



Ciemat

Centro de Investigaciones
Energéticas, Medioambientales
y Tecnológicas



Membrane PD Modules: ProtoDune-VD

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on behalf of the Ciemat Neutrino group.

2022 October 07

Time schedule of the PDm suspension system:

++ Design readiness: Waiting for latest modifications on numbers of PDm and latest version of the PDm to can start to redesign (**starting point**).

-Need to redesign suspension system to adapt to 2 top and 2 bottom PDm? Design the fixation points of the PDm (glass fiber pieces to fix the PDm to the suspension system). **1 week.**

++Purchasing of components necessary to start the production: (**in stock**)

-We have at home the springs, rod bars, tubes and glass fibre material to produce the adapter pieces between the PDm and rod bars. **In stock.**

Rest of elements (Eye bolts, Straining Screws and *shackles*). We are waiting for some units of them. **1-2 week.**

++Fabrication: it can be started once the design is fixed: (**~< weeks**)

-For the suspension system (rod bar and tubes) . **1 week.**

-Glass fibre pieces. In parallel. **2-4 weeks.**

(But this last pieces are not definitive, because the PDm are not yet decided the final version of the mechanics. I am using on the 3D model the Cold Box test version).

-In parallel we are perform cryo-room temp. tests on the bars welds and springs to characterize them. **3-4 weeks.**

-Clean and packing. **1 week.**

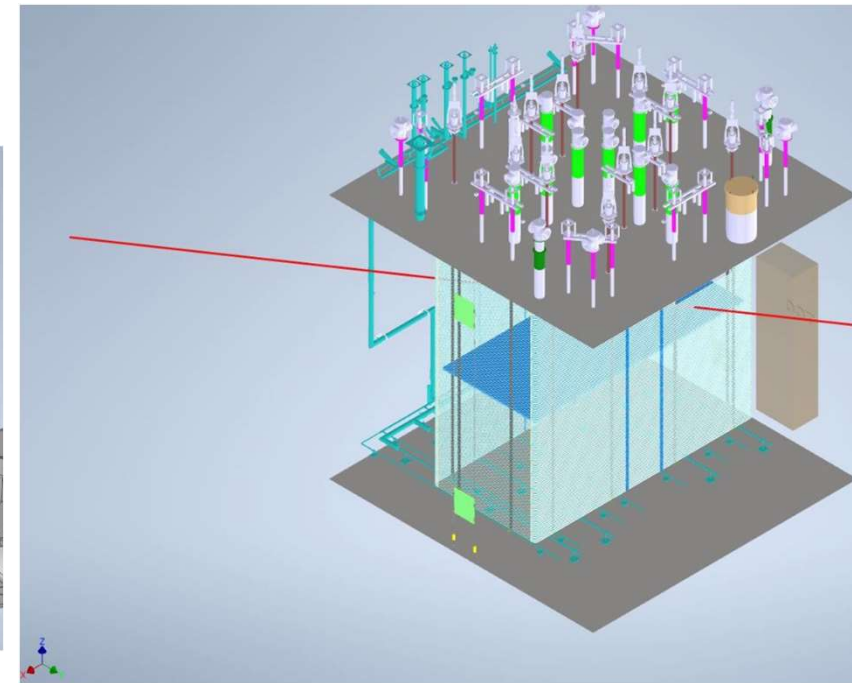
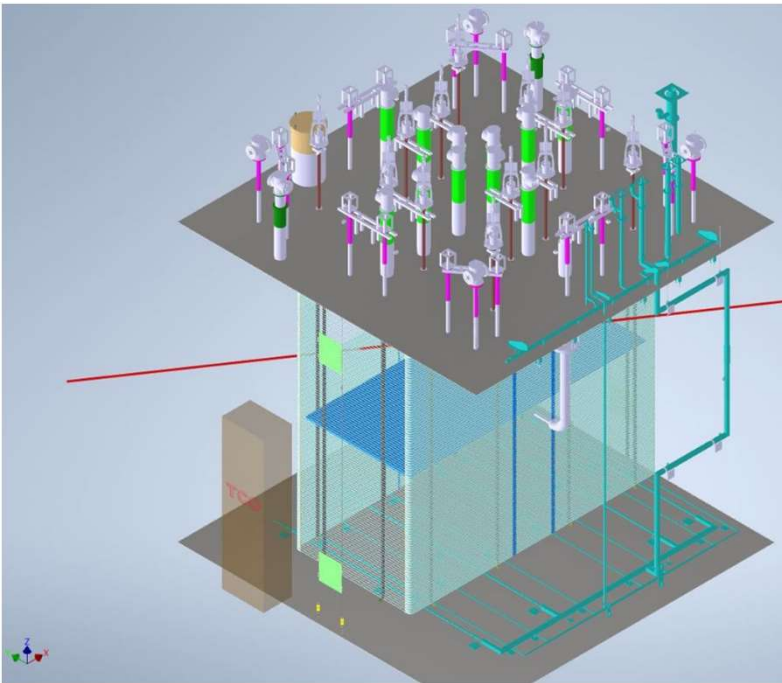
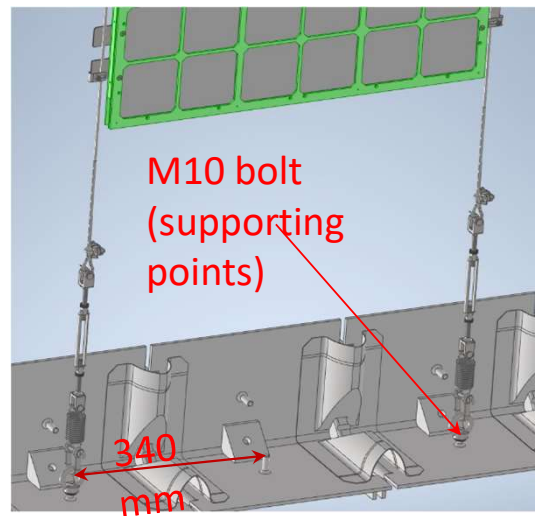
++Delivery to CERN. **1 week**

Backup

2.- ProtoDUNE-VD: *Photon Detector Modules*

1 column of 2 PD modules by short FC side:
4 PD modules on the vertical membranes (or 8 PDM).

Modular system fixed on the top and bottom of the cryostat,
on the *M10 bolt of the corners*.

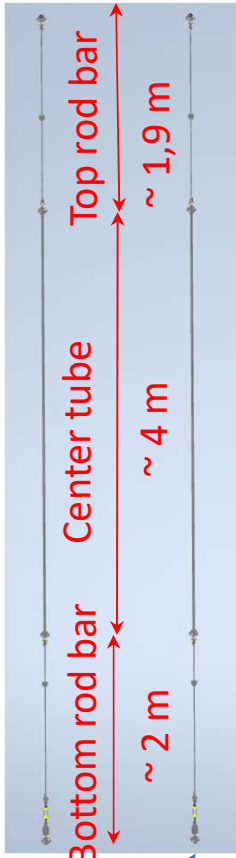
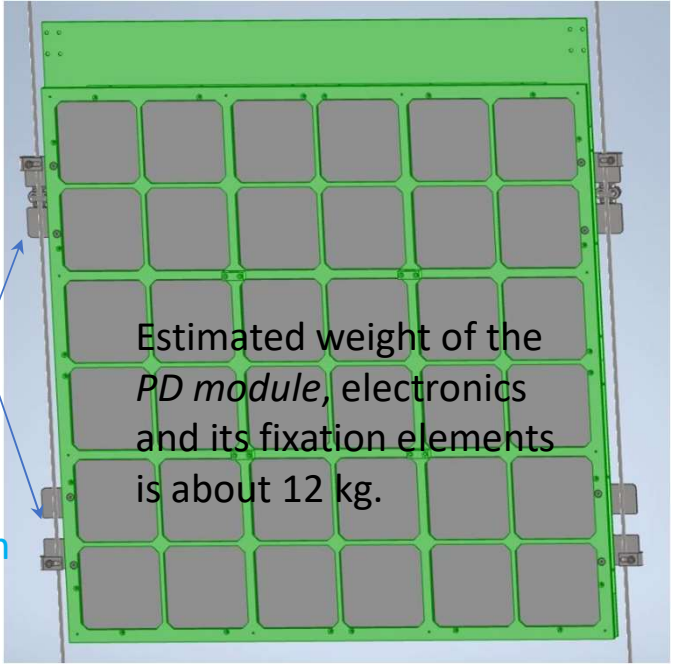
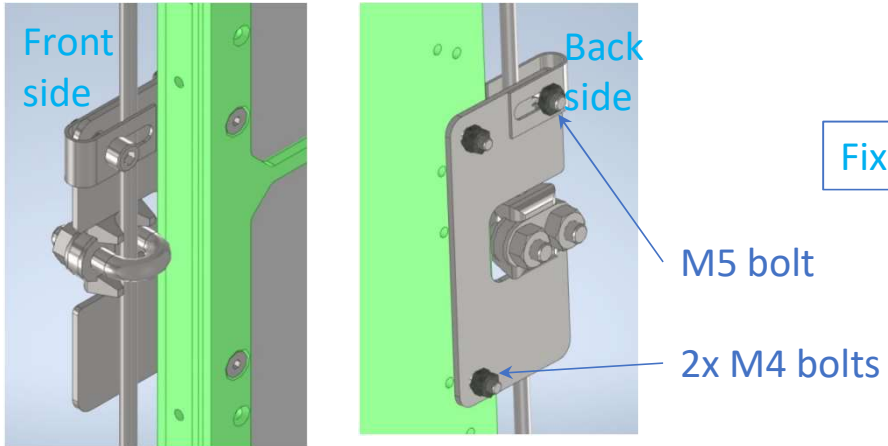
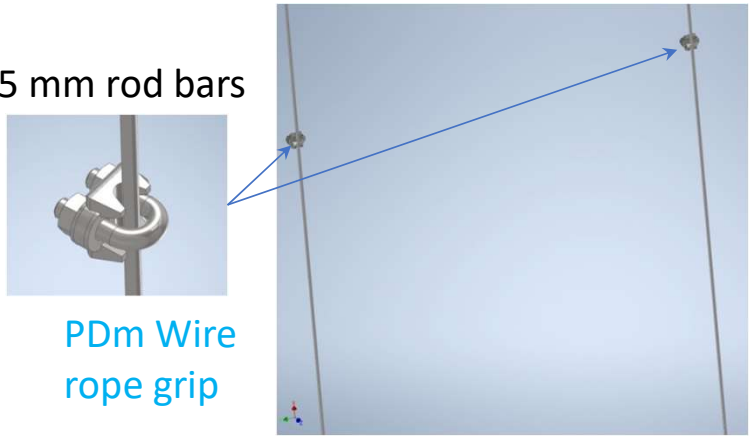


2.1.1.- Suspension lines description:

Each *PD module column* has two suspension lines compose of two 5 mm rod bars (top & bottom) & 12/10 mm diam. tube in the center

Each *PD module* is supported on both lines by two 'Wire Rope Grip' pre-positioned along the 5 mm rod bars, on the top side of each PD module.

Each *PD module* has four 'fixation points'.
 The two top fixation points will be inserted on the two 'Wire Rope Grip' pre-positioned along the rod bars.
 The fixation points are fixed to the PD module by two M4 bolt.

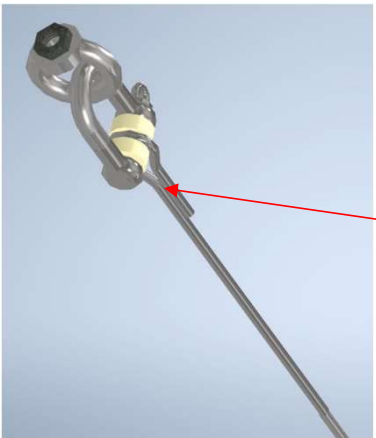


Suspension lines

2.1.2.- PD modules fixation along the suspension lines. Top Rod bar description:

Suspension lines are supported at top and bottom on the wall: The top rod bar end has an *eye bolt* to be fixed in the M10 bolt and then fix the top rod bar by the *shackles*. They can be previously pre-assembled on the ground or at home, like a chain.

The bars will have the '*wire rope grip*' pre-positioned at home.

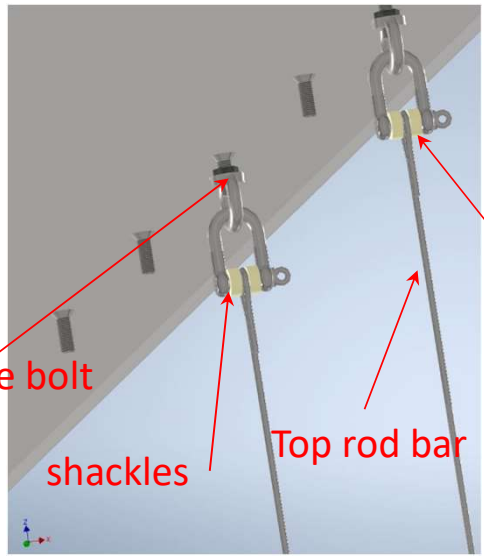


Top end



PDM '*wire rope grip*'

bottom end



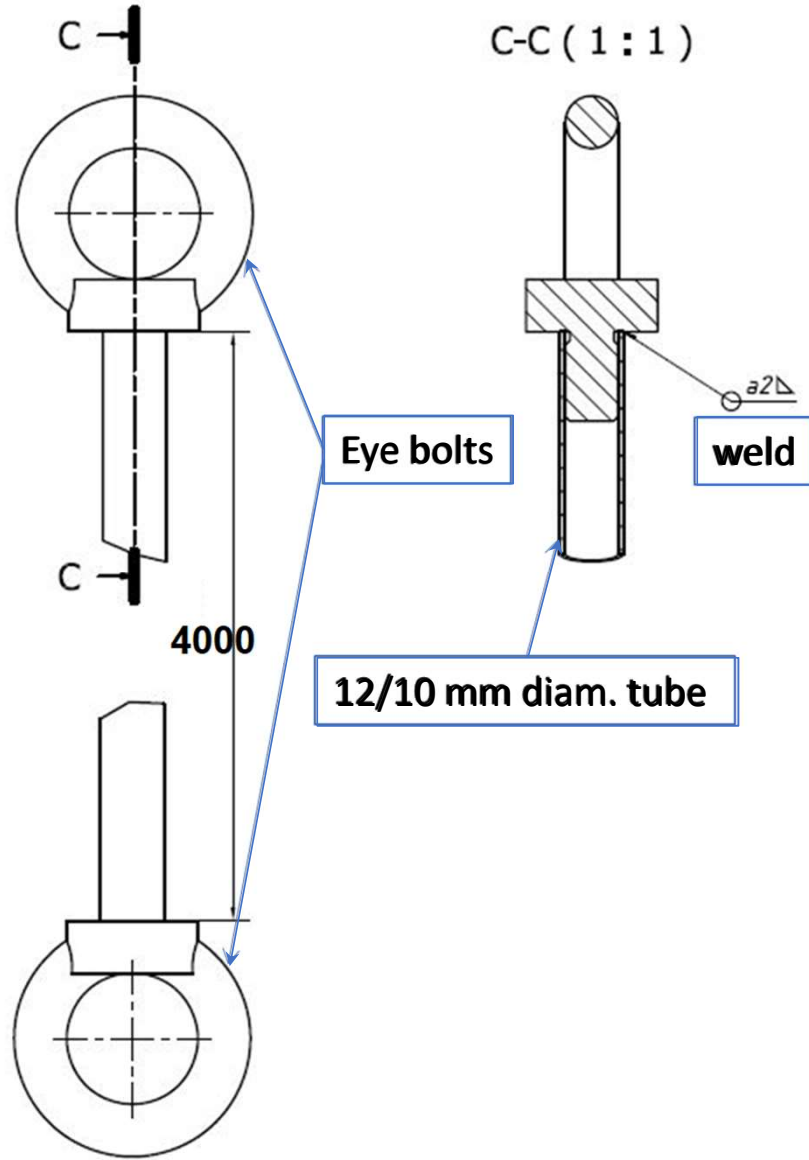
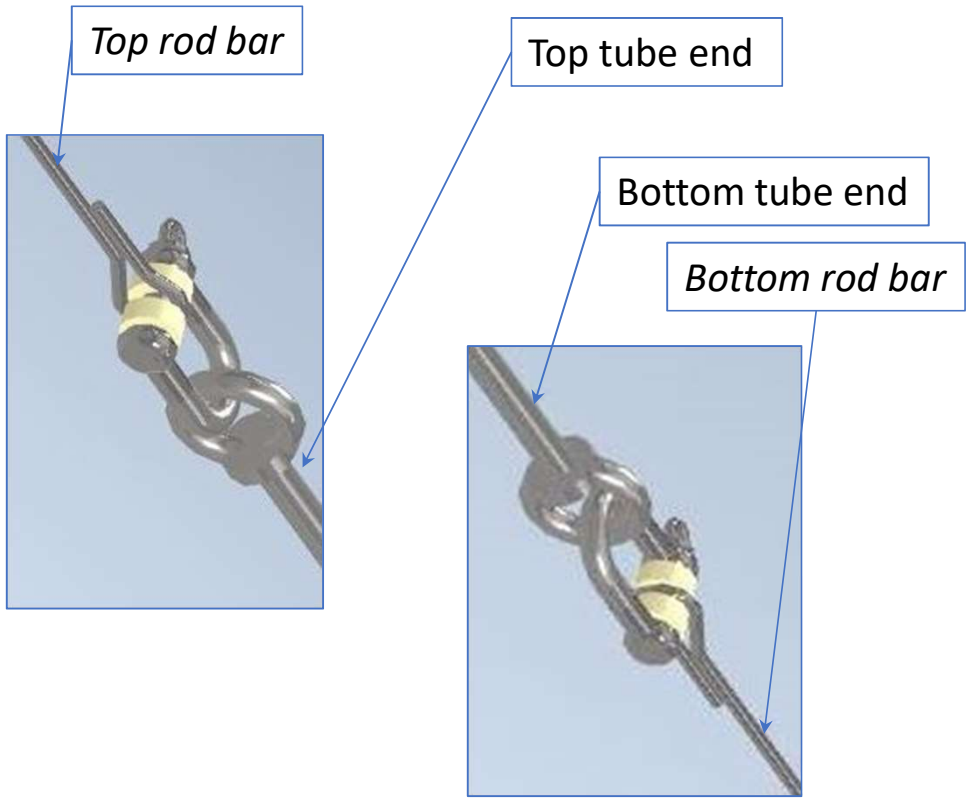
The tools to perform it are ready and tested. Several prototypes has been produced.

Spot welds at the end of the rod bars replacing the wire rope grips.

2.1.3.- PD modules fixation along the suspension lines. Central tube description

Following the recommendation from the HV team: In the central region close to the cathode we should use at least 10 mm diameter tube, to avoid induce a big field gradient.

The end eye bolt of tubes will be welded. Prototypes are ready.

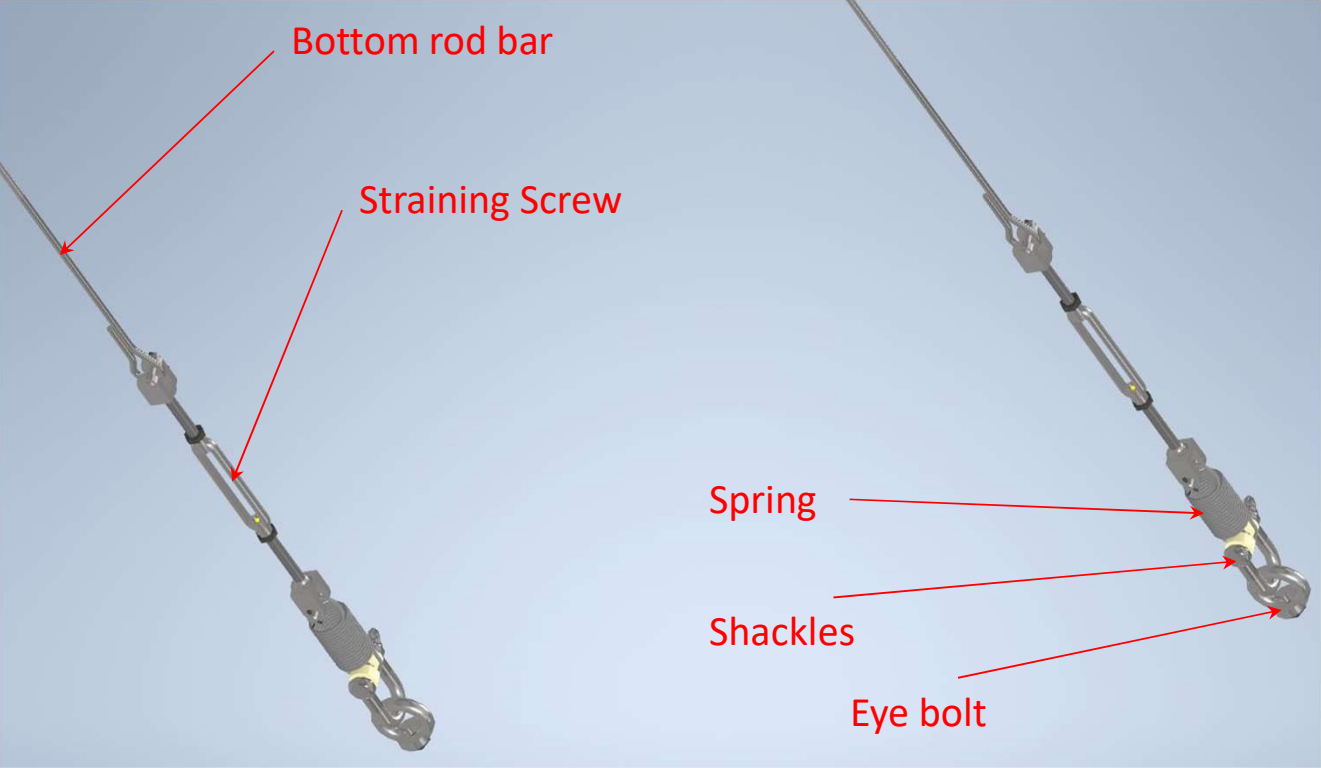


2.1.4.- PD modules fixation along the suspension lines. Bottom Rod bar description:

Bottom rod bars of the support lines: The bottom rod bar end has an *eye bolt* to be fixed in the M10 bolt and then fix the bottom rod bar by the *shackles*.

The Straining Screw, Jaw to Jaw (adjustment range 75 mm) needs to be installed to compensate the differences between nominal and real dimension of the suspension lines.

The spring is needed to absorb the overload produced by thermal expansion and to Pre-tension suspension lines (15-20 kg).



All material sent will be cleaned and double-bagged (Filled with nitrogen atmosphere, if necessary), to dispose of the outer bag before entering the clean area of the detector, avoiding contamination inside.

3.- Suspension Line Prototype



The rod bar line has 2 rod bars and one tube that can be previously pre-assembled on the ground or at home, like a chain.





**We have the tools
for this issue ready**

- Rod bars and central tube could be produced for the ProtoDUNE-VD in a couple of days.
- And for the DUNE-FD2-VD in 4-8 week.

- *Cryo-Test of the spring & rod/tube prototypes. On going.*

4.- Cables routing length.

ProtoDUNE-VD-PDm Cables length

	Cable length Bottom	Cable length Top
A	650	
B	1700	
C	3800	
D	7900	
E	4200	4200
F	1600	1600
G	2100	2100
H		650
I		750
J		3800
Length (mm)	21950	13100

