ICARUS geometry description in LArsoft

ICARUS Collaboration meeting

September 12th, 2019

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Outline

➢ Description of the present status ICARUS geometry description.

➢ Introduction of Induction 1 plane split wires.

➢ New feature of CRT description.

➢ Next steps.

The present «stable» version (29 April 2019)

➢ The ICARUS T600 geometry, the CRT and the ICARUS building are described within LArsoft framework using Geant4 gdml geometry files.

➢ The present status foresees:

   ➢ Correct size, mass and positioning of all external shells (cryostat, thermal insulation, warm vessel).

   ➢ Correct PMT description (active + passive part).

   ➢ Lateral mechanical structure (stainless steel).

   ➢ All merged within a perl file including CRT description python script (by C. Hilgenberg).
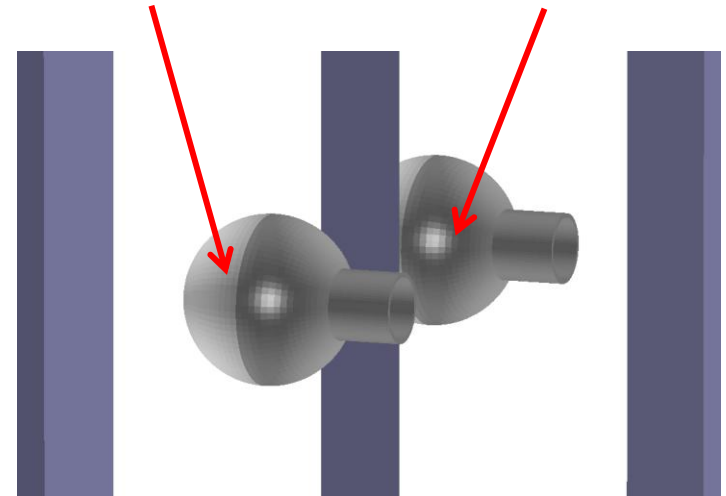
The present «stable» version (29 April 2019)

➢ <u>Cathode</u> panel made of 64 stainless-steel strips (Width = 2.1 cm, Pitch = 5.0 cm) → good compromise choice to have the correct cathode transparency to scintillation light (58%), with a limited number of geometry objects.
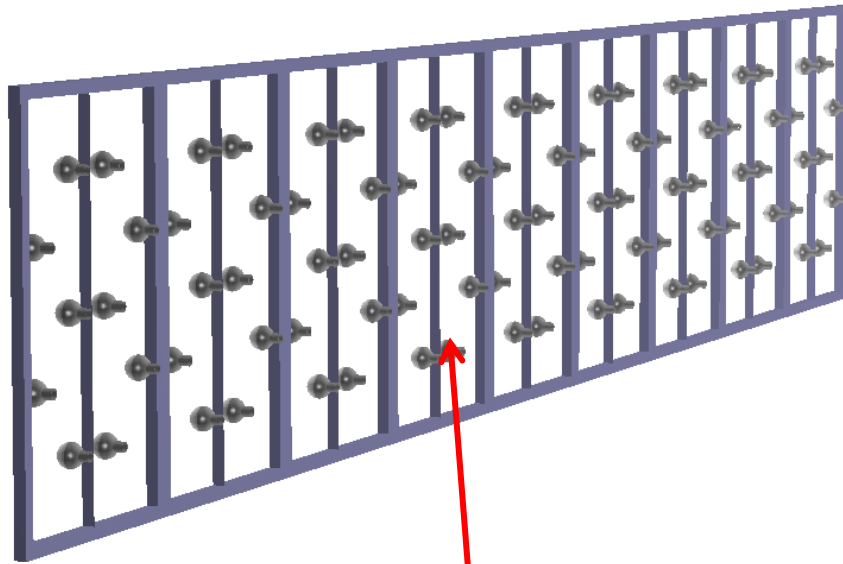
Active PMT window   Passive PMT
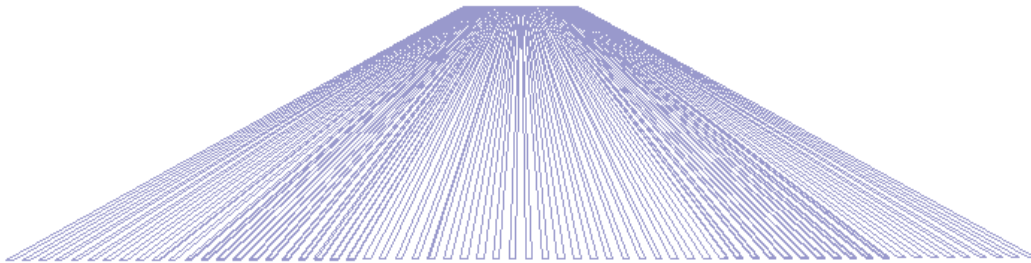
➢ 360 8'' hemispherical window PMTs placed in the correct position behind the wire planes.

The present «stable» version (29 April 2019)

Race track electrodes

TPC0   TPC1

PMT wall geometry + stainless steel structure

Semi-transparent cathode

Cryostat

The present «stable» version (29 April 2019)

➢ **Aluminum Cryostat**: 19 cm thick; total mass 39 tons, volume of the shell = 58.6 m^3 → ρ = 0.665 g/cm^3;

➢ **thermal insulation**: 60 cm thick; full polyurethane, ρ = 0.9 g/cm^3;

➢ **warm vessel**: 27.4 cm thick; made of steel, total mass 88 tons, volume of the shell = 228.9 m^3 → ρ = 0.384 g/cm^3;

➢ correct distances between cryostats and thermal insulation.
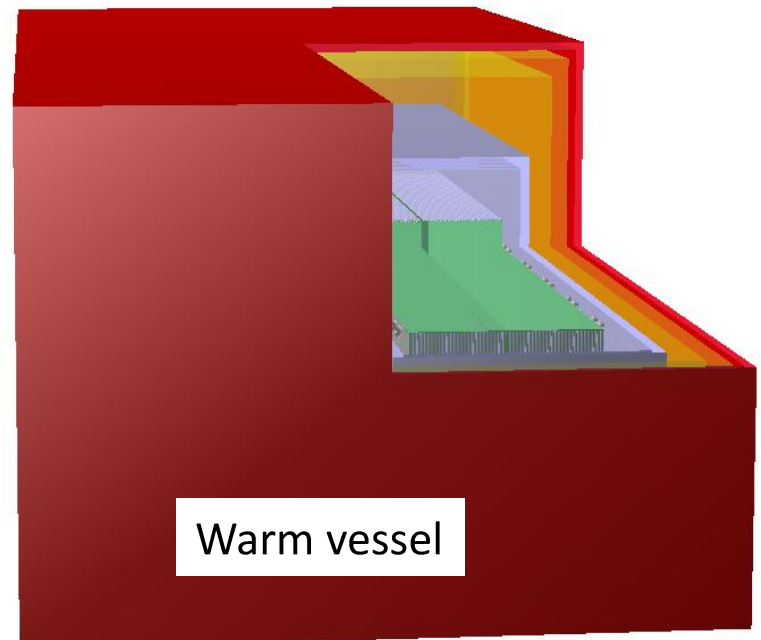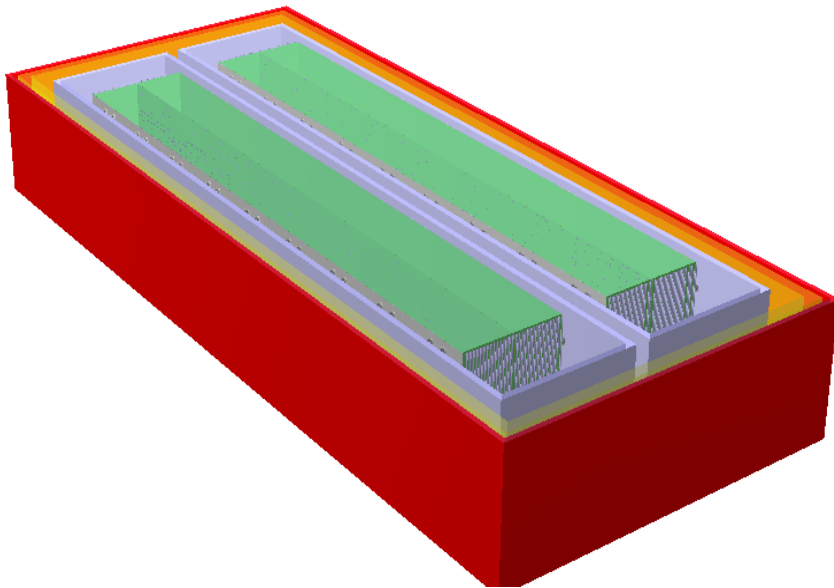
Warm vessel

The present «stable» version (29 April 2019)

Detector Enclosure with (from outer to inner):

➢ CRT (light green);
➢ Warm vessel (red);
➢ Thermal insulation (blue);
➢ Cryostat (lilac);
➢ TPC (green).

Building

ICARUS «World»

Dirt
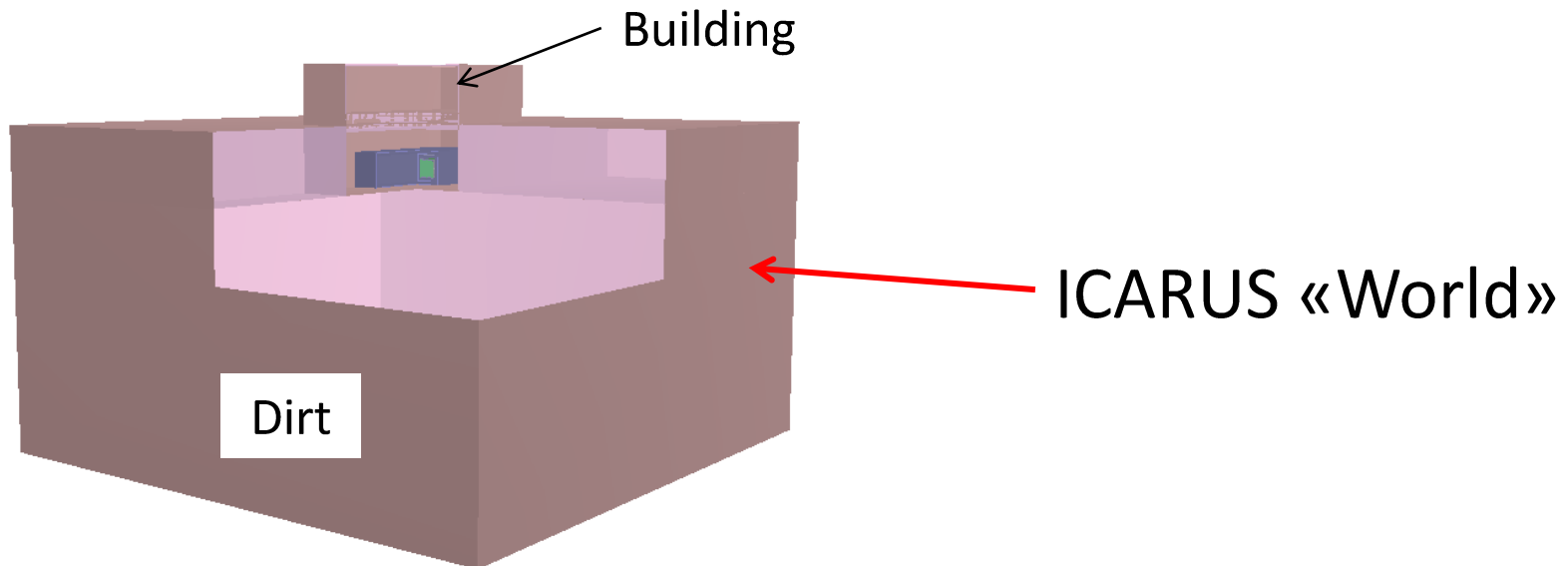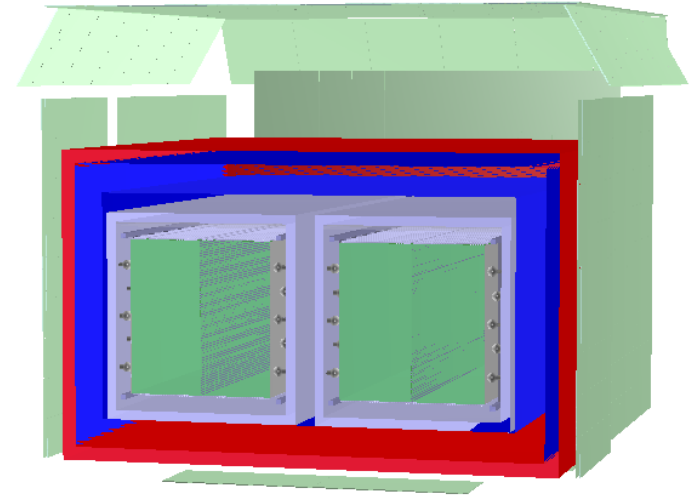
The new version with Induction 1 split wires

➢ Attempt to insert the split wires for Induction 1 plane.

➢ Larsoft does not allow more than one type (Coll, Ind1, Ind2) of wire plane for TPC -> impossible to directly halving Induction 1 wire length and put two Induction 1 planes in the old TPC volume.

➢ Major intervention on TPC wire definition and on TPC structure necessary.

➢ One TPC volume is now defined (volTPC0), with upstream racetrack on one side only and longitudinal size halved with respect to the «true» TPC volume:

Here there are no race tracks

Race track electrodes

New volTPC0

894.95 cm
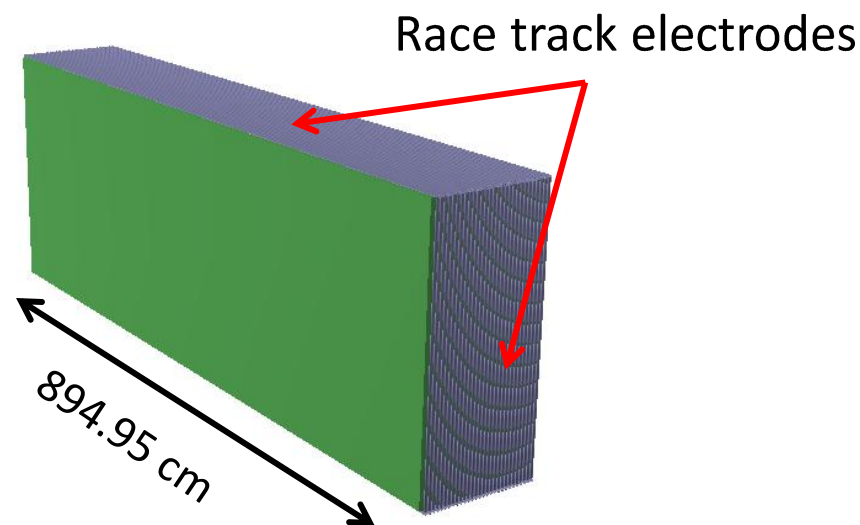
The new version with Induction 1 split wires

➢ volTPC0 is copied four times and, after proper translations and rotations, correcly placed inside the cryostat → four adiacent TPCs.

➢ In this way race tracks volumes are put in the TPC volume (easier to avoid overlaps with cryostat volumes), but their length is halved.

Section of one ICARUS
module (seen from top)
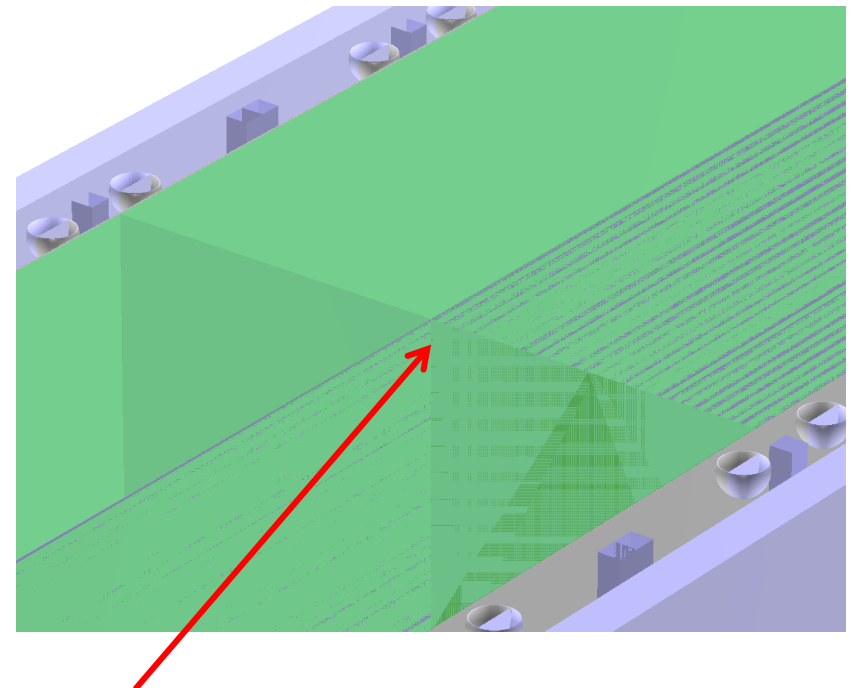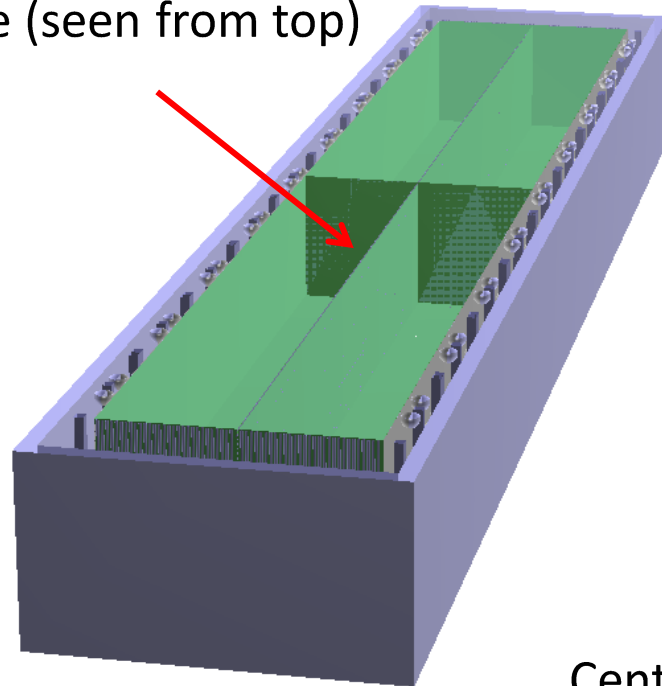


Central match between the four TPCs

The new version with Induction 1 split wires

➢ **The idea for the three wire planes on the «shorter» TPC0:**

   ➢ Induction 1 (volTPCPlaneY) : 1056 wires (as it must be).

   ➢ Induction 2 and Collection (volTPCPlaneV &U): 3064 wires.

      ➢ 2056 wires with common length.

      ➢ 480 corner wires with decreasing length at one side.

      ➢ 528: 480 corner wires + 48 wires to complete the plane at the other side.

volTPC0

480 wires

2056 wires

528 wires
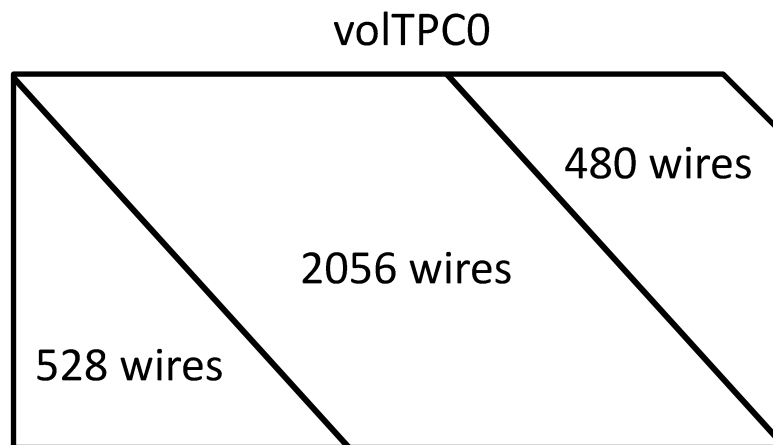
The new version with Induction 1 split wires

➤ The idea for the three wire planes:

   ➤ Induction 1 (volTPCPlaneY) : 1056 wires (as it must be).

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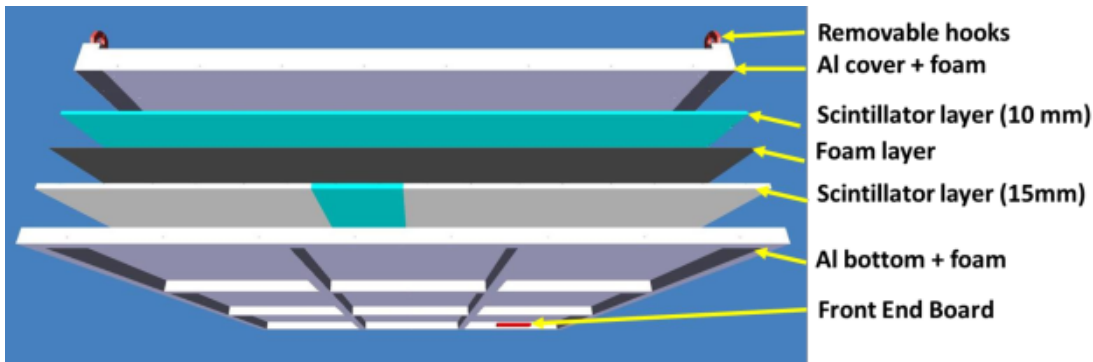   ➤ 528: 480 corner wires + 48 wires to complete the plane at the other side.
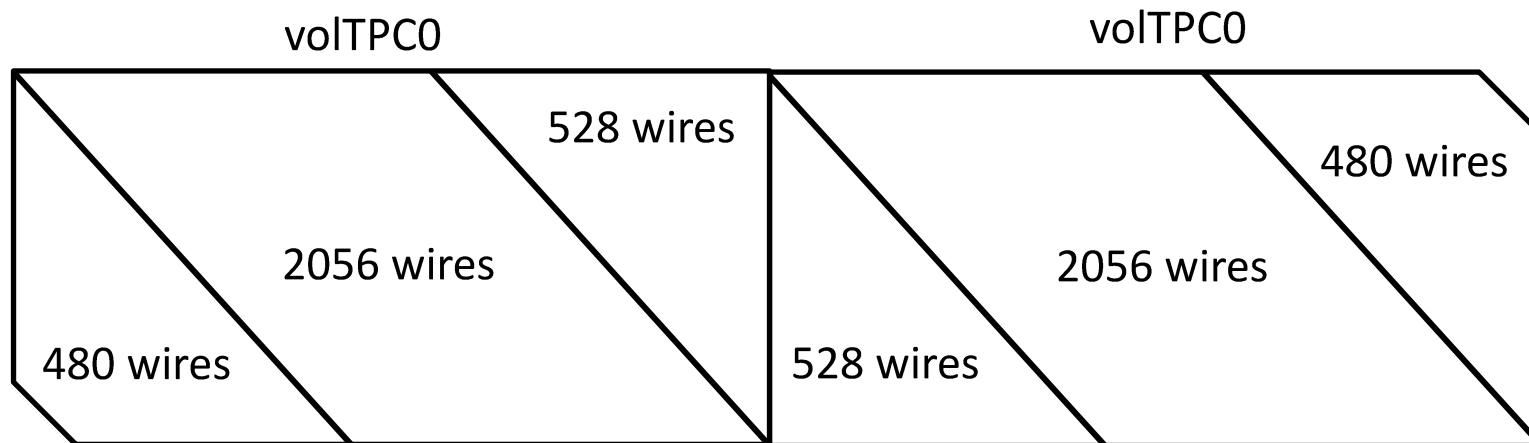
Collection + Induction2 planes: 480 + 2056 + 528 + 2056 + 480 = 5600 wires

CRT Module Description: last changes

- Bottom CRT – no changes.

- Top CRT:

  - Previously used 1.5 cm thickness for top and bottom layers.

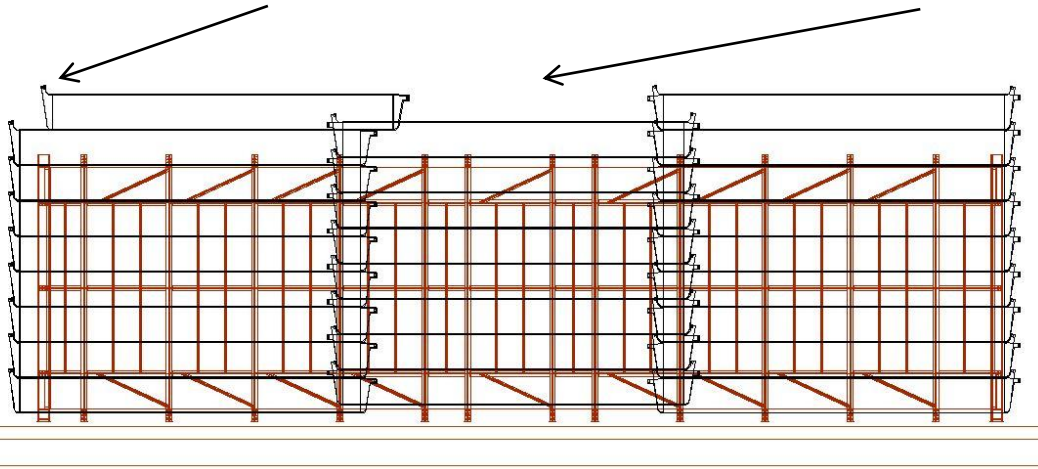 - Now reflects reality w/bottom layer 1.5cm, top layer 1cm thick.

- Side CRT:

  - Need to cut some modules to fit.

  - South wall Y-layer now consists of half modules.

  - North wall consists entirely of cut modules, 3 different lengths.

Removable hooks
Al cover + foam
Scintillator layer (10 mm)
Foam layer
Scintillator layer (15mm)
Al bottom + foam
Front End Board

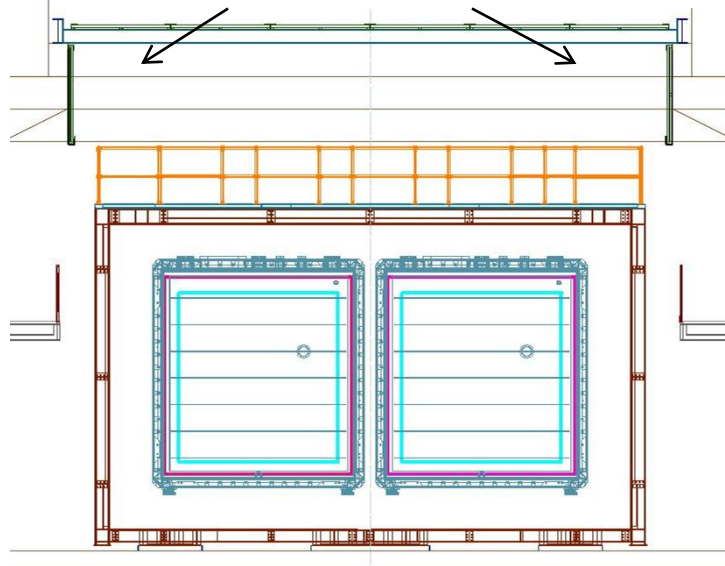# Changes to Configuration

shifted in z to avoid interference   top row removed for cable tray

Cold vessels
Active volume

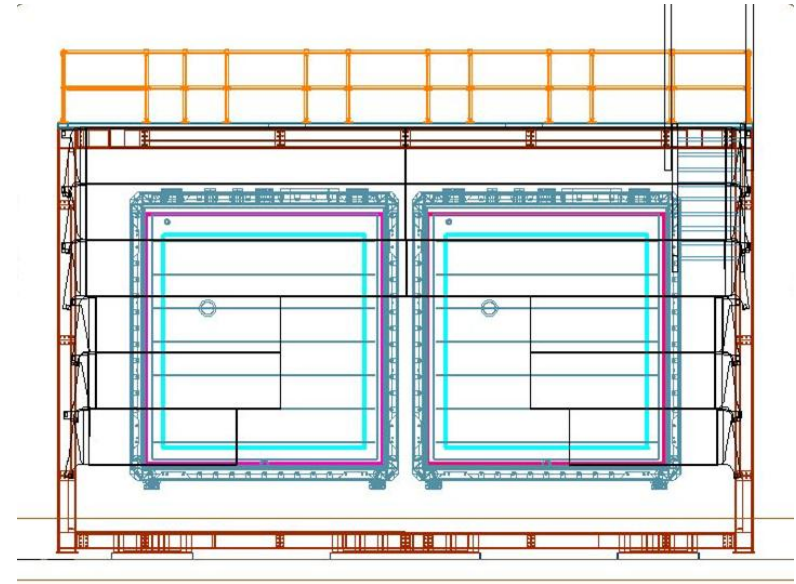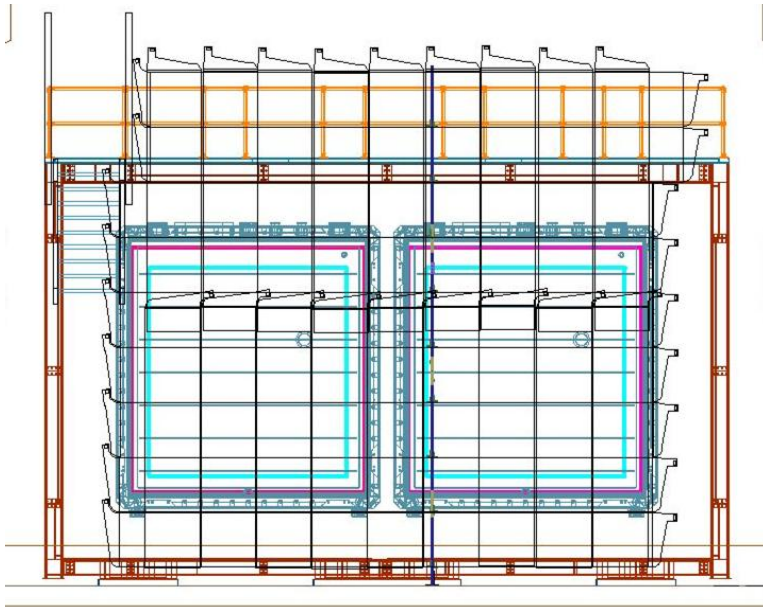sloped modules now form vertical rim

Top:

➢ top CRT is offset in the z by ~3m.
➢ Small gap between rim and roof due to I-beams.

Changes to Configuration
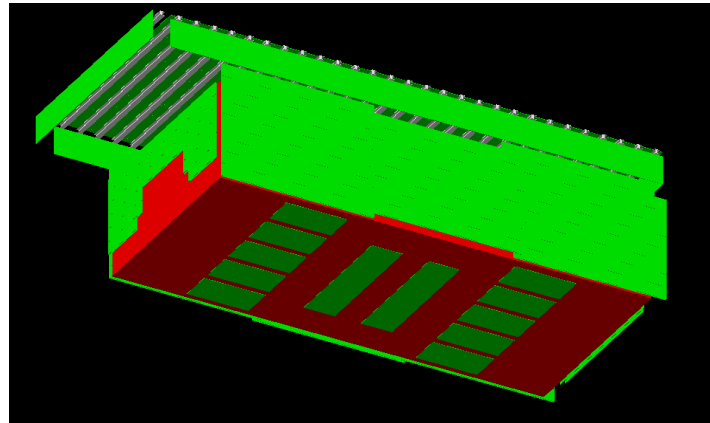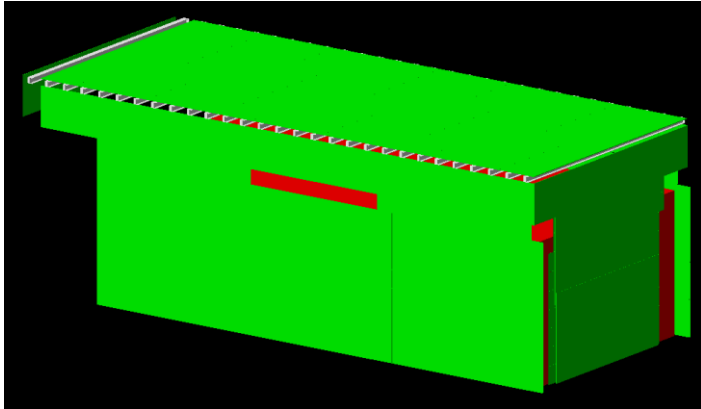

Cold vessels
Active volume

South Wall:

➢ X-Y maintained
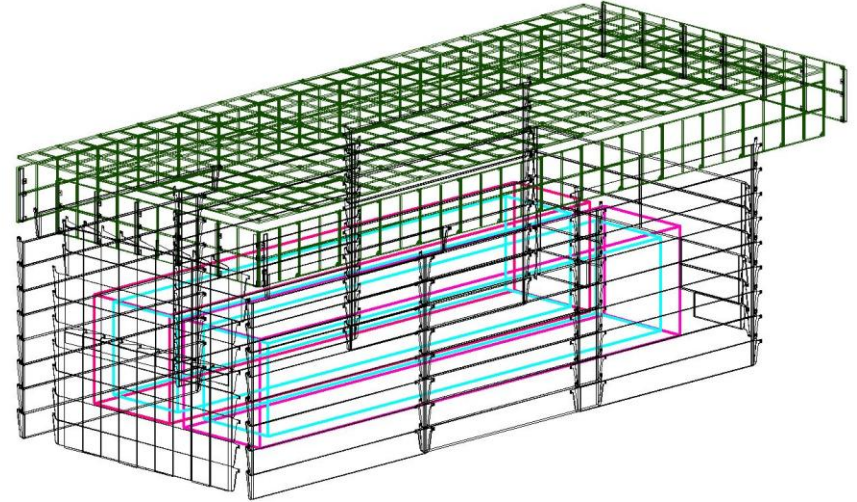➢ 2 rows offset for stairs
➢ Vertical modules cut in half

North Wall:

➢ Yields to cryo. introducing large hole
➢ Now X-X configuration.
➢ Modules cut, 3 different lengths

Current Geometry

Reference drawing from CAD model

CRT
Warm Vessel
Top CRT Support I-beams

➢ GDML description now current with latest CAD drawings.

➢ TOP CRT support beams added – should have significant impact on auto-veto rates, generation of secondaries.

➢ GDML generation script uses parametrization for module positioning for easy updating after installation, true positions measured.

Next steps

➢ Complete the inner detector mechanical structure (top/bottom stainless steel beams and pillars).

➢ Insert the small spacing between the Induction one horizontal (split) wire planes.

➢ Insert more details of the instrumentation placed outside the cryostats (chimneys, flanges etc.).