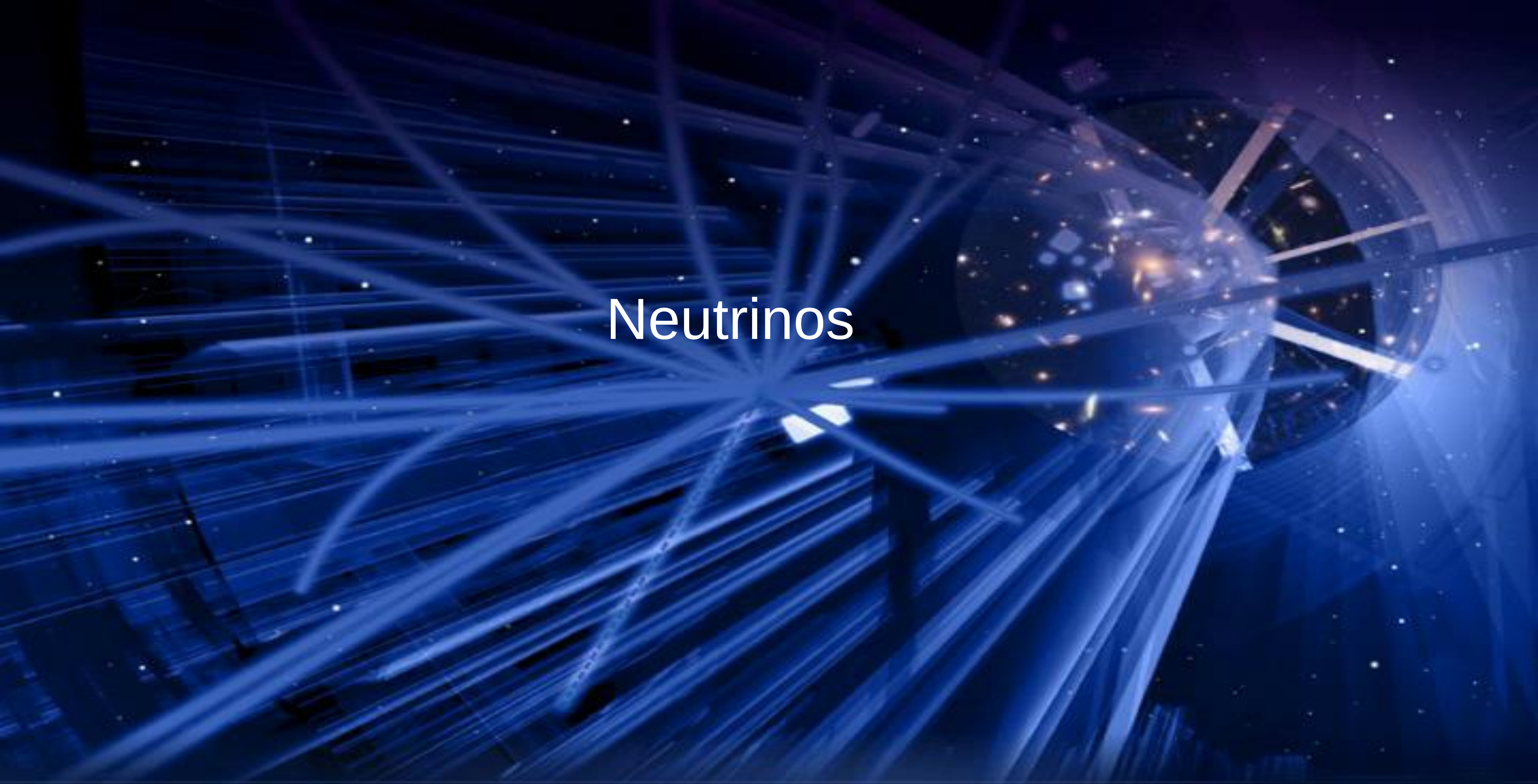


Localization Result
0
200
400
600
800
1000
0
200
400
600
800
1000
1200
60 frames @ 1 sec




PR 786
DYTAN
CH-6048 Horw
CMU 4T

Neutrinos

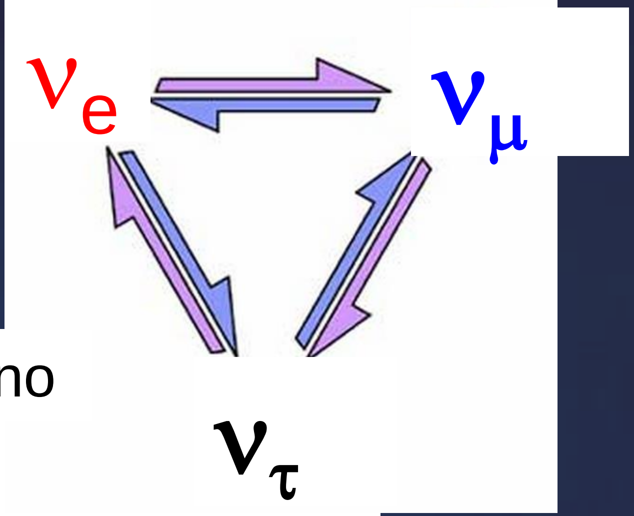


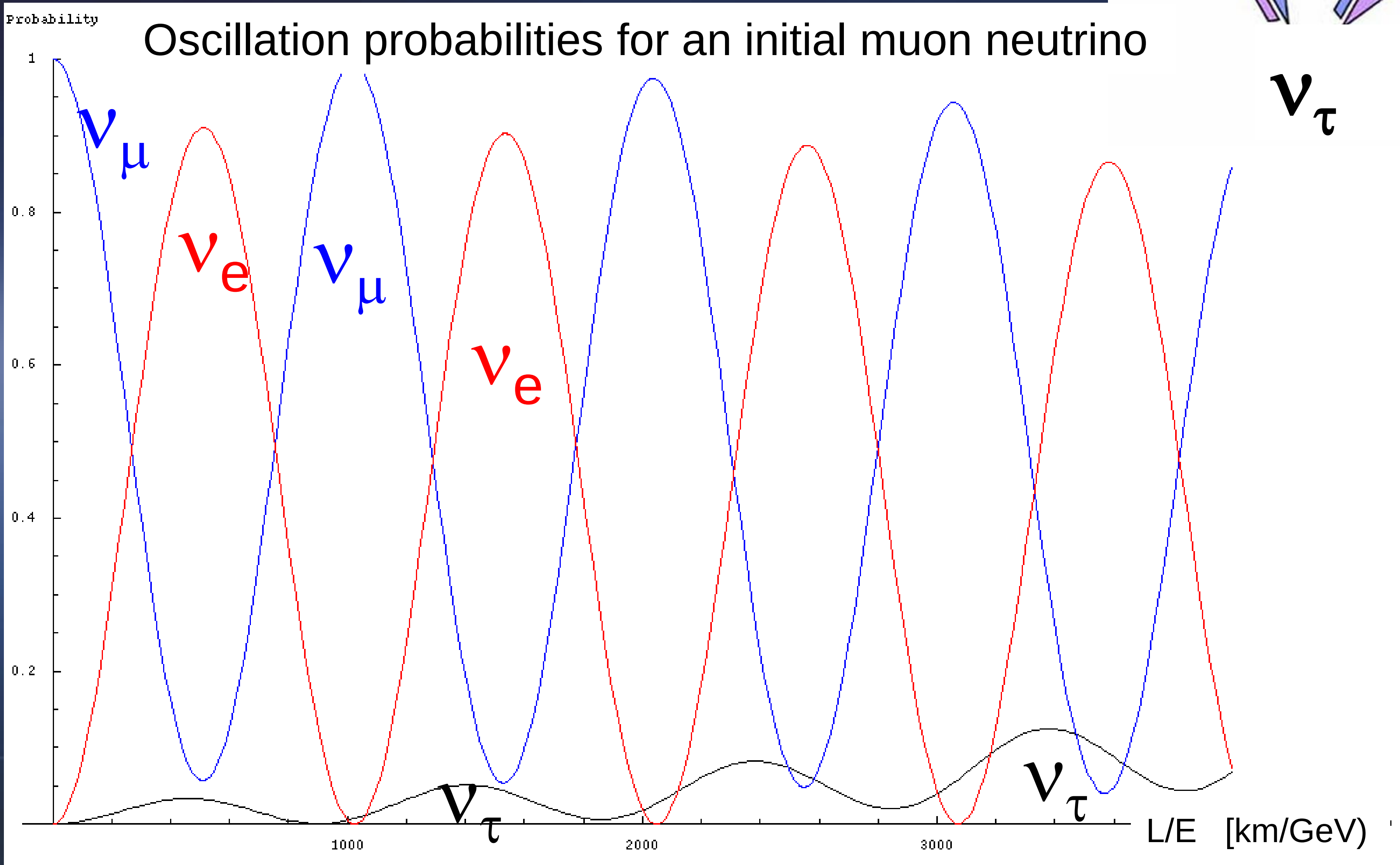
Is there new physics beyond our knowledge ?

- ✓ are the most abundant particles in our 4% universe
- ✓ they carry no electrical charge
- ✓ they have a very small mass, that we are unable to quantify
- ✓ they interact very weakly with atoms
- ✓ we are not sure that just 3 species exists (families)
- ✓ they probably carry the mystery of why anti matter has disappeared
- ✓ they oscillate in their main properties

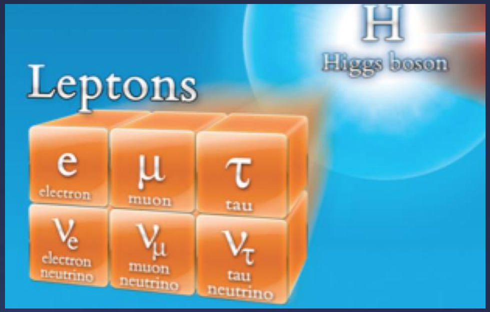
Neutrinos are hiding new physics !!!

Neutrinos oscillate !!





Neutrinos are difficult to detect

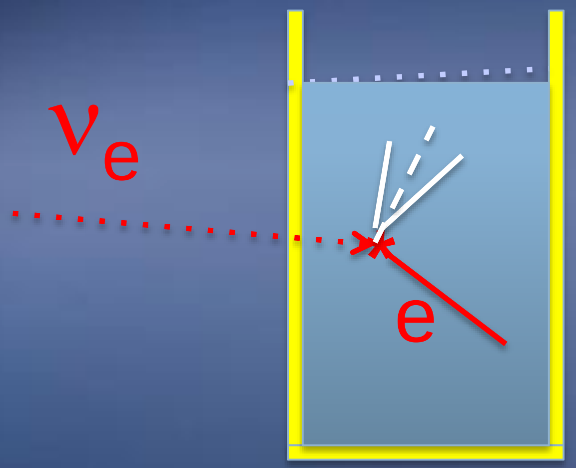


~10^{-9} = 0.000000001

Probability to interact with the earth matter

So we need massive detectors and very intense neutrino beams !!!!

How to detect Neutrinos



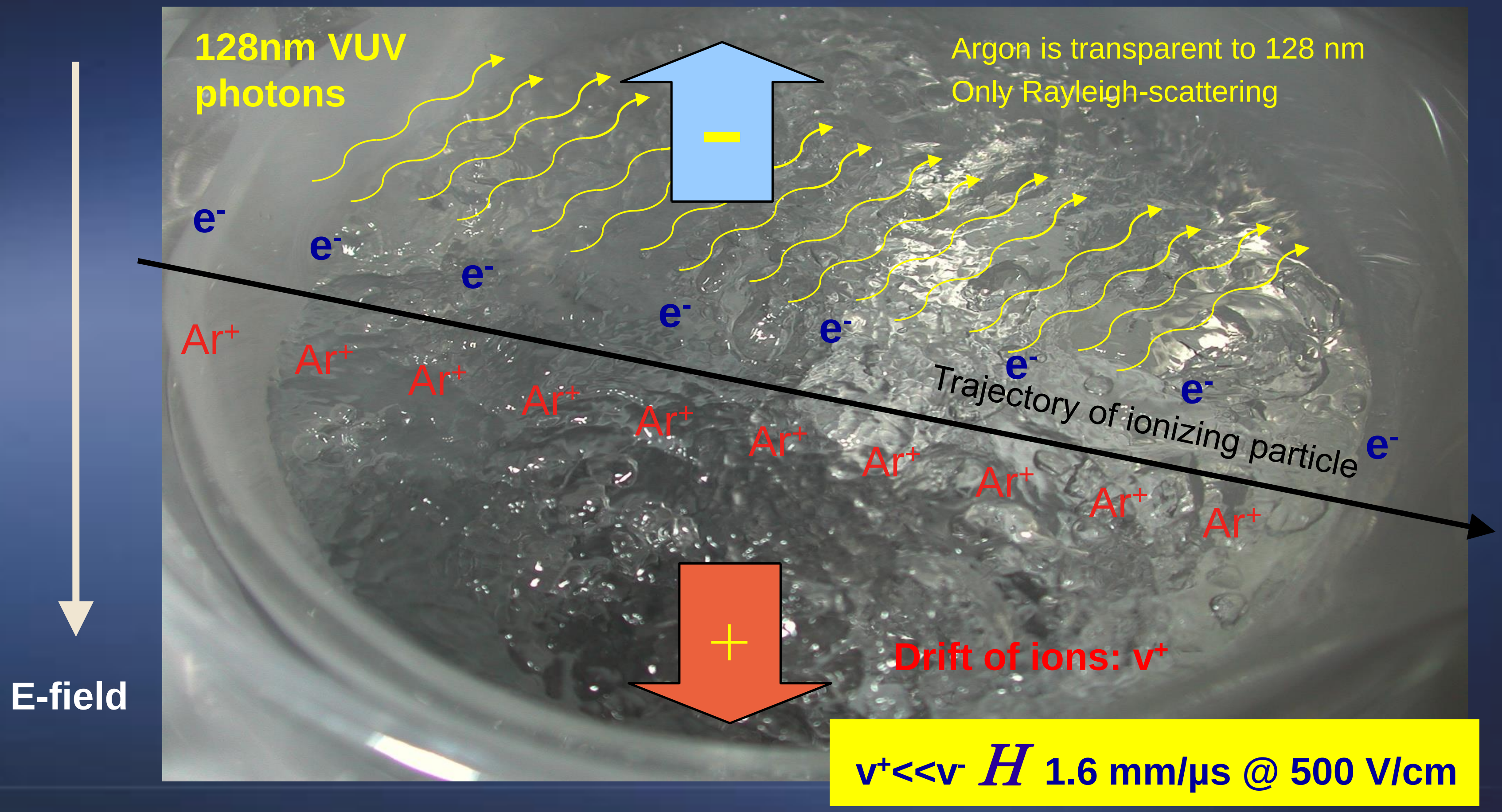
Neutrinos interact with the Argon Nuclei as for example in the following nuclear reaction:

$$\nu_e + Ar^{40} \longrightarrow e + K^{40}$$

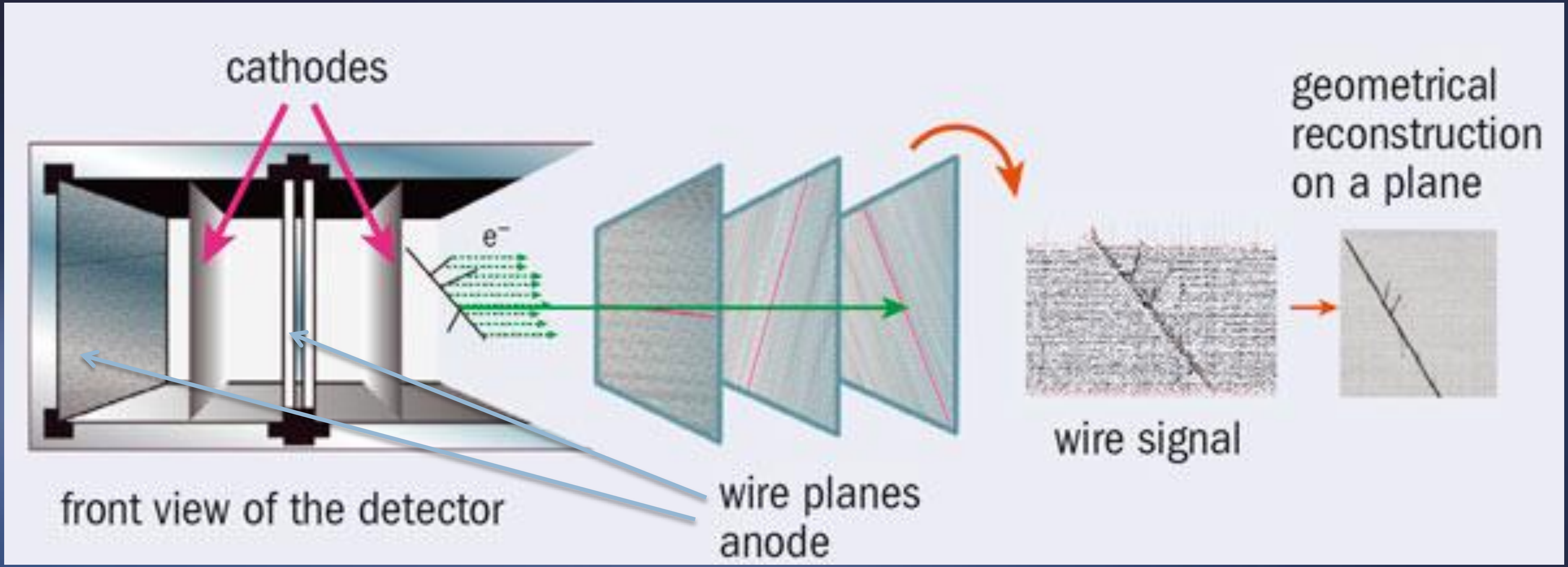
The neutrino signature is in this case the appearance of an energetic electron in the bath of LAr

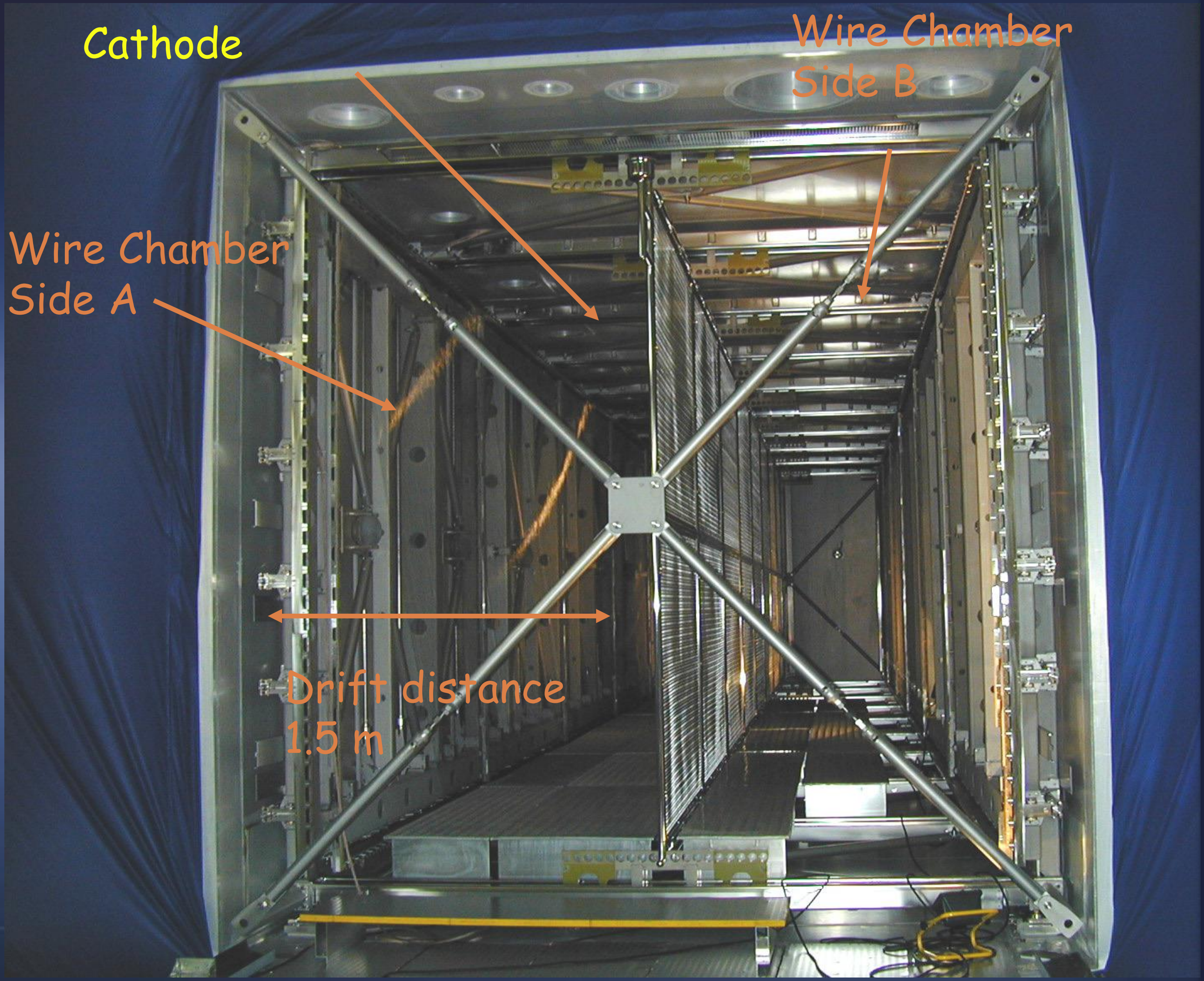
How to detect Neutrinos

In the presence of electric field

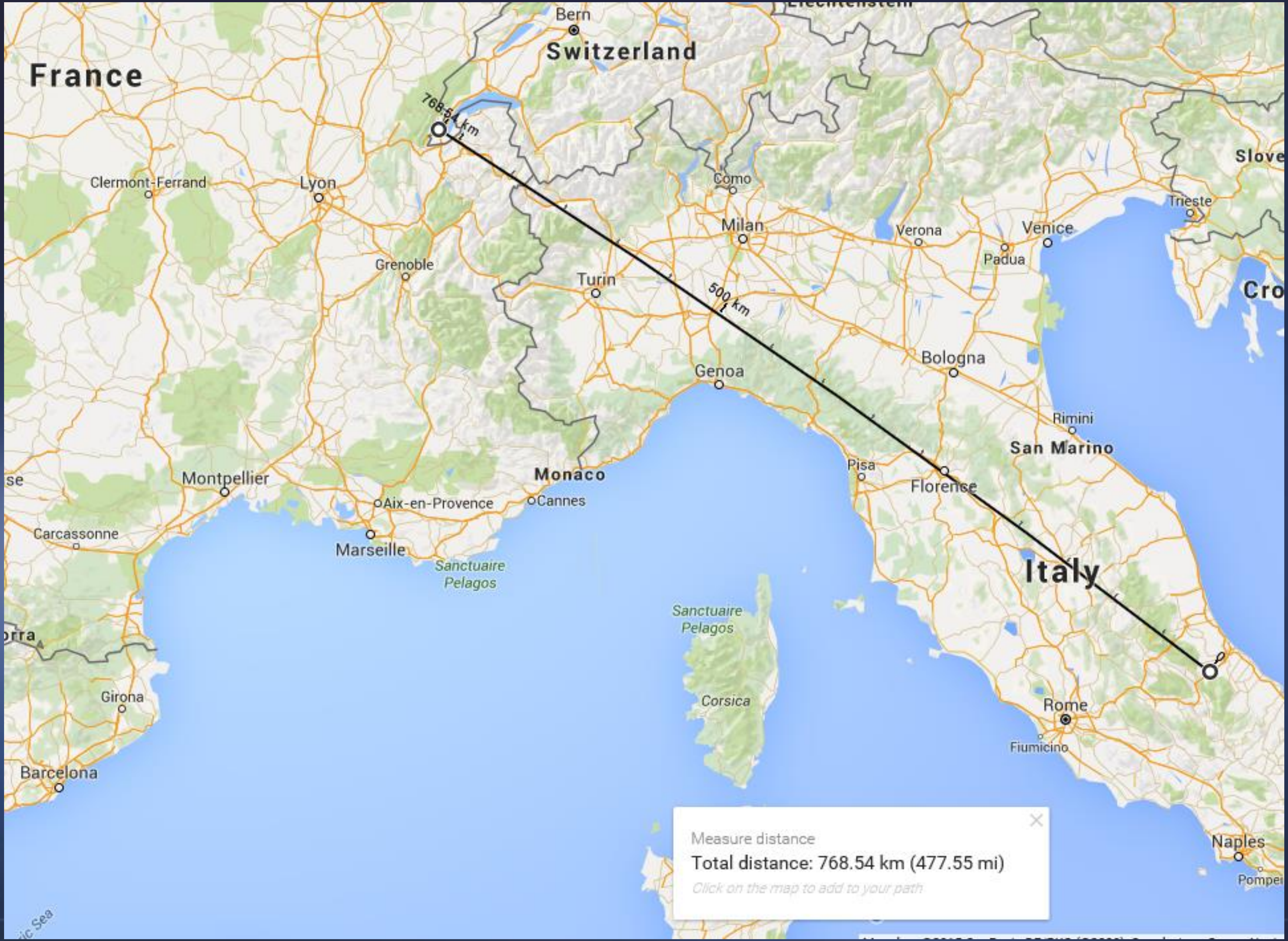


How to detect Neutrinos

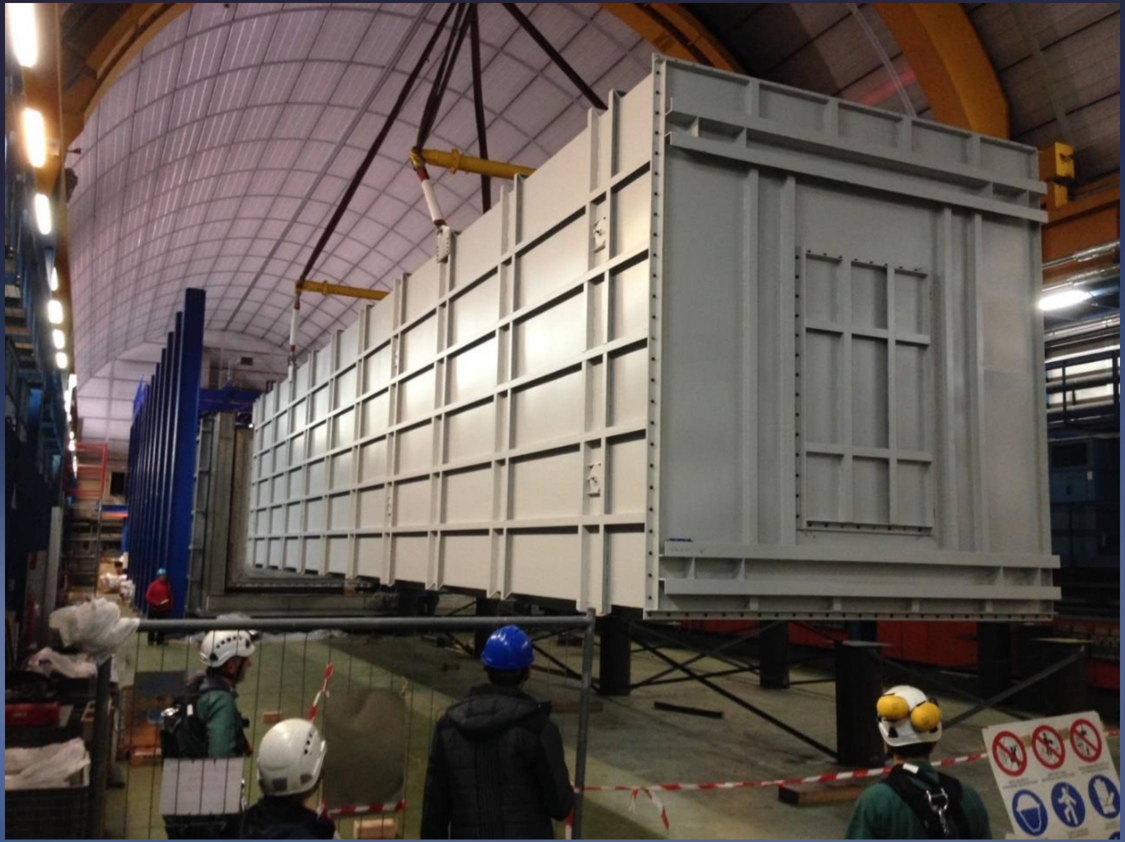




Cathode
Wire Chamber Side B
Wire Chamber Side A
Drift distance 1.5 m


France
Switzerland
Bern
768.54 km
Clermont-Ferrand
Lyon
Como
Milan
Verona
Venice
Padua
Trieste
Grenoble
Turin
500 km
Genoa
Bologna
Rimini
San Marino
Pisa
Florence
Monaco
Montpellier
Aix-en-Provence
Cannes
Carcassonne
Marseille
Sanctuaire Pelagos
Italy
Corsica
Girona
Rome
Fiumicino
Barcelona
Naples
Measure distance
Total distance: 768.54 km (477.55 mi)
Click on the map to add to your path

First step almost done



First step almost done


CONVOI
EXCEPTIONNEL
Aliani

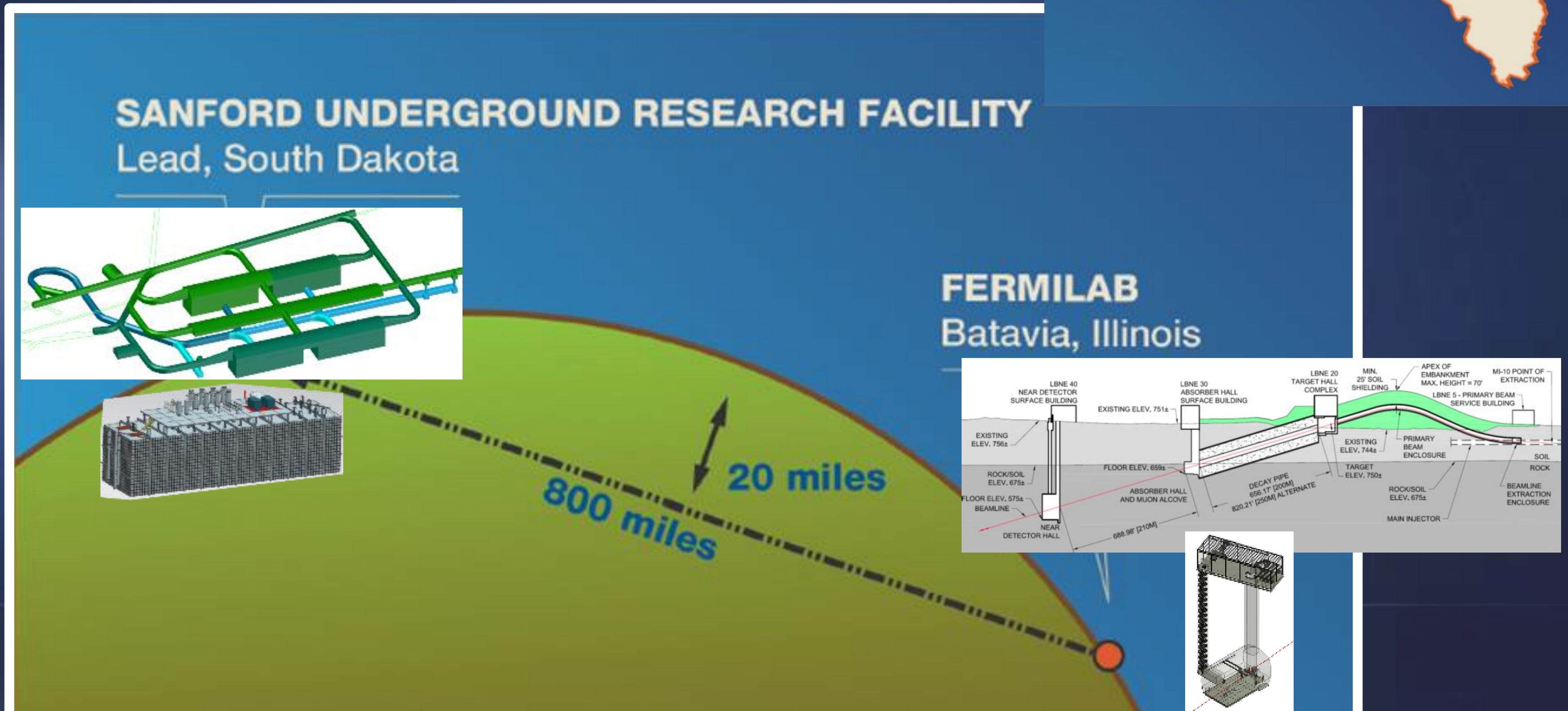
First step almost done

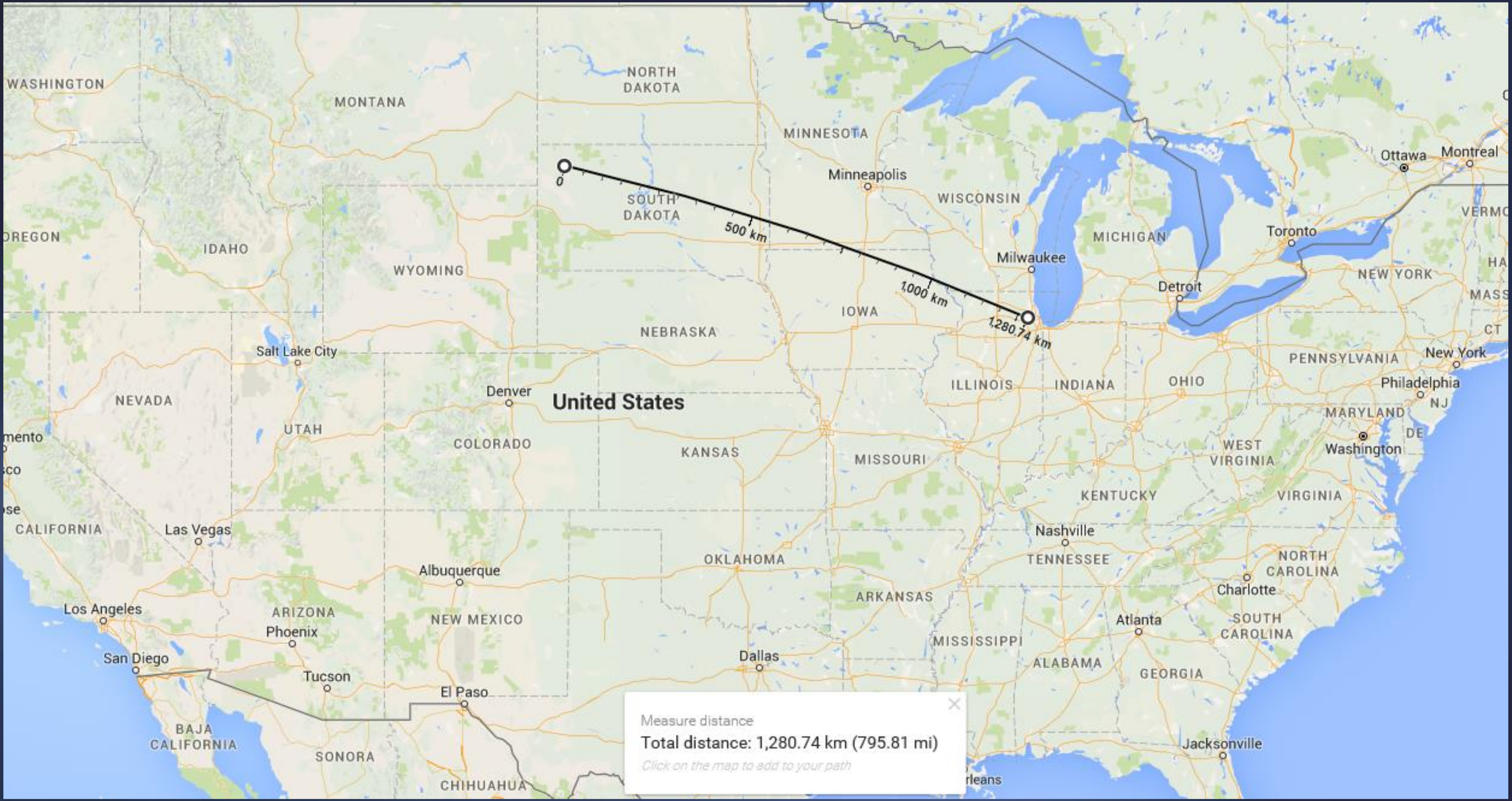

Compact 10N
Haulotte

What do we need ?

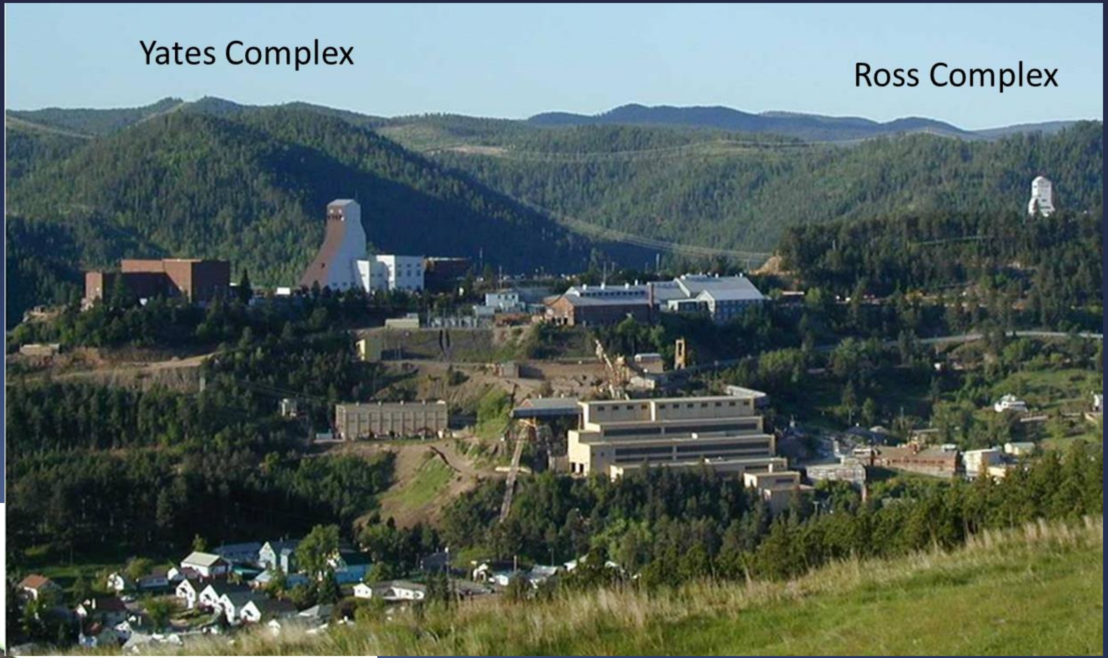
- ✓ Large cryogenic containers ~ 14’000 m^3 of liquid (~96%)
- ✓ Where we control the purity of the LAr at the ppt level
- ✓ Stable in time, filled for ~20 years
- ✓ Control temperature of the liquid at the 0.1 K level
- ✓ Operating temperature : 86-89 K
- ✓ Easy to install underground (~ 1 mile)
- ✓ Two level of liquid containment (primary and secondary membrane)
- ✓ Residual Heat Input (RHI) : 5 W/m^2 (to avoid bubbles)

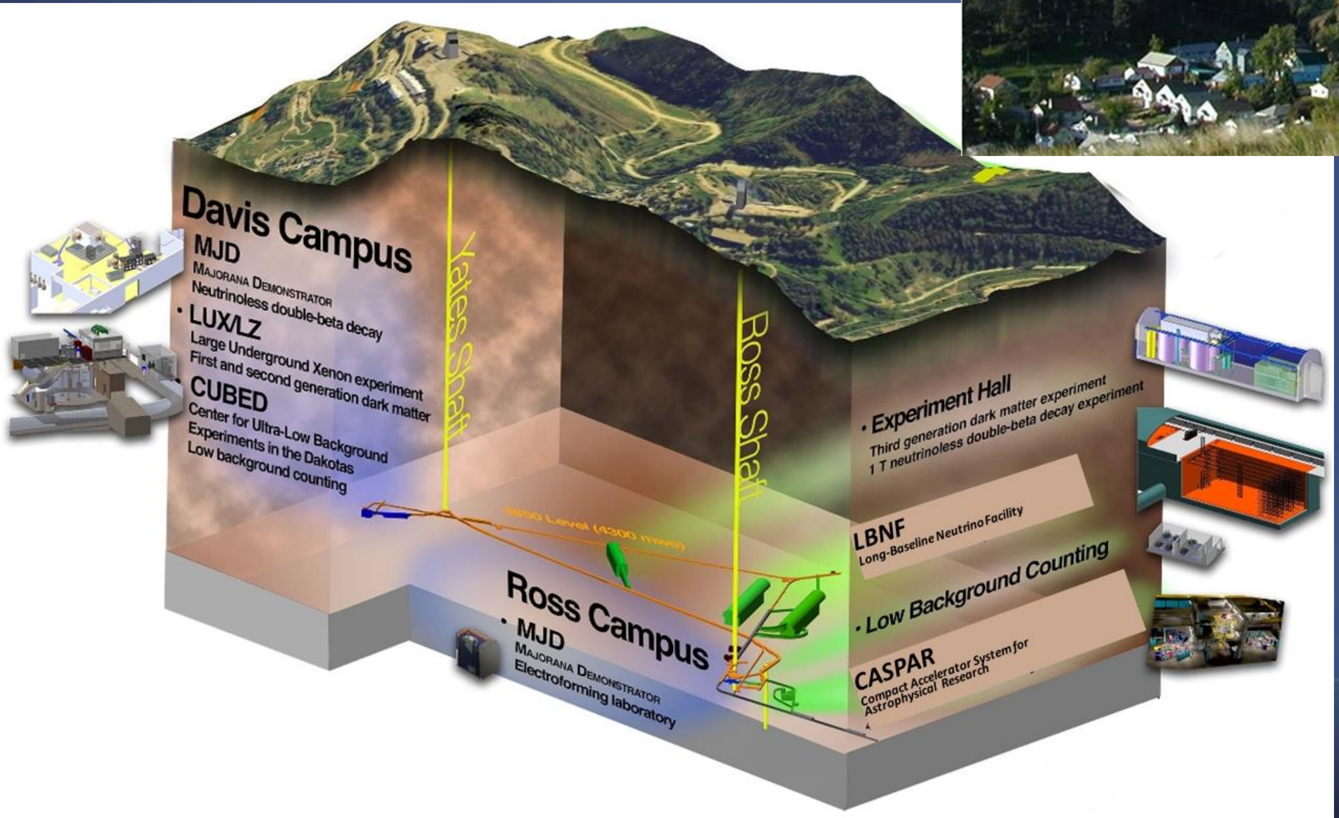
Neutrino Long Baseline




WASHINGTON
MONTANA
NORTH DAKOTA
MINNESOTA
OREGON
IDAHO
WYOMING
SOUTH DAKOTA
0
500 km
1,000 km
1,280.74 km
Minneapolis
WISCONSIN
MICHIGAN
Milwaukee
Ottawa
Montreal
Toronto
Detroit
NEW YORK
IOWA
NEBRASKA
Salt Lake City
NEVADA
UTAH
Denver
United States
COLORADO
KANSAS
MISSOURI
ILLINOIS
INDIANA
OHIO
PENNSYLVANIA
New York
Philadelphia
NJ
MARYLAND
DE
Washington
WEST VIRGINIA
VIRGINIA
KENTUCKY
CALIFORNIA
Las Vegas
Nashville
TENNESSEE
NORTH CAROLINA
Charlotte
OKLAHOMA
Albuquerque
ARKANSAS
Los Angeles
ARIZONA
Phoenix
NEW MEXICO
MISSISSIPPI
ALABAMA
Atlanta
SOUTH CAROLINA
GEORGIA
San Diego
Tucson
El Paso
Dallas
BAJA CALIFORNIA
SONORA
CHIHUAHUA
Jacksonville
Measure distance
Total distance: 1,280.74 km (795.81 mi)
Click on the map to add to your path

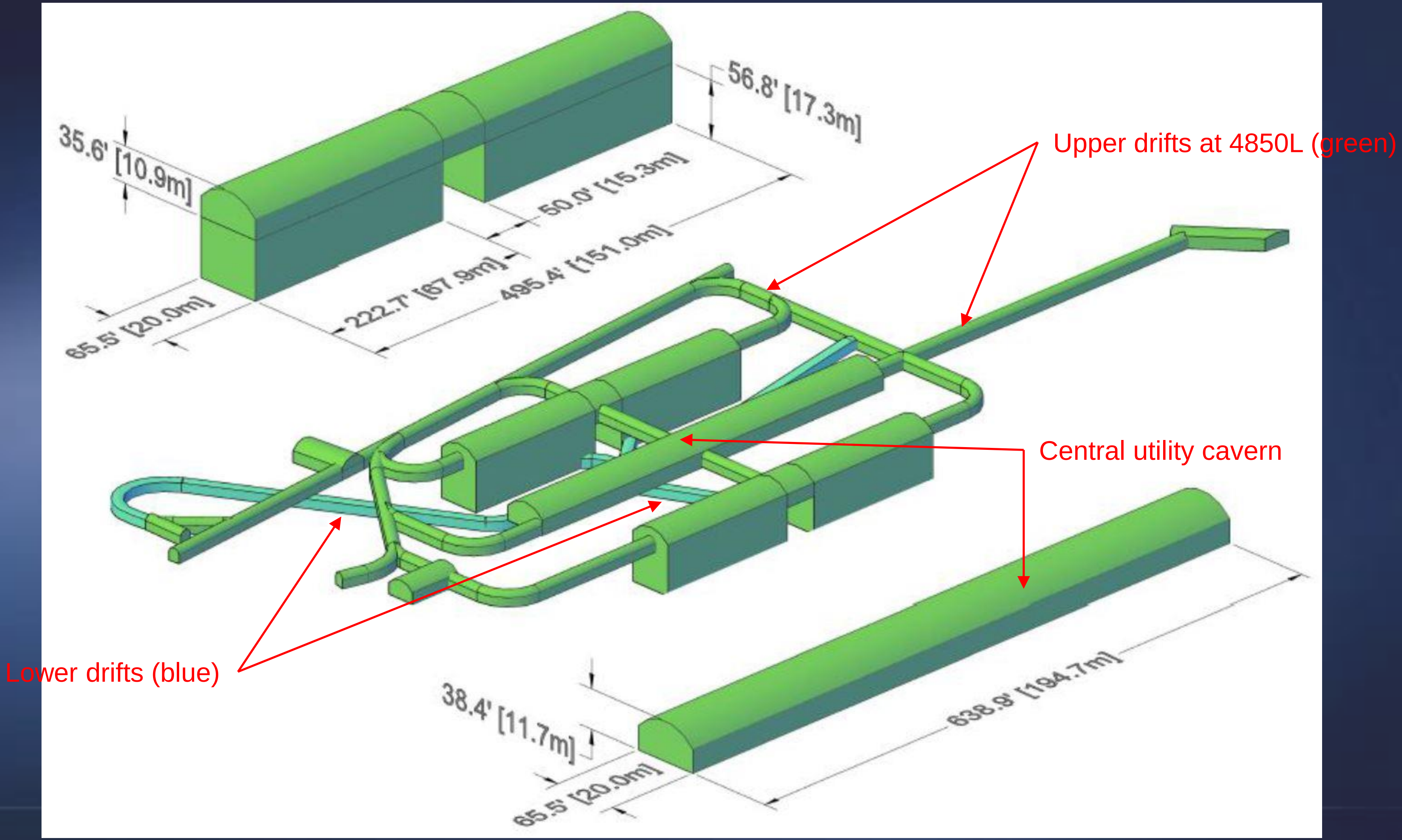
Far detector @ the SURF laboratory in South Dakota (Lead)



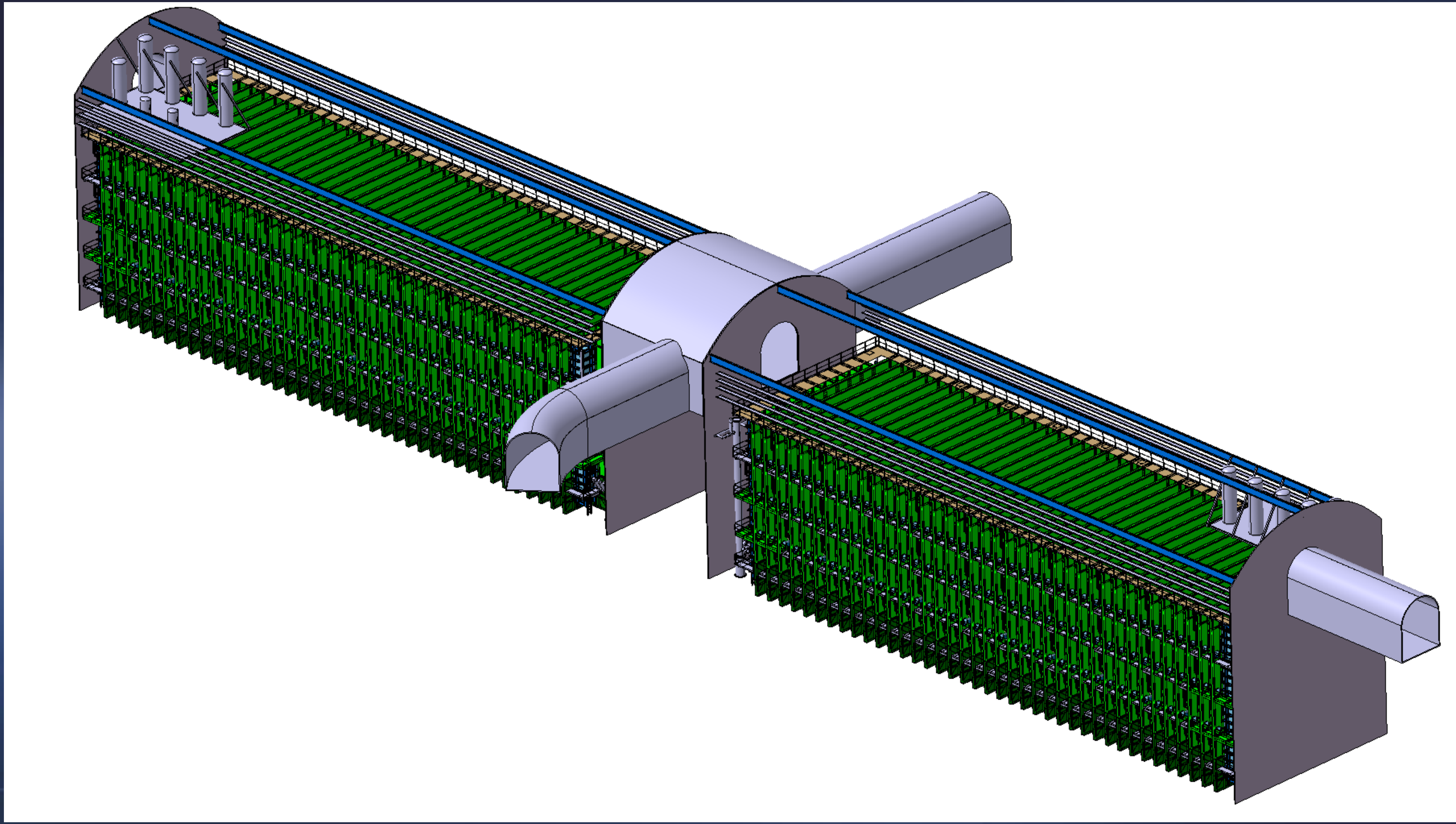


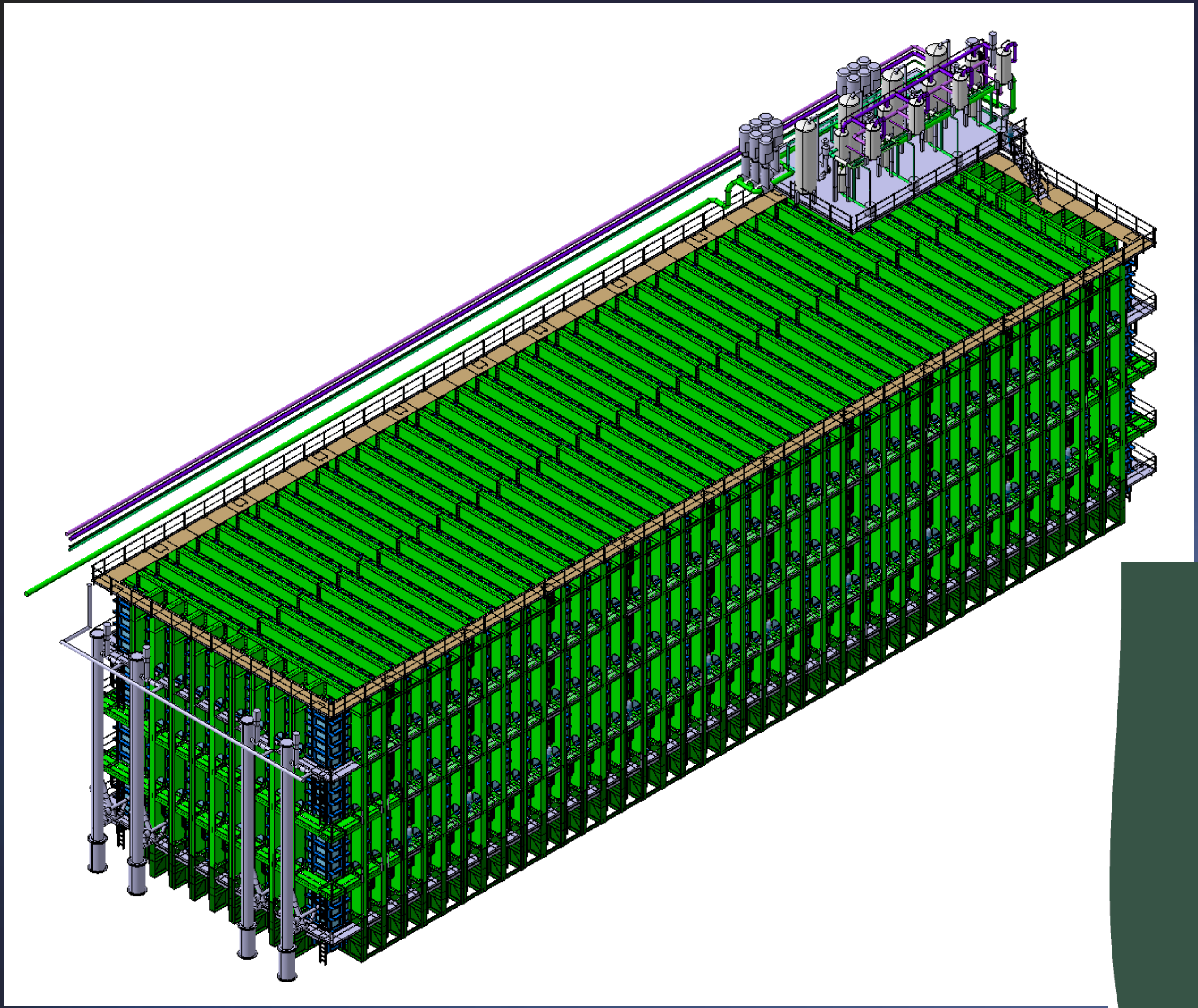
- 1500 m

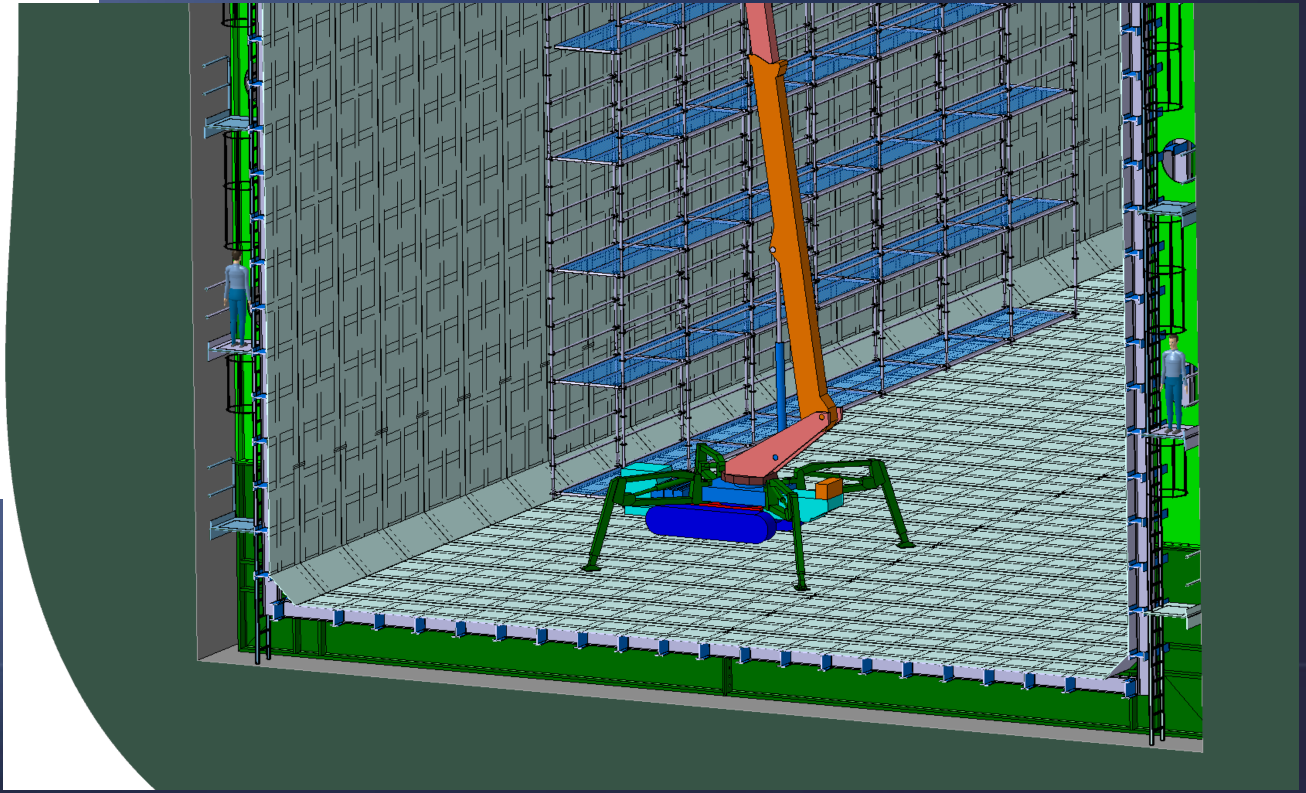
4 caverns, 4 detectors (TPC), 80 Ktons of LAr



4 caverns, 4 detectors (TPC), 80 Ktons of LAr







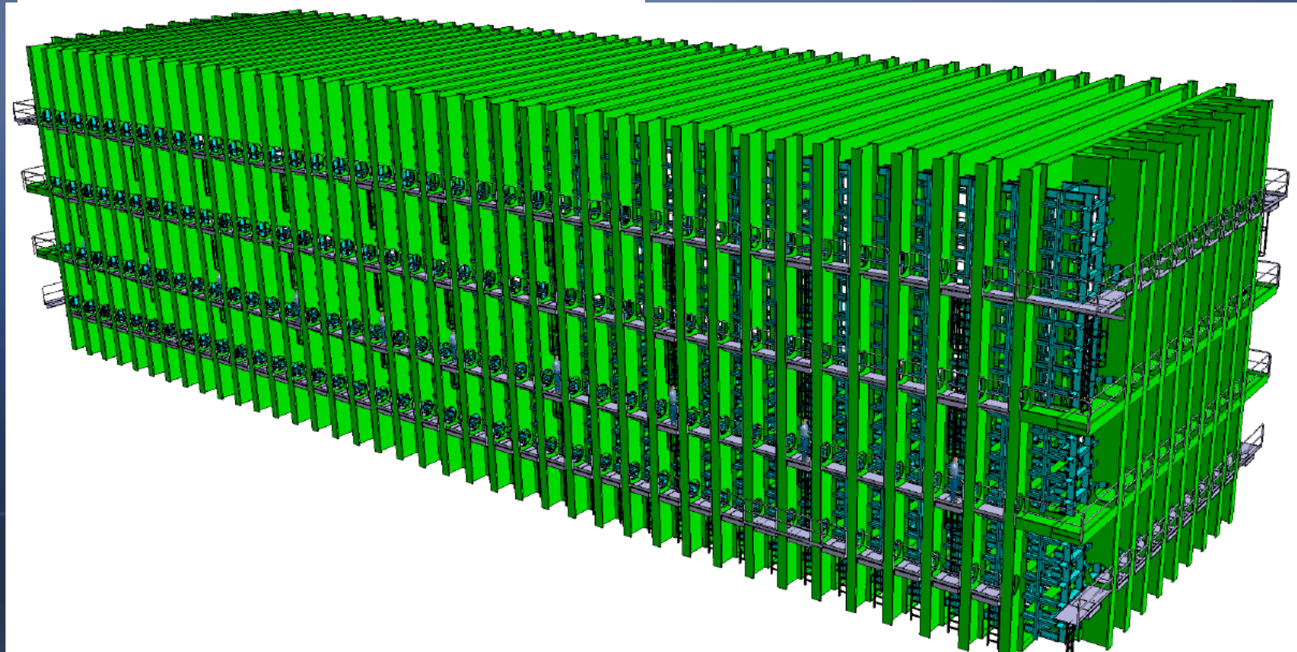
4 caverns, 4 detectors (TPC), 80 Ktons of LAr

Excavation starts in 2017

4 Cryostats assembly
2019 - 2025

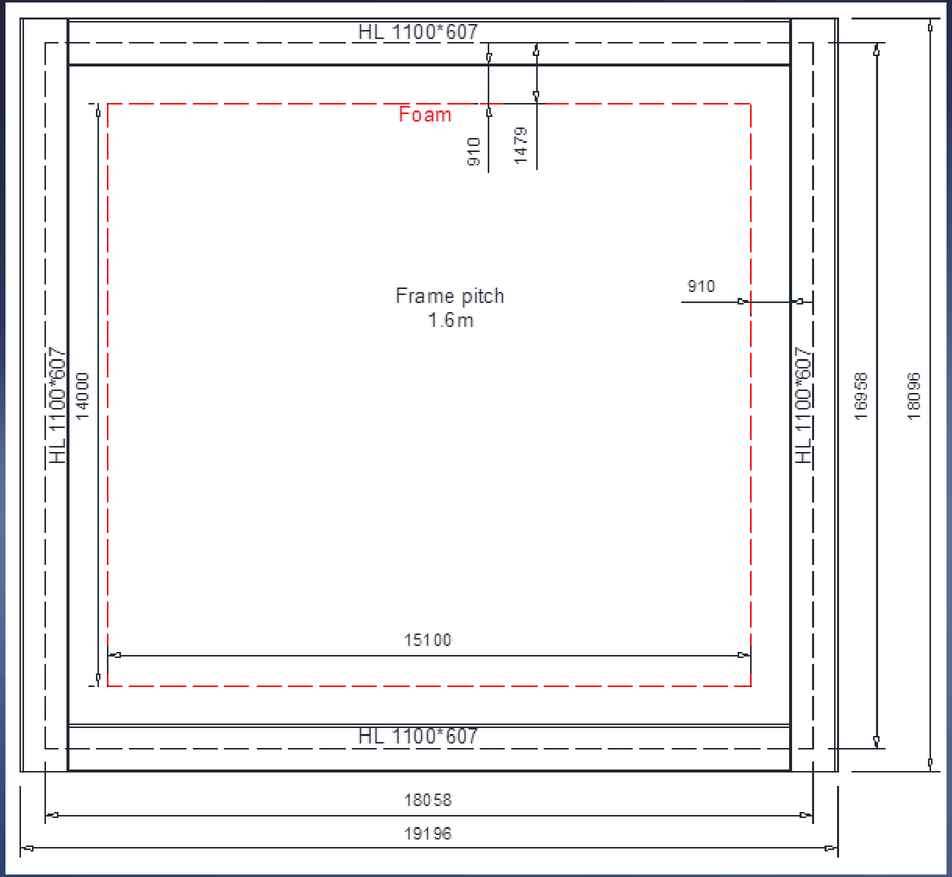
Inner dimension (liquid+gas):

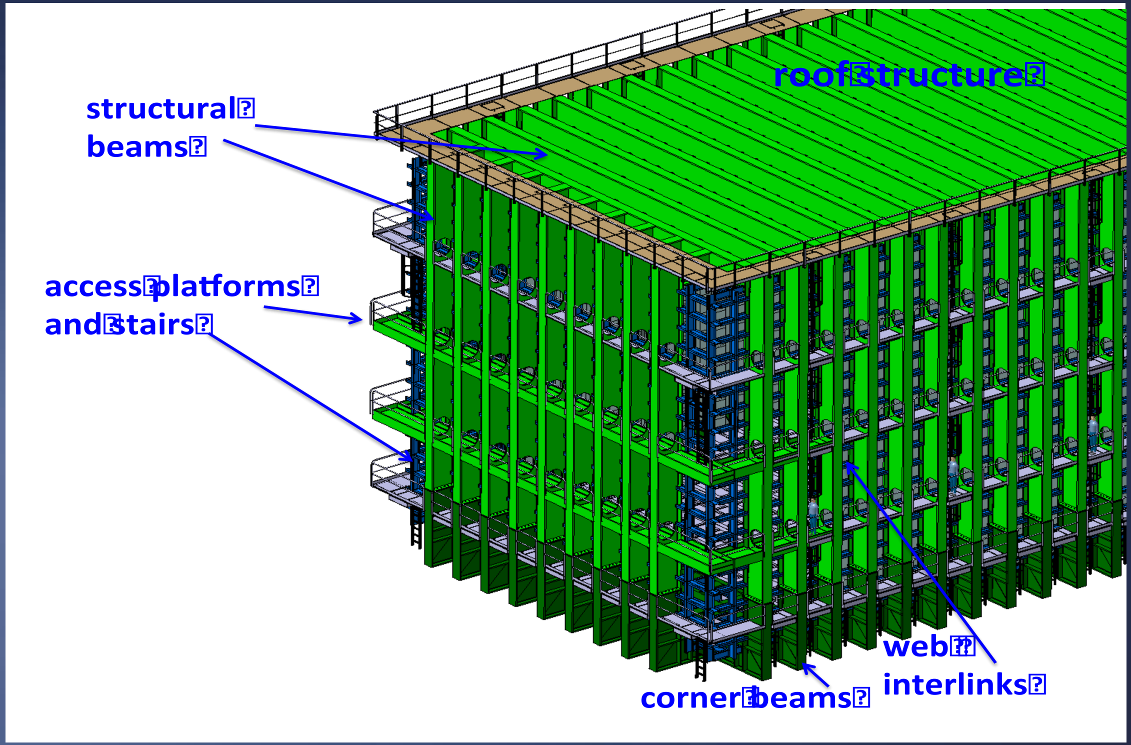
- **L = 62.00 m**
- **W = 15.10 m**
- **H = 14.00 m**



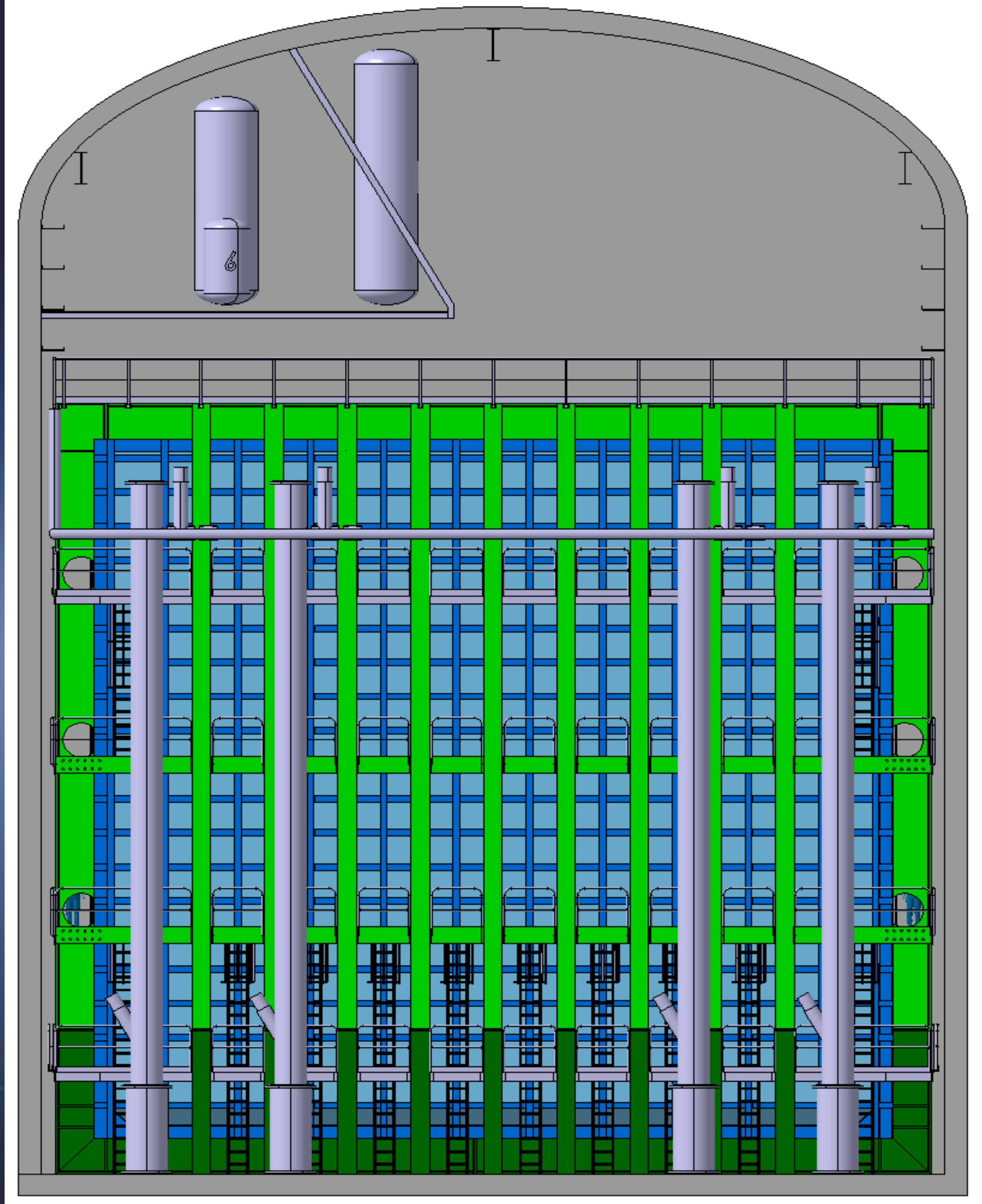
First cryostat
operational in 2022

Design & dimensions



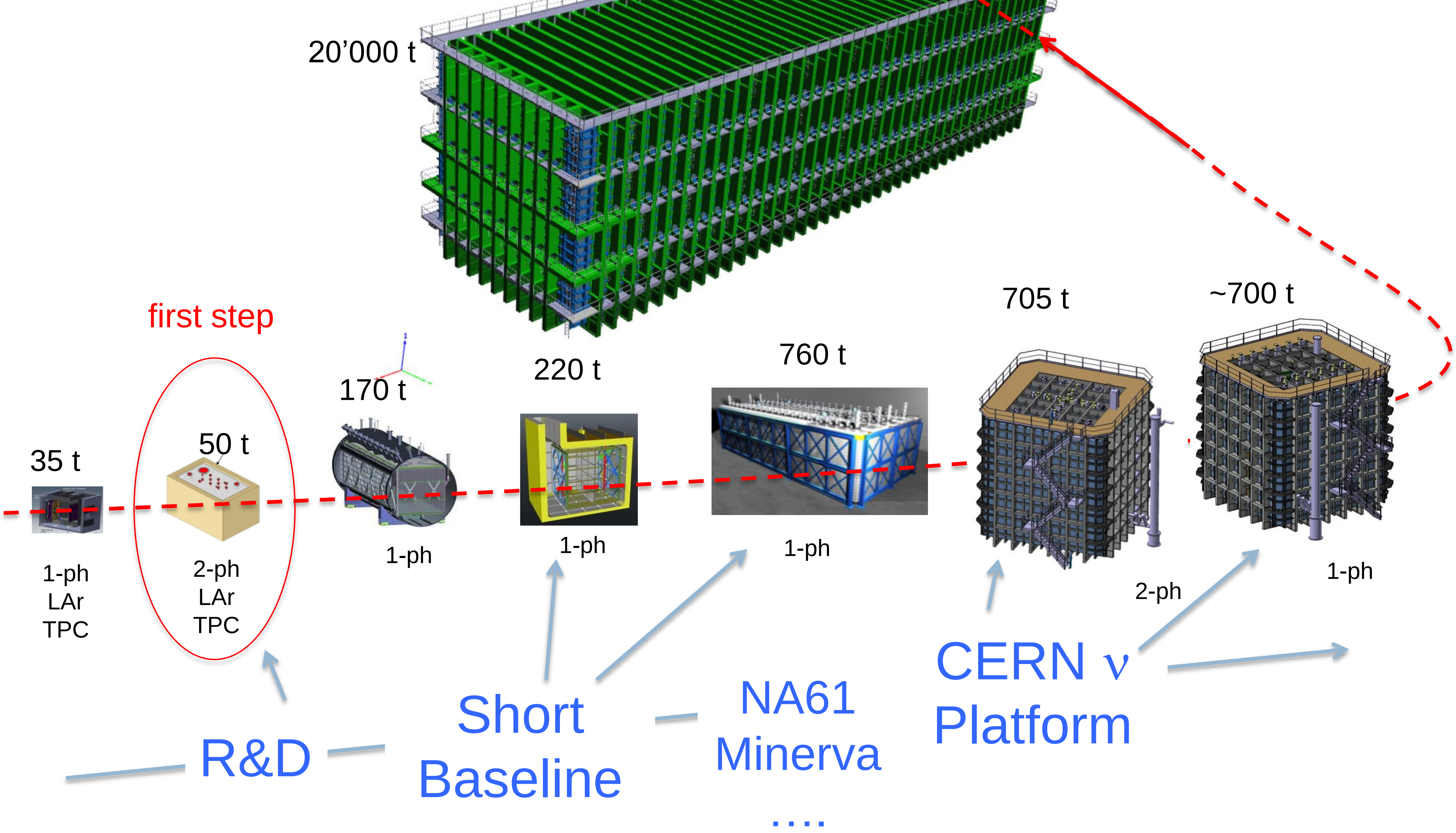


	Length [mm]	Width [mm]	Height [mm]
Membrane Internal dimensions	62’000	15’100	14’000
SS plate Internal Dimensions	63’800	16’900	15’800
External Dimensions of the Structure	66’096	19’196	18’096



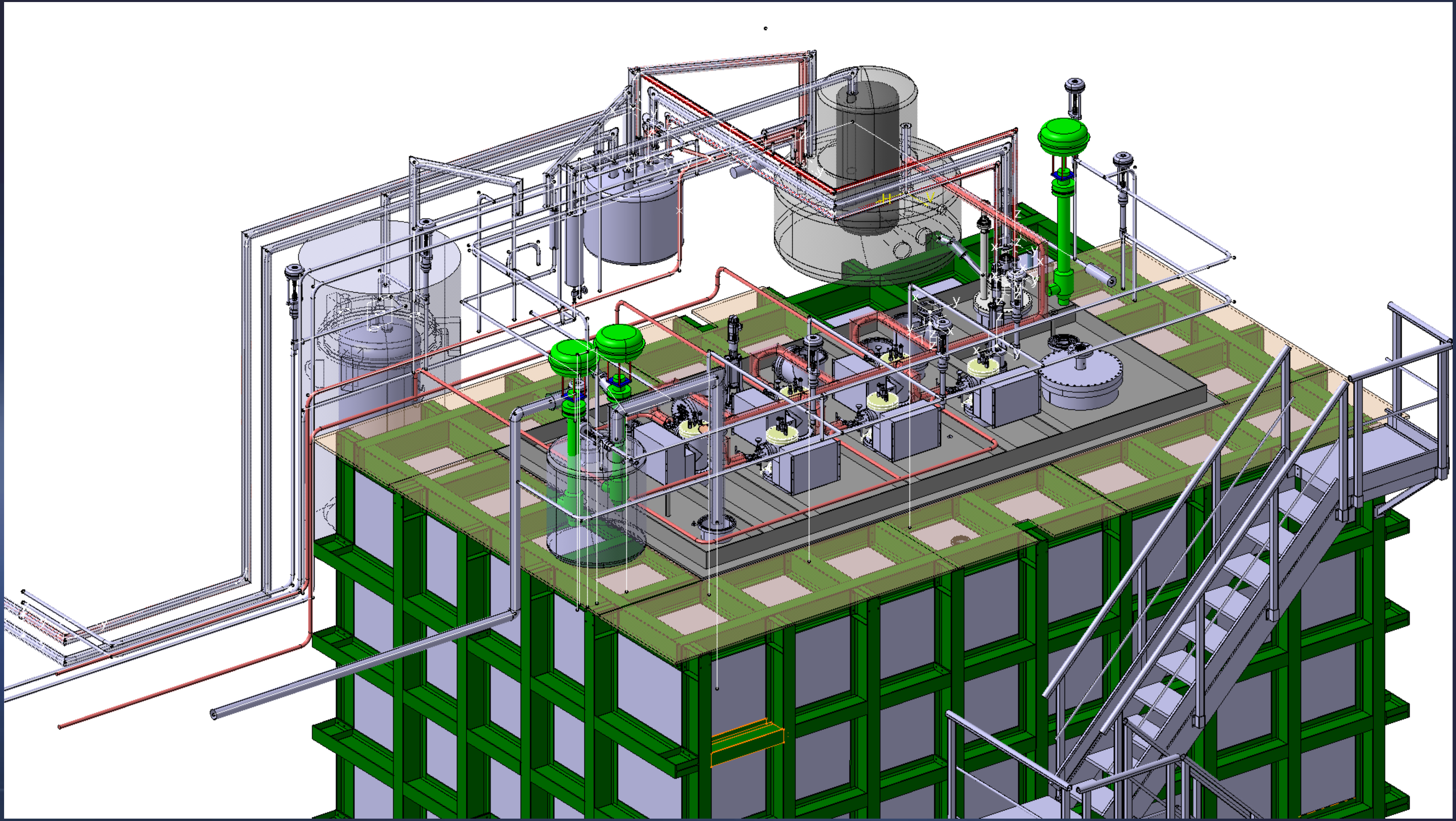
~ 4.2 m

~ 6 m



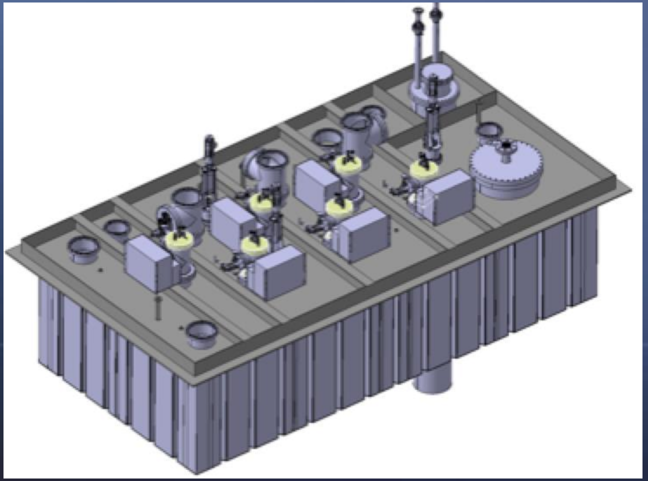
To succeed we need to proceed in steps
(for cryostats, cryogenics and detectors)

First step almost done



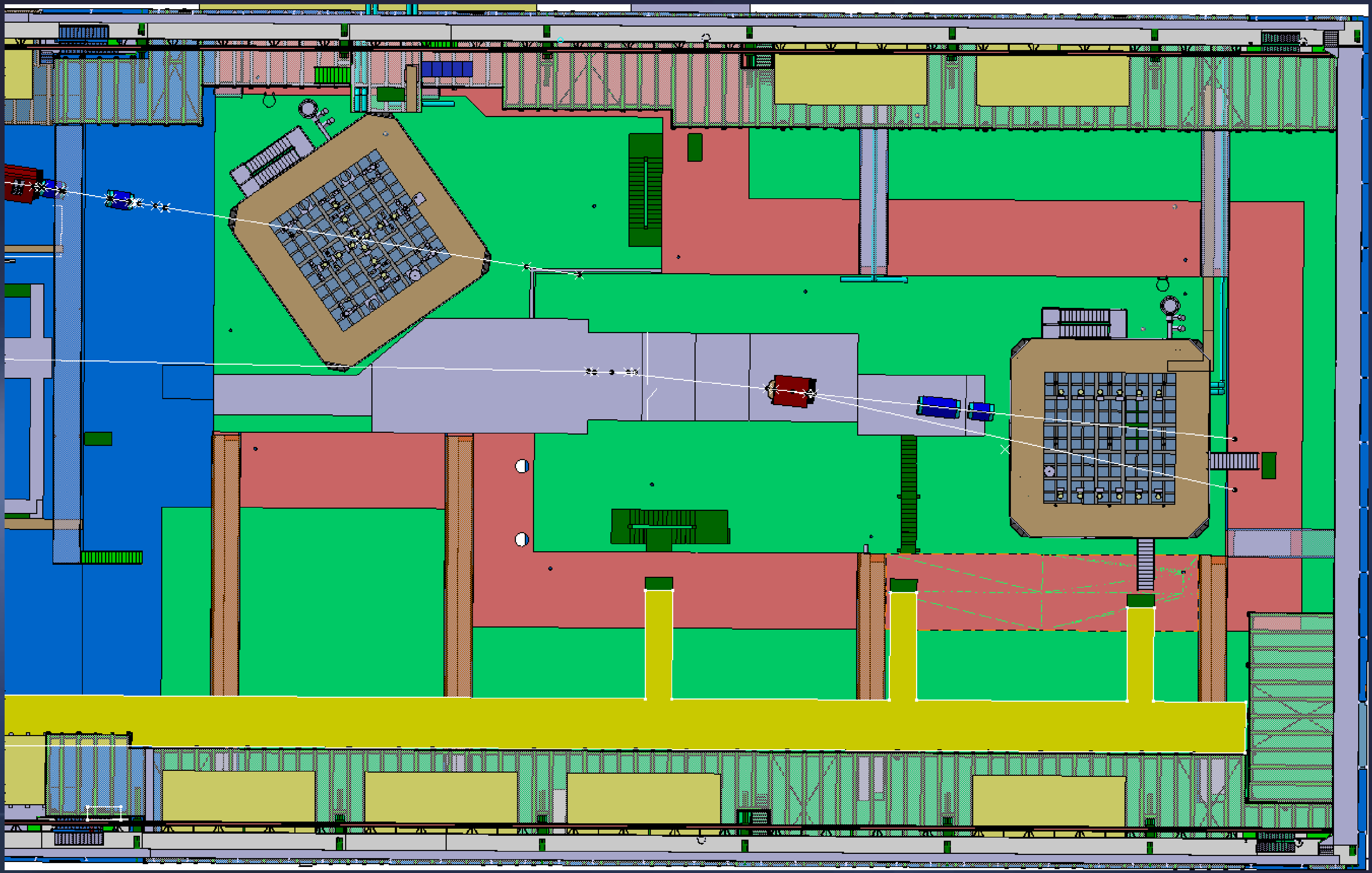

HÖEGH

First step done

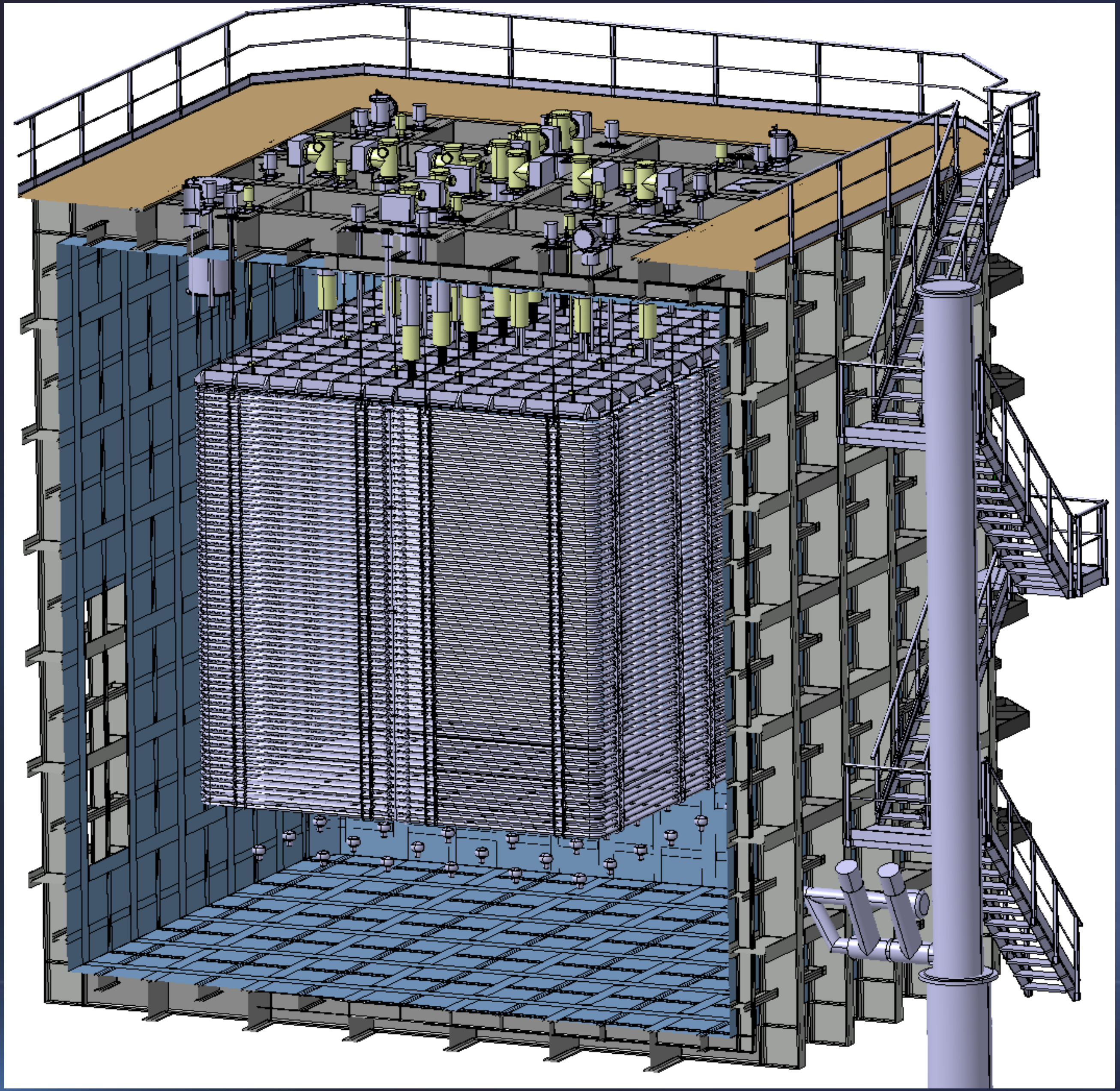


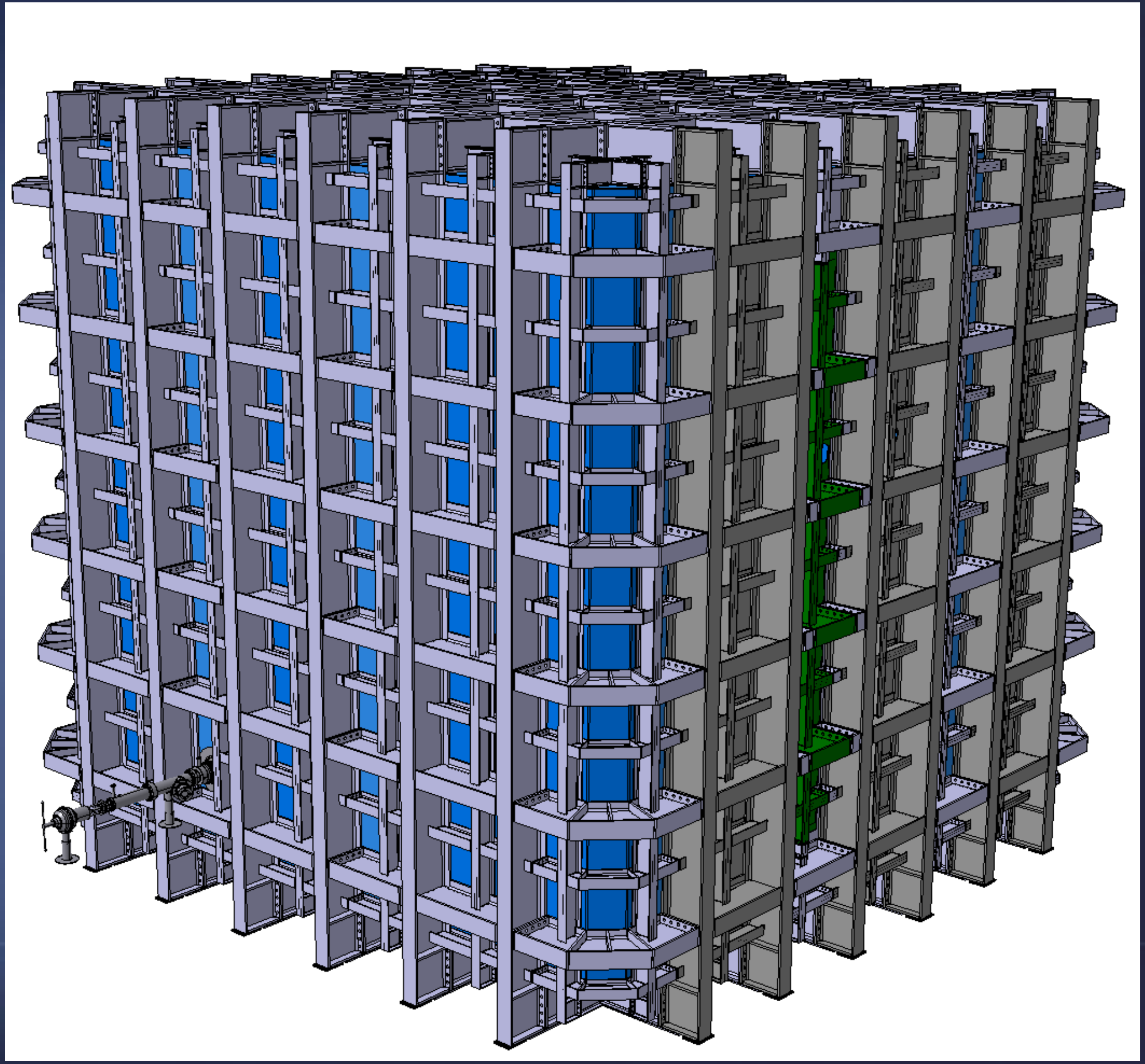
Video


EHN1 - Extension



NP02 & NP04






First step almost done

PRESS RELEASE

6 October 2015

The Nobel Prize in Physics 2015

The Royal Swedish Academy of Sciences has decided to award the Nobel Prize in Physics for 2015 to

Takaaki Kajita
Super-Kamiokande Collaboration
University of Tokyo, Kashiwa, Japan

Arthur B. McDonald
Sudbury Neutrino Observatory Collaboration
Queen's University, Kingston, Canada

"for the discovery of neutrino oscillations, which shows that neutrinos have mass"

Metamorphosis in the particle world

The Nobel Prize in Physics 2015 recognises **Takaaki Kajita** in Japan and **Arthur B. McDonald** in Canada, for their key contributions to the experiments which demonstrated that neutrinos change identities. This metamorphosis requires that neutrinos have mass. The discovery has changed our understanding of the innermost workings of matter and can prove crucial to our view of the universe.

Around the turn of the millennium, Takaaki Kajita presented the discovery that neutrinos from the atmosphere switch between two identities on their way to the Super-Kamiokande detector in Japan.

Meanwhile, the research group in Canada led by Arthur B. McDonald could demonstrate that the neutrinos from the Sun were not disappearing on their way to Earth. Instead they were captured with a different identity when arriving to the Sudbury Neutrino Observatory.

A neutrino puzzle that physicists had wrestled with for decades had been resolved. Compared to theoretical calculations of the number of neutrinos, up to two thirds

lenges for more than twenty years. However, as it requires neutrinos to be massless, the new observations had clearly showed that the Standard Model cannot be the complete theory of the fundamental constituents of the universe.

The discovery rewarded with this year's Nobel Prize in Physics have yielded crucial insights into the all but hidden world of neutrinos. After photons, the particles of light, neutrinos are the most numerous in the entire cosmos. The Earth is constantly bombarded by them.

Many neutrinos are created in reactions between cosmic radiation and the Earth's atmosphere. Others are produced in nuclear reactions inside the Sun. Thousands of billions of neutrinos are streaming through our bodies each second. Hardly anything can stop them passing; neutrinos are nature's most elusive elementary particles.

Now the experiments continue and intense activity is underway worldwide in order to capture neutrinos and examine their properties. New discoveries about their deepest secrets are expected to change our current understanding of the history, structure and future fate of the universe.

Thank you!