IFIC
11/05/2017

“Other” temperature sensors inside the ProtoDUNE-SP cryostat

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IFIC - (CSIC & Univ. Valencia)

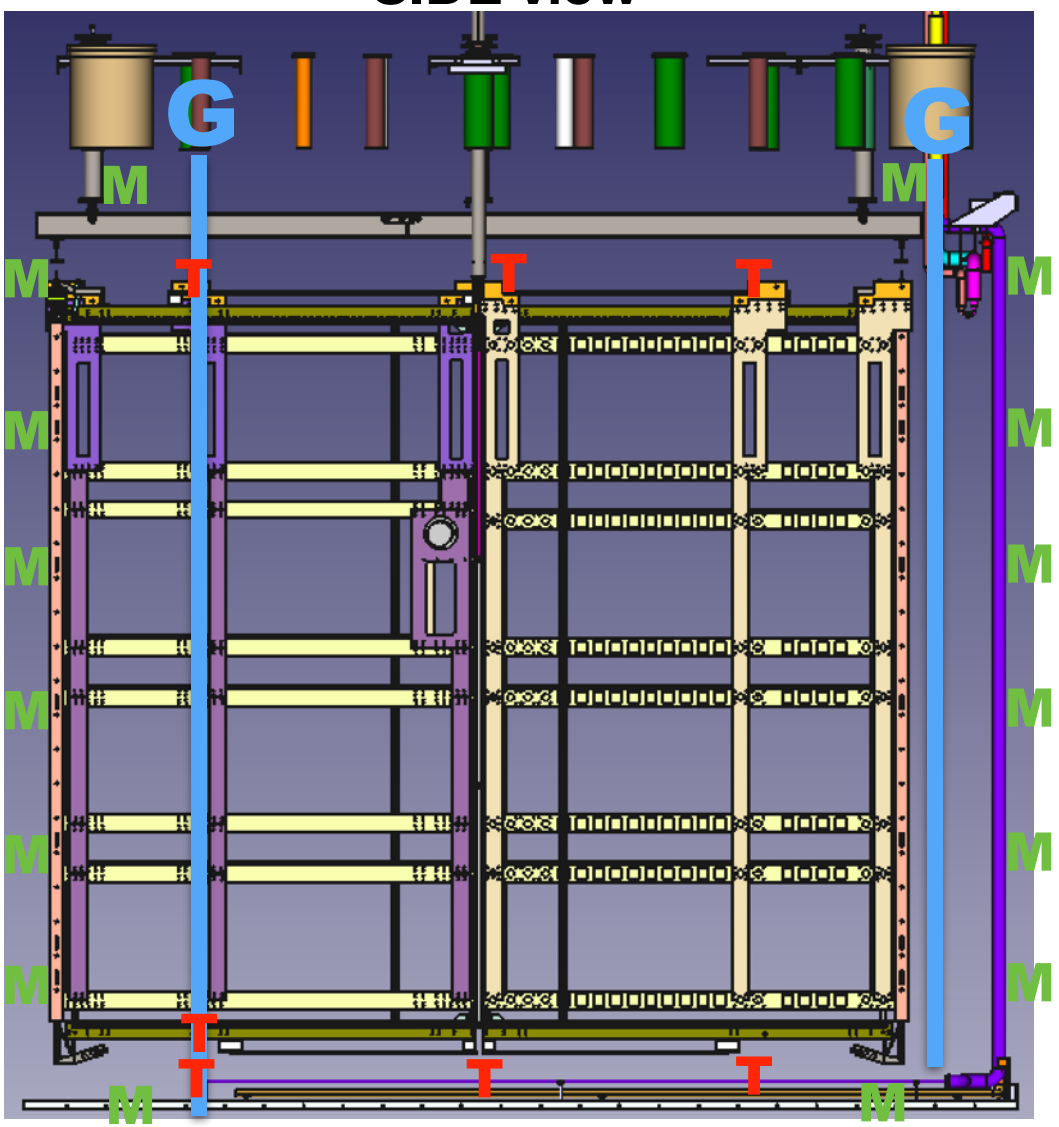
News

- CERN will take care of the installation of sensors on the walls of the cryostat. They will also figure out how to attach them and route the cables
- CERN can help us with the installation of sensors and cables on the bottom pipes as well
- We have news about the cables

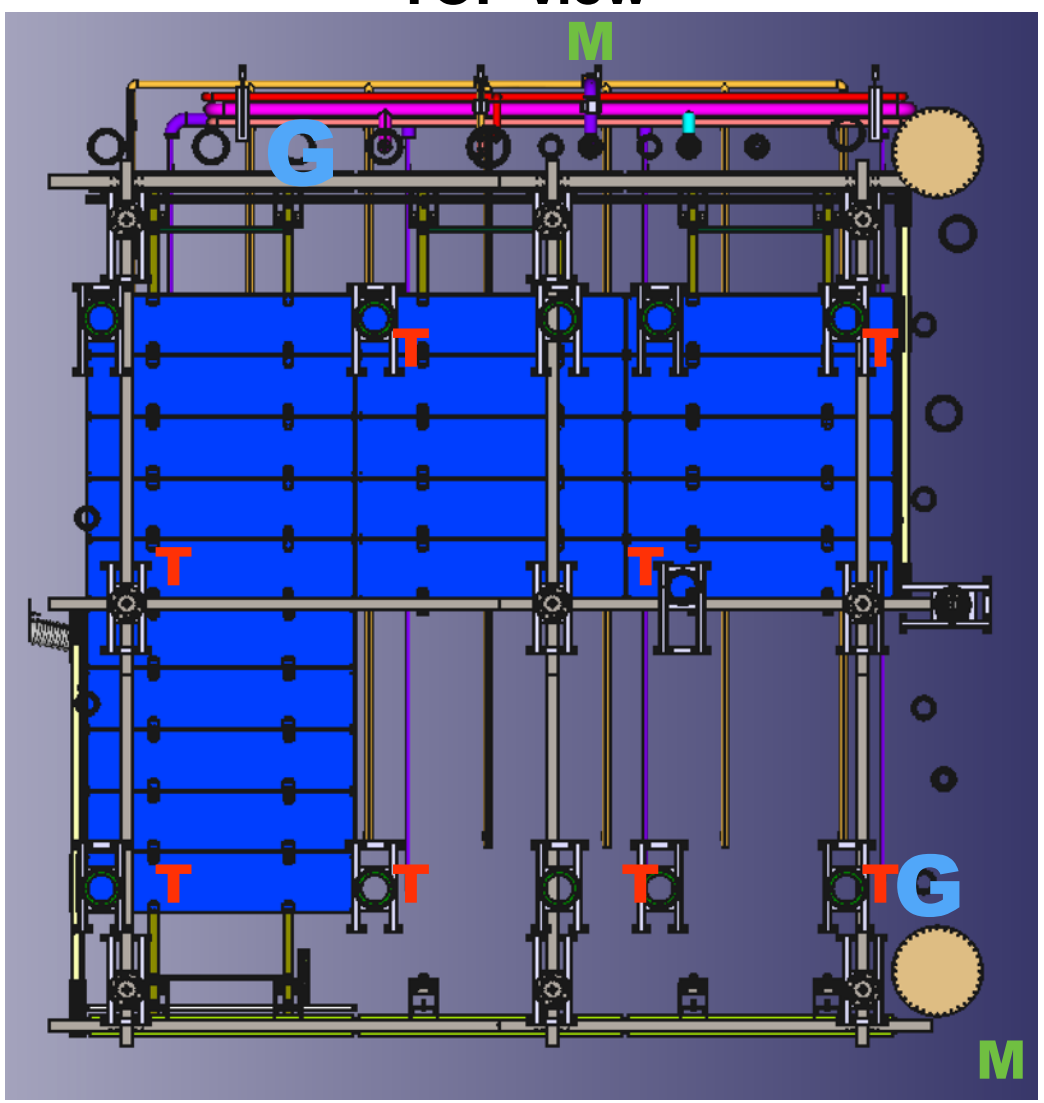
Sensor map

T Top-bottom **G** T-Gradient monitors **M** Cryostat wall

SIDE view

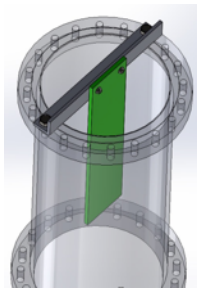


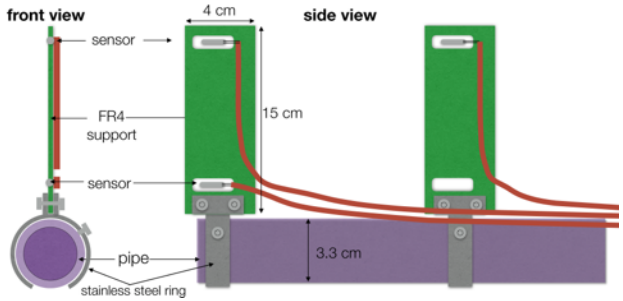
TOP view



Priorities

- **May 16**: preliminary 3D model for sensor's support for bottom pipes and temporary support for calibration



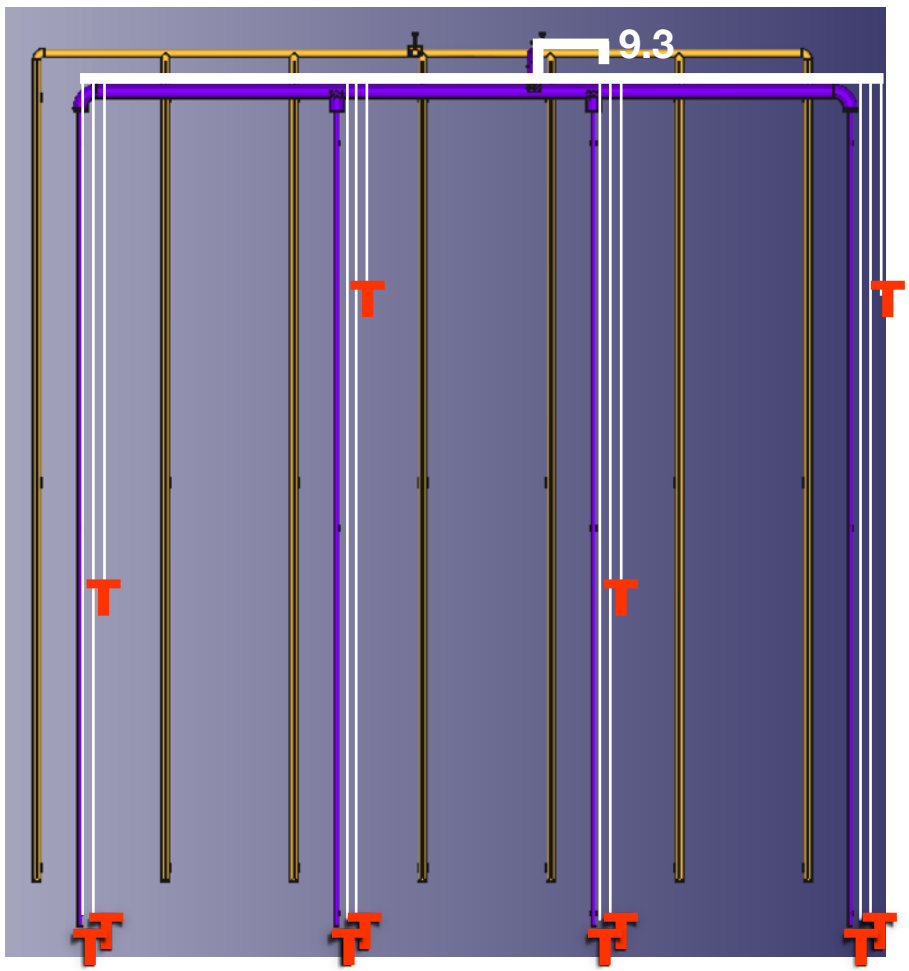


- **May 18**: Cable choice for single sensors
- **May 22**: Temporary Sensor's support for calibration
- **June 20**: Final sensor's support for calibration
- **July 15:** sensor's support for pipes

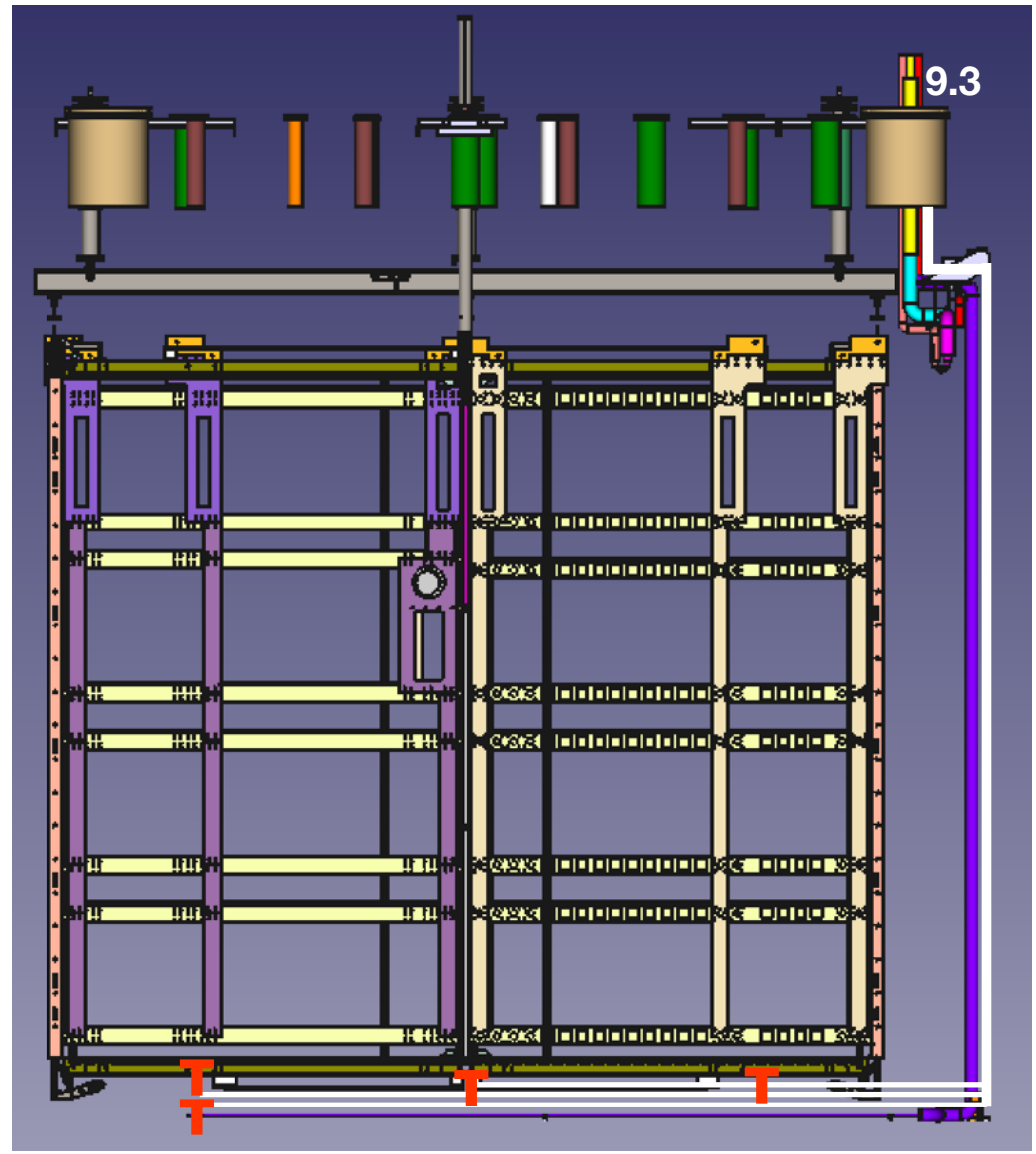
Cabling for pipes

- Cables can run attached to the pipes all the way to port 9.3
- Pipes in purple, cables in white

TOP view

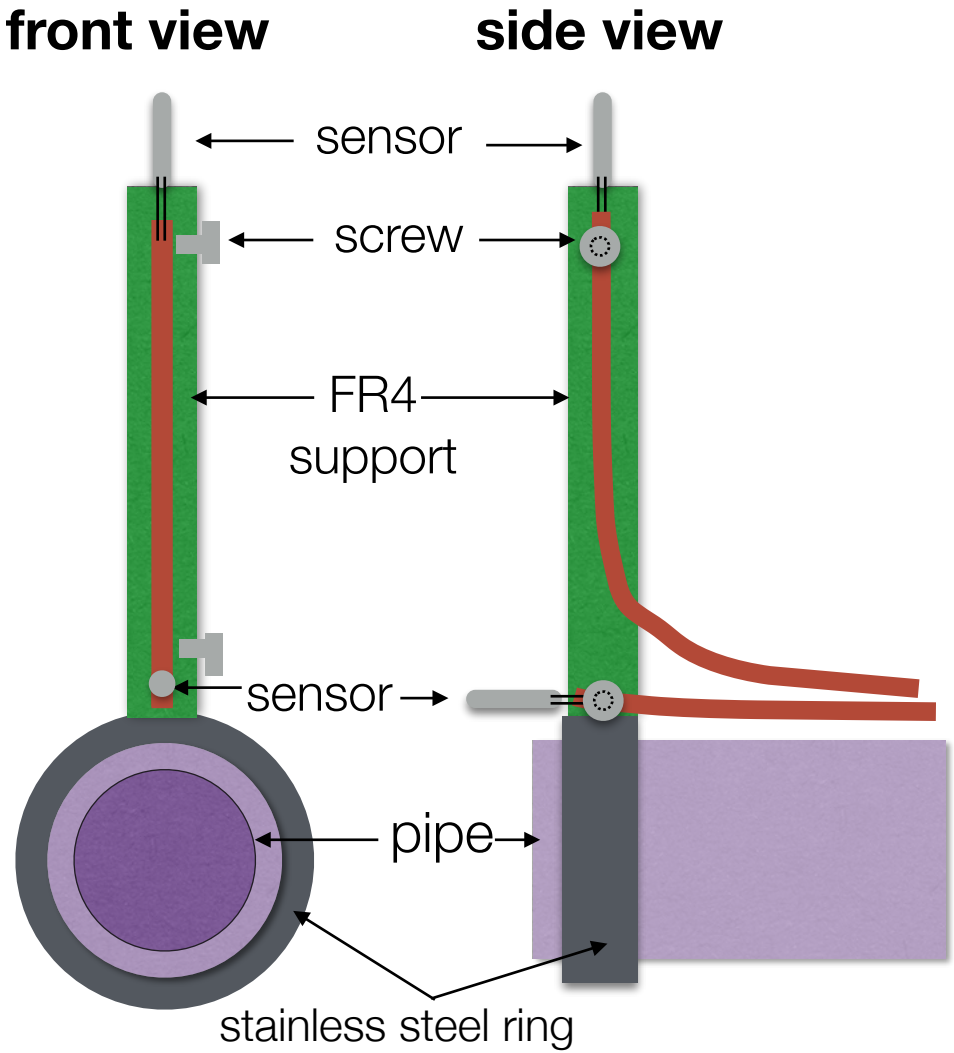


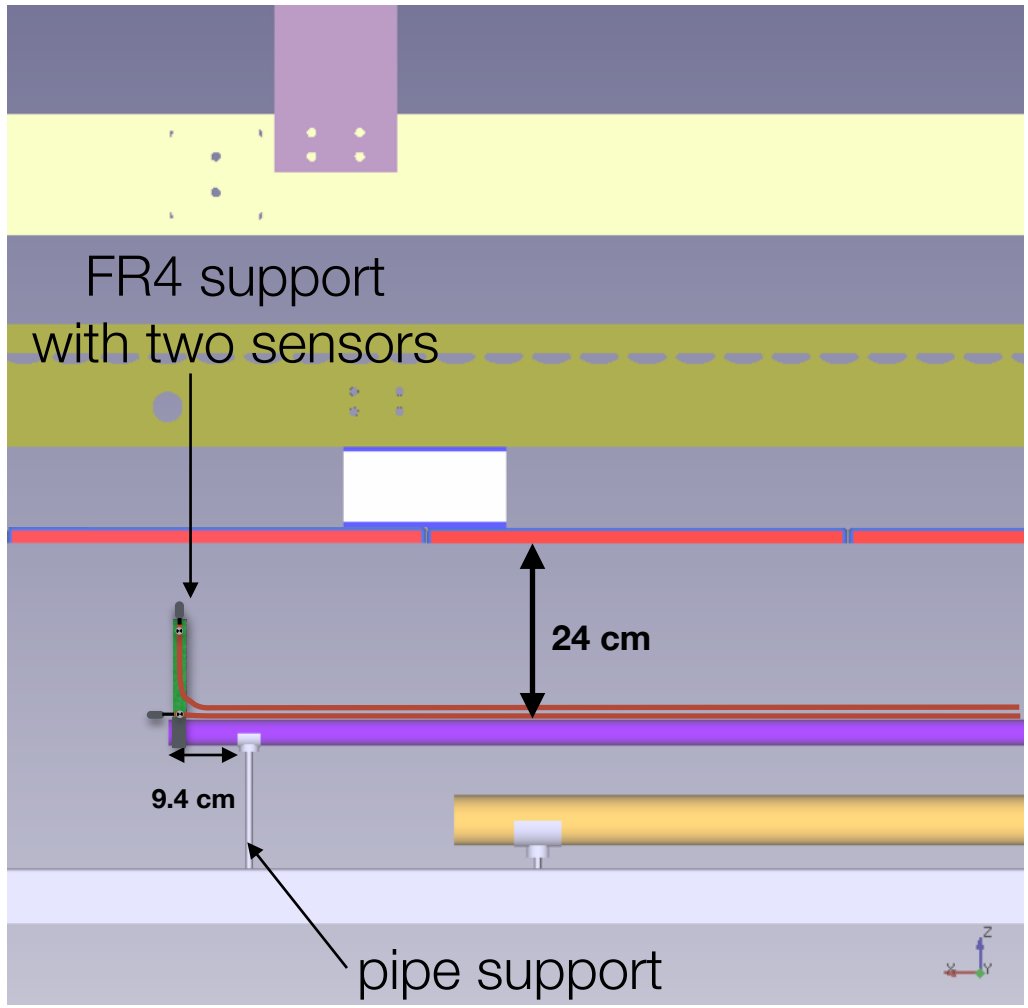
SIDE view



Sensor's support

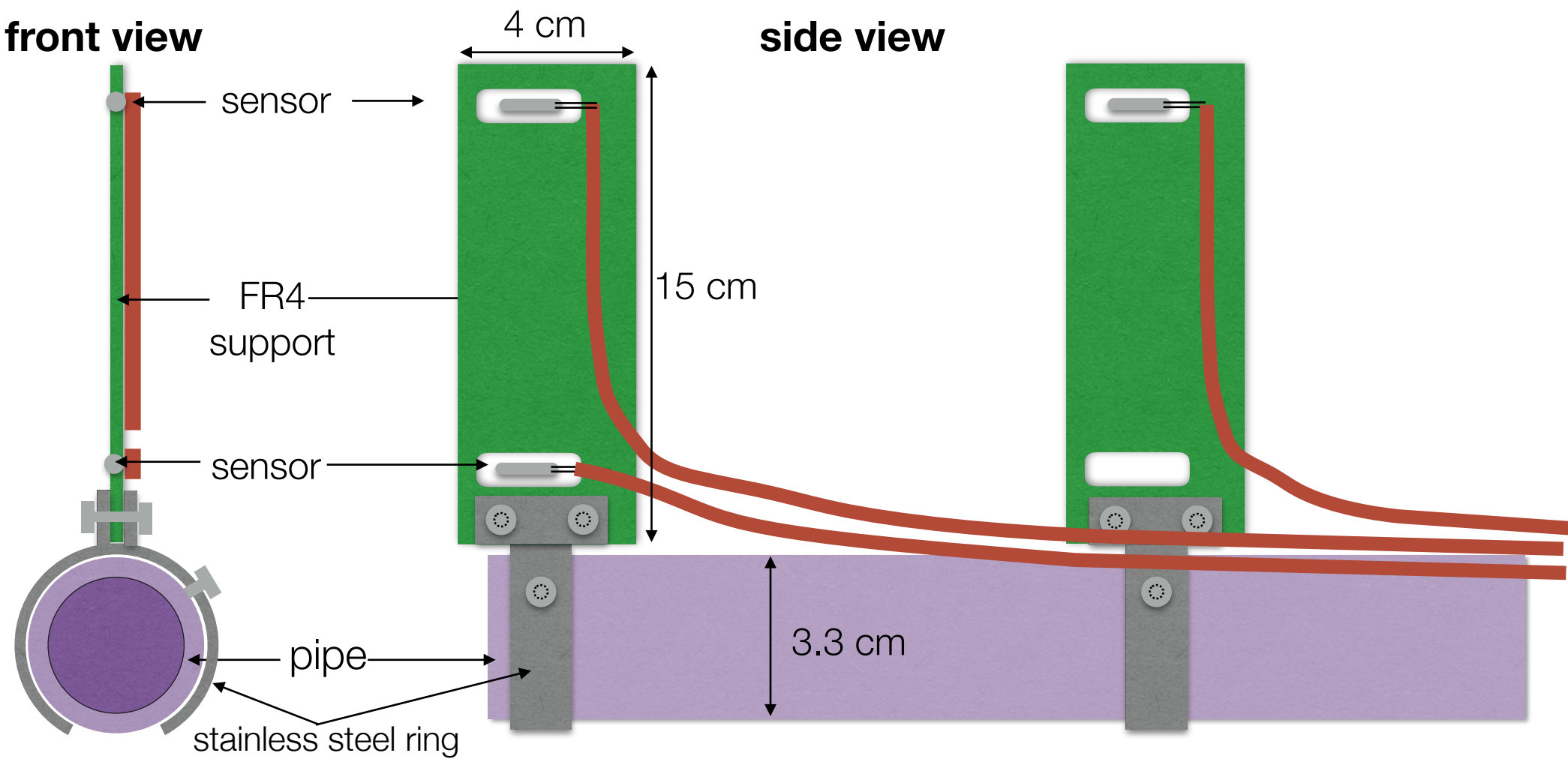
- Needs to be designed (two weeks)
- Depending on false floor height it may need to be temporarily rotated





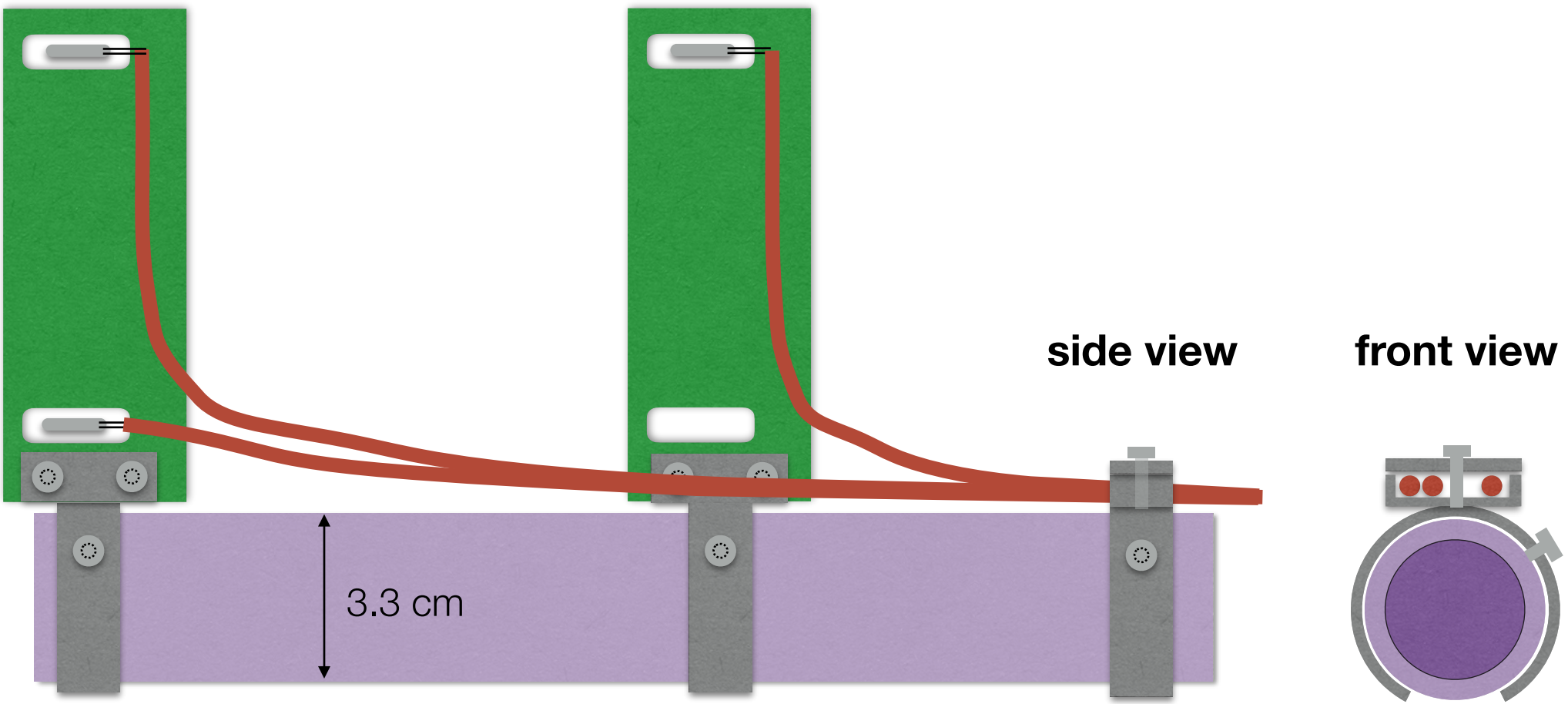
Another design

- A simple flat PCB can be easily fabricated at IFIC
- The bridle ring should be fixed to the pipe with a screw (probably just pressing the pipe) to avoid movements. Notice that the pipes will shake during cool-down



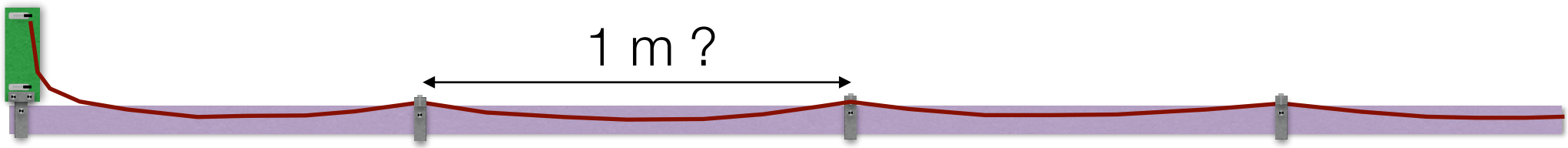
Cable's support

- Use the same bridle ring



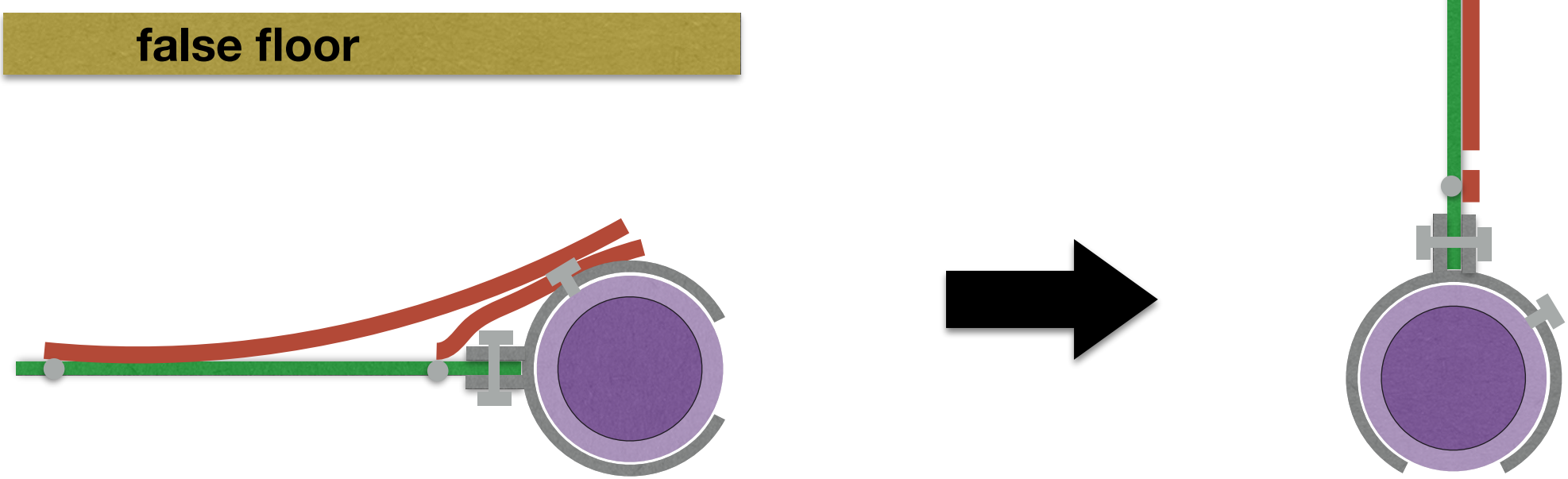
Distribution

- Is it sufficient a bridle ring every meter ?
- The cable could be a bit loose to account for shrinkage
  - We should understand the coefficient of thermal expansion for the cable
    - FEP: 25 mm/m
    - copper: 3 mm/m
    - SS (pipe): 2.8 mm/m
  - I have asked Axon about the behaviour of FEP+copper

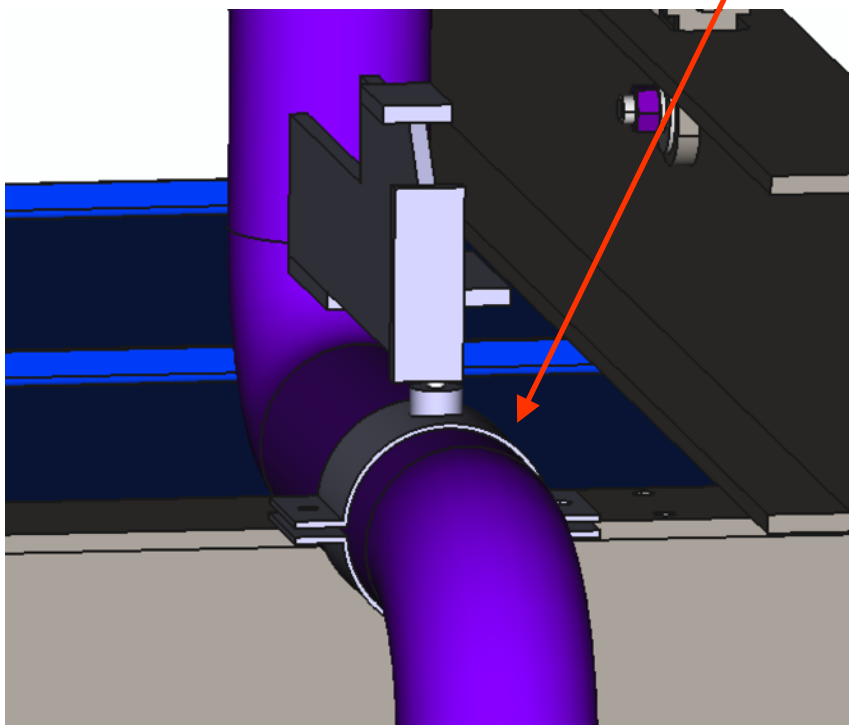


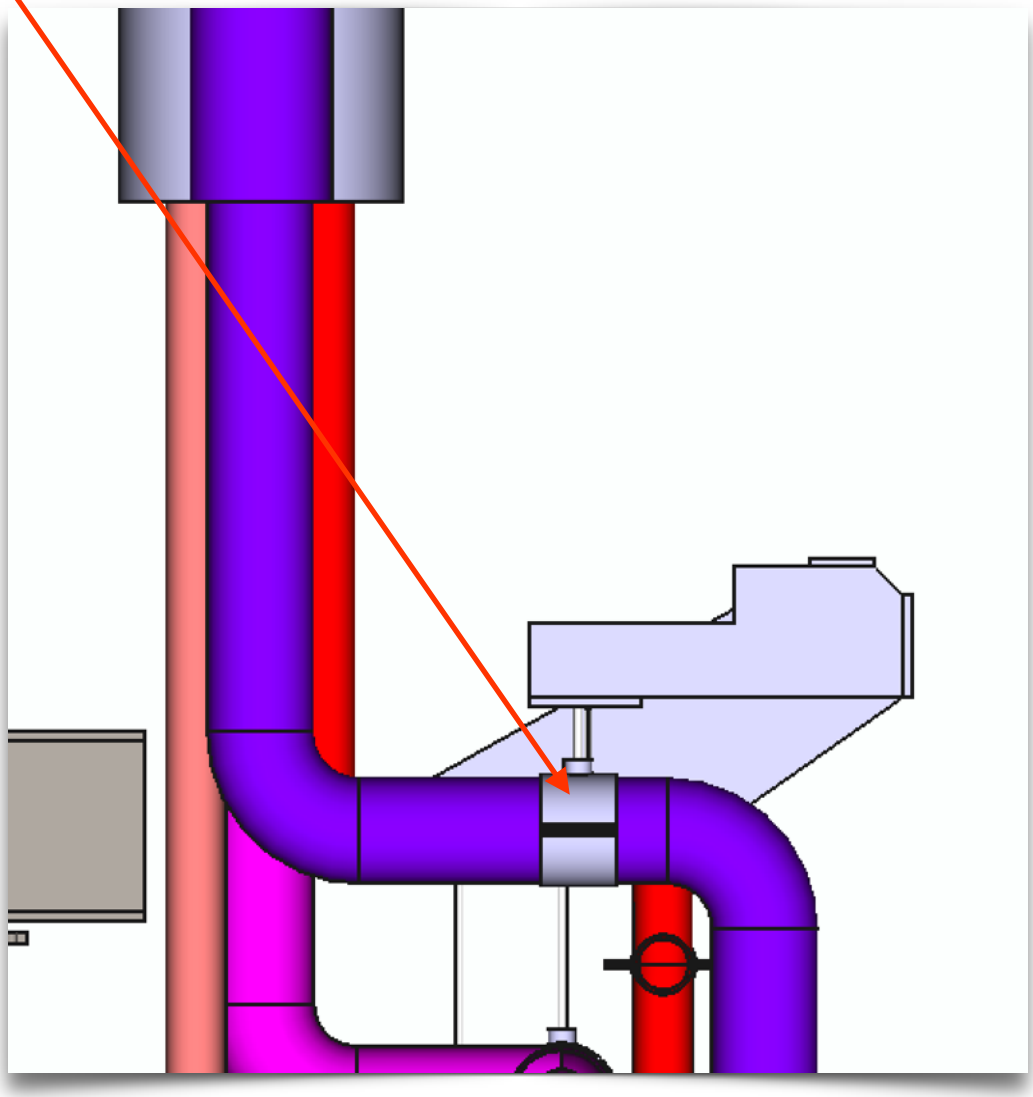
False floor

- The sensor's support will initially installed in horizontal position
- And rotated only when the false floor is removed
- Cables should be a bit loose such that they can tolerate the rotation
- False floor is removed before rotating the bottom FC/GP assemblies. At this moment one can walk through the cryostat floor to rotate the sensor's support and securely fix it again



- We could use something similar to what is used to hold the pipes





Single twisted pairs

REV	MODIFICATIONS	DRAWN BY	CHECKED BY	DATE
B1	Creation	BCa	NLe	10/05/17

CABLE COMPOSITION

1- PTFE fillers for roundness

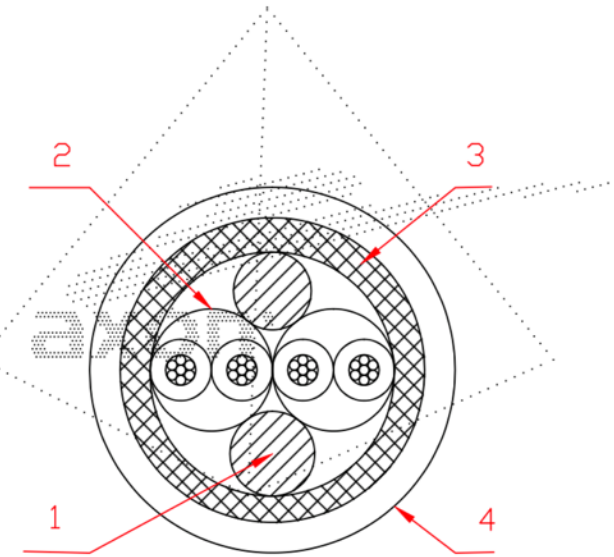
2- 2x twisted pairs ref. 2x PT3007
Description of one wire PT3007
Conductor
Material: Nickel plated annealed copper
Composition: AWG30 or 7x0.102mm nom
Diameter: 0.303 mm nom
Section: 0.057mm² nom
Resistance: 34.63 Ω/100m nom @ 20°C
Insulation
Material: Extruded PFA
Diameter: 0.62mm nom
Colors: Red/Black and Brown/Orange

3- Braided shield
Material: Nickel plated annealed copper
Strand diameter: 0.127mm nom

4- Outer jacket
Material: Extruded PFA
Color: White

MAIN DATA

Outer dimensions: 3.35 mm nom
Temperature rating: -200°C/+260°C
Voltage rating: 250V AC
Approximative weight: 23.20 g/m nominal



PRELIMINARY DRAWING

UNLESS OTHERWISE SPECIFIED, DIMENSIONS : MM ANGLES : d.

KEY CHARACTERISTICS
C : 0

CUSTOMER N° IFIC

FILE N° A22721B1.dwg

axon' CABLE & INTERCONNECT

AXON'CABLE SA
51210 MONTMIRAIL - FRANCE
TEL : +33 3 26 81 70 00
FAX : +33 3 26 81 28 83
www.axon-cable.com

TITLE : PT3007 StP2x2

SIZE A4

SCALE : N.D.

AXON'SA N° A22721B1

REV – Prod. – Doc.

SHEET 1 of 1

Single twisted quads

REV	MODIFICATIONS	DRAWN BY	CHECKED BY	DATE
B4	Creation	BCa	NLe	11/05/17

CABLE COMPOSITION

1- Twisted quads of wire ref. PT3007

Conductor

Material:	Nickel plated annealed copper
Composition:	AWG30 or 7x0.102mm nom
Diameter:	0.303 mm nom
Section:	0.057mm² nom
Resistance:	34.63 Ω/100m nom @ 20°C

Insulation

Material:	Extruded PFA
Diameter:	0.62mm nom
Colors:	Red/Black/Brown/Orange

2- Braided shield

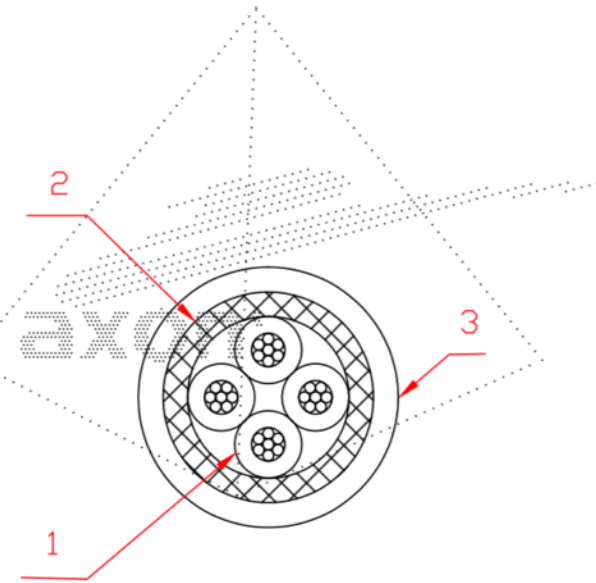
Material:	Nickel plated annealed copper
Strand diameter:	0.102mm nom

3- Outer jacket

Material:	Extruded PFA
Color:	Black

MAIN DATA

Outer diameter:	2.40 mm nom
Temperature rating:	-200°C/+260°C
Voltage rating:	250V AC
Approximative weight:	12.90 g/m nominal



PRELIMINARY DRAWING

UNLESS OTHERWISE SPECIFIED, DIMENSIONS : MM ANGLES : d.

KEY CHARACTERISTICS
C : 0

CUSTOMER N° IFIC

FILE N°
A22721B4.dwg

axon' CABLE & INTERCONNECT

AXON'CABLE SA
51210 MONTMIRAIL - FRANCE
TEL : +33 3 26 81 70 00
FAX : +33 3 26 81 28 83
www.axon-cable.com

TITLE :
PT3007 StP4

SIZE
A4

SCALE : N.D.

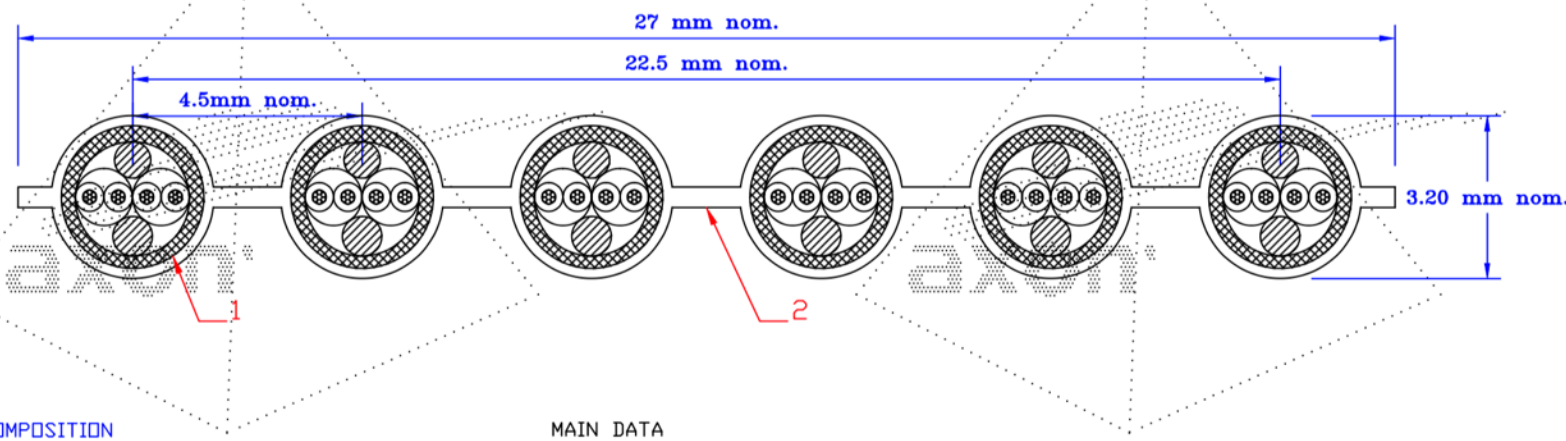
AXON'SA N°
A22721B4

REV
–
Prod. | Doc.

SHEET 1 of 1

Flat twisted pairs

REV	MODIFICATIONS	DRAWN BY	CHECKED BY	DATE
A1	Creation	BCa	NLe	10/04/17
B3	Update design	BCa	NLe	11/05/17



FLAT CABLE COMPOSITION

1- 6x Shielded double twisted pairs ref. PT3007 S2x2

Conductor

Material:	Nickel plated annealed copper
Composition:	AWG30 or 7x0.102mm nom
Diameter:	0.303 mm nom
Section:	0.057mm² nom
Resistance:	34.63 Ω/100m nom @ 20°C

Insulation

Material:	Extruded PFA
Diameter:	0.62mm nom
Colors:	Red/Black and Brown/Orange

PTFE fillers for roundness

Braided shield

Material:	Nickel plated annealed copper
Strand diameter:	0.127mm nom
Diameter:	3 mm nominal

2- Outer Jacket

Material:	Extruded PFA
Color:	Black

MAIN DATA

Outer dimensions:	27 mm nom x 3.20 mm nom.
Temperature rating:	-200°C/+260°C
Voltage rating:	250V AC
Approximative weight:	155 g/m nominal

PRELIMINARY DRAWING

UNLESS OTHERWISE SPECIFIED DIMENSIONS : MM ANGLES : d.

KEY CHARACTERISTICS

C : 0

CUSTOMER N° IFIC

FILE N° A22721B3.dwg

axon' CABLE & INTERCONNECT

AXON'CABLE SA
51210 MONTMIRAIL - FRANCE
TEL : +33 3 26 81 70 00
FAX : +33 3 26 81 28 83
www.axon-cable.com

TITLE : Flat cable [6x (PT3007 S2x2)] P

SIZE A4

SCALE : N.D.

AXON'SA N° A22721B3

REV – Prod. – Doc.

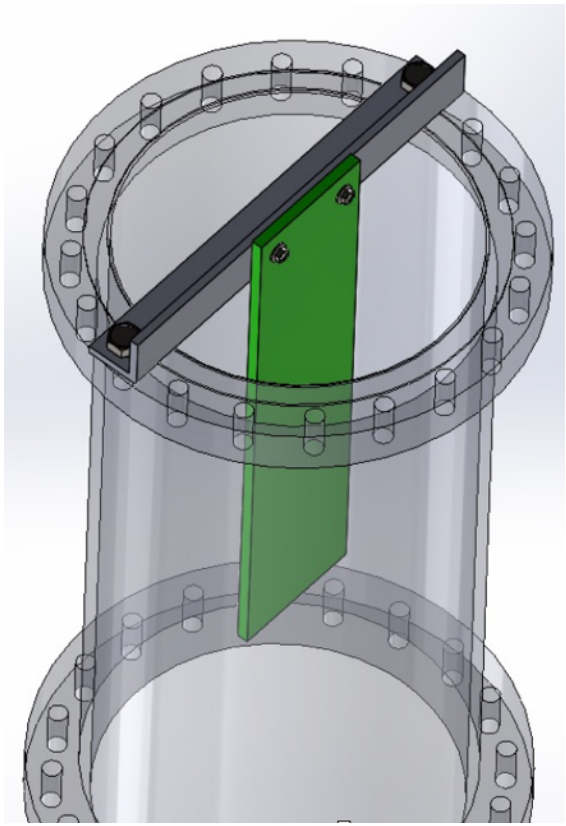
SHEET 1 of 1

Sample

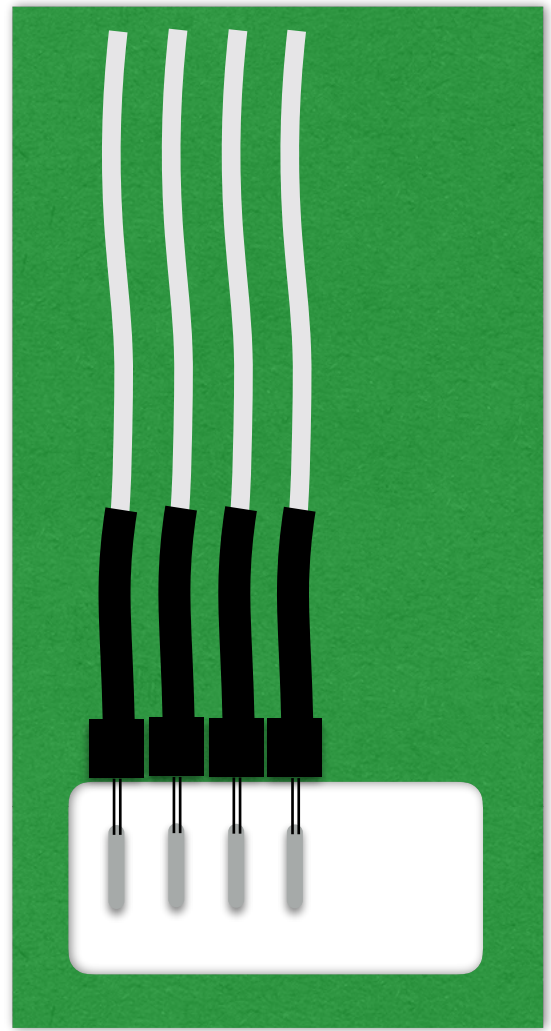
- The can provide a 10 meters sample of
  - P556951A^B, es un hilo que se compone de un conductor de ‘silver plated copper’ y de un aislante de PFA.

Sensor calibration

- We got the readout system from Xavier. First tests at ambient temperature done
- The plan is to start the calibration with open dewar right after the CM
- During the next to weeks we will design the definitive support and the flange for the final calibration, to be done during July



- Seria interesante tener flexibilidad a la hora de distribuir los sensores, pudiendo acercarlos o alejarlos



backup

Critical items

- Bottom sensors must be installed between August and September
- Most critical items:
  - **cable derogation**: must apply next week if possible
  - **sensor calibration**: will start next week

	2017									2018				
	Apr	May	Jun	Jul	Aug	Set	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Conceptual design	x													
Engineering design		x												
Prototyping		x	x											
Design calibration system	x													
Calibration system commissioning		x												
Sensor calibration			x											
Cable preparation and sensor-cable calibration				x										
Installation of bottom sensors					x	x								
Installation of membrane sensors					x	x								
Installation of top sensors								x	x					
Deployment of GPs										x	x			

Installation plan

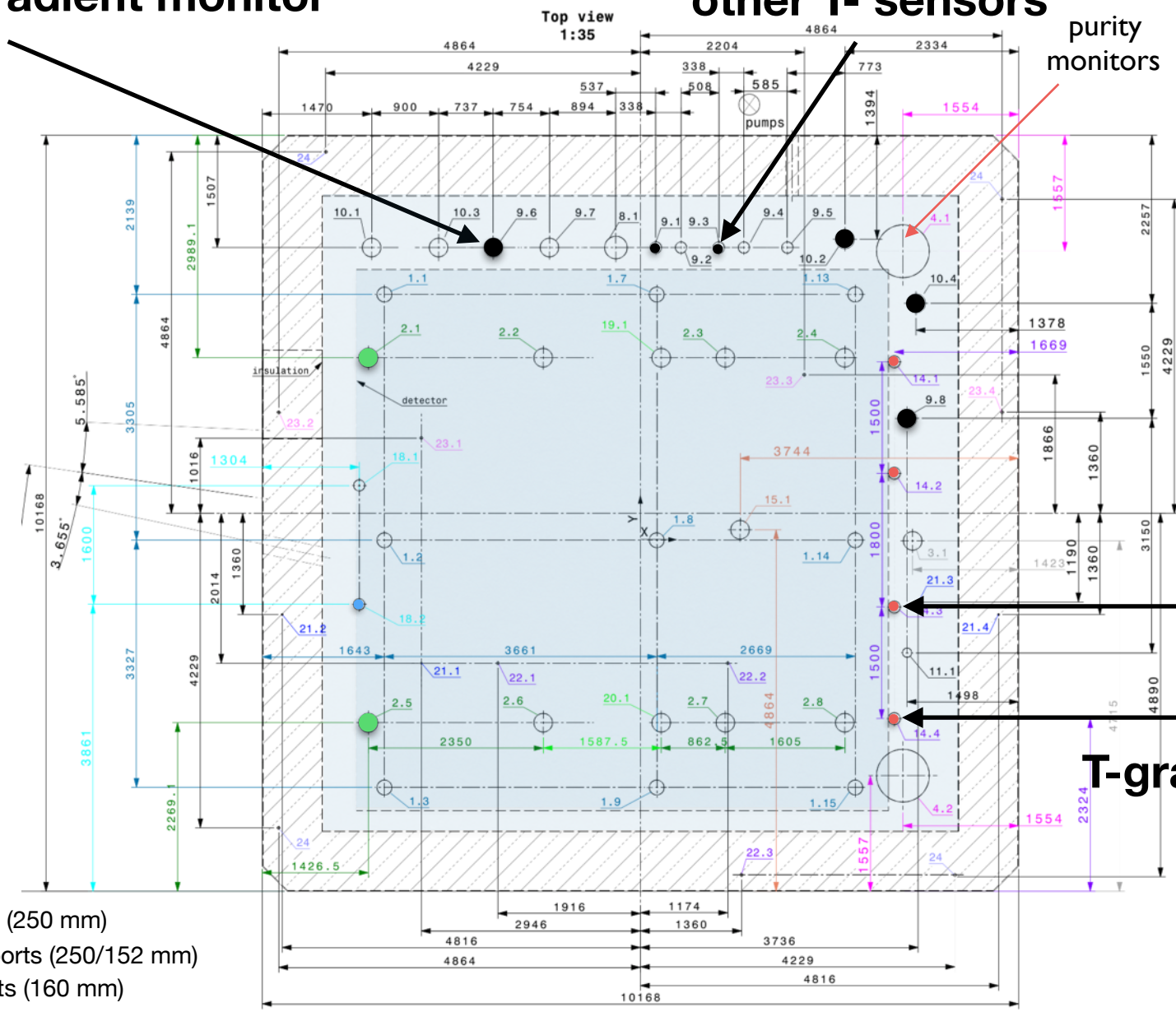
end July-Sep 27	**pipes**	● End of June, beginning of July: Pipes are mounted on the cryostat
	bottom sensors	● Install sensors (12 sensors) on the **bottom pipes** and route cables from sensors to the bottom of the vertical section of the LAr pipe
		● Install sensors on the **cryostat floor** (2 sensors)
	false floor	● Install false floor
		● Once false floor is installed the scaffolding can be used to route cables from the bottom of the vertical section of the LAr pipe to port 9.3
	wall/roof sensors	● Sensors/cables can be also installed on the lateral walls and roof of the cryostat. North cables will go to port 14.3 and south ones to port 9.3
Nov 7-Jan 5	**top GP sensors**	● For each top GP module in the clean room, sensors and cables are installed (8 sensors in total)
		● CPA/FC/GP modules are move sequentially into the cryostat. As they arrive there we route the cable to modules beside
Jan 5-20		● south GPs are rotated and cables between GP modules are tighten and routed towards port 14.3
		● north GPs are rotated and cables between GP modules are tighten and routed towards port 14.3

Cryostat ports

Hawaii T-gradient monitor

other T- sensors

purity monitors



other T- sensors

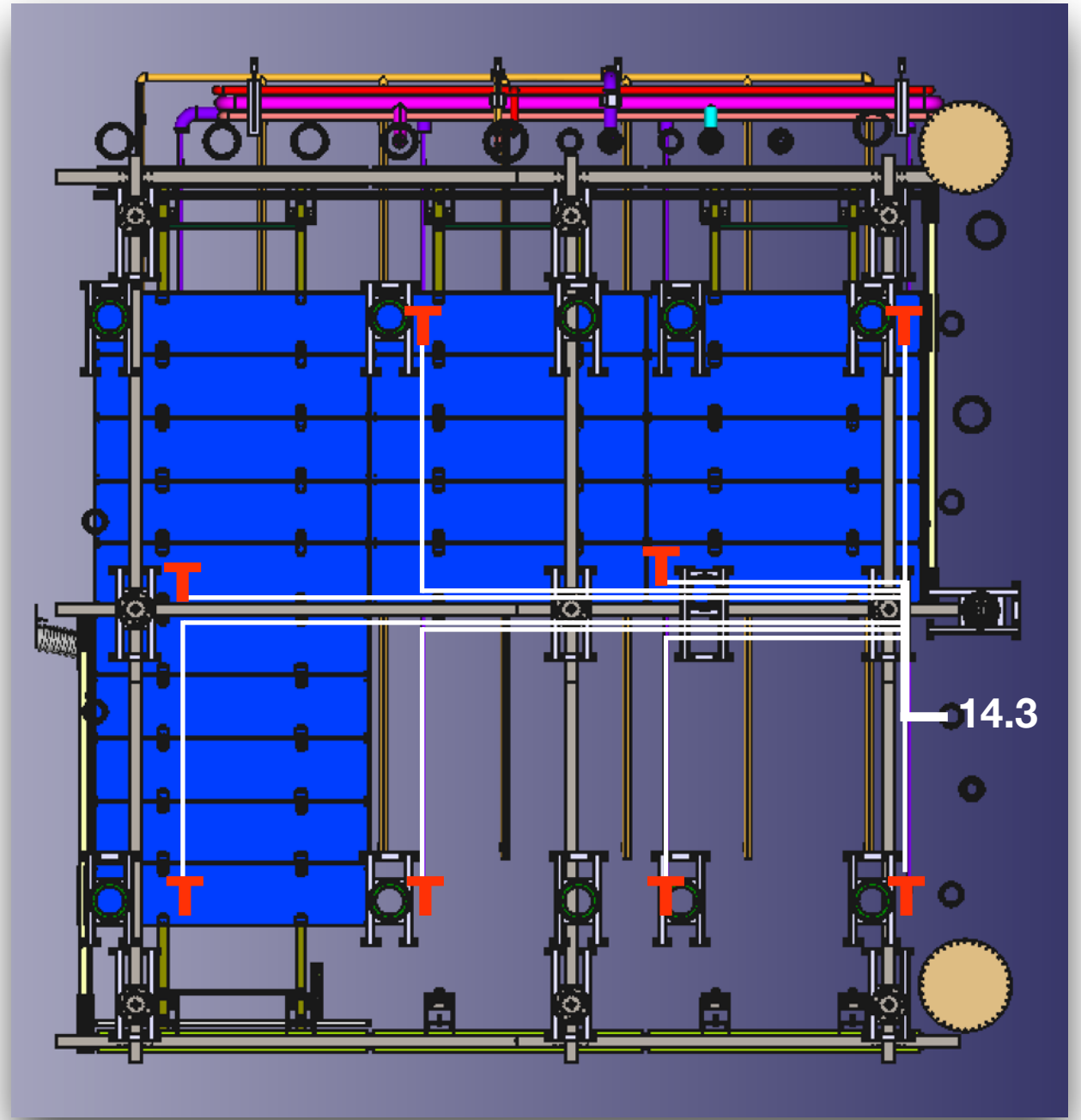
Valencia T-gradient monitor

9.1 to be shared

- Spare signal ports (250 mm)
- Spare cryogenic ports (250/152 mm)
- Unused Laser ports (160 mm)
- Spare (150 mm)

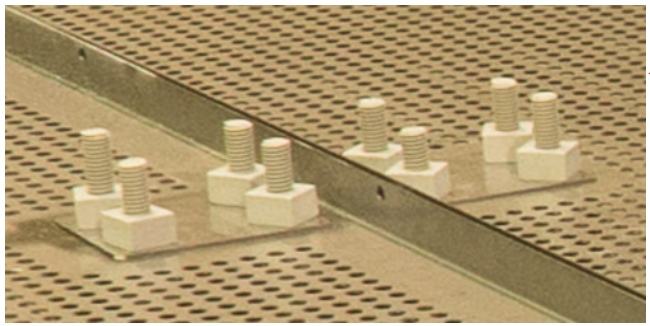
Top sensors: at the review

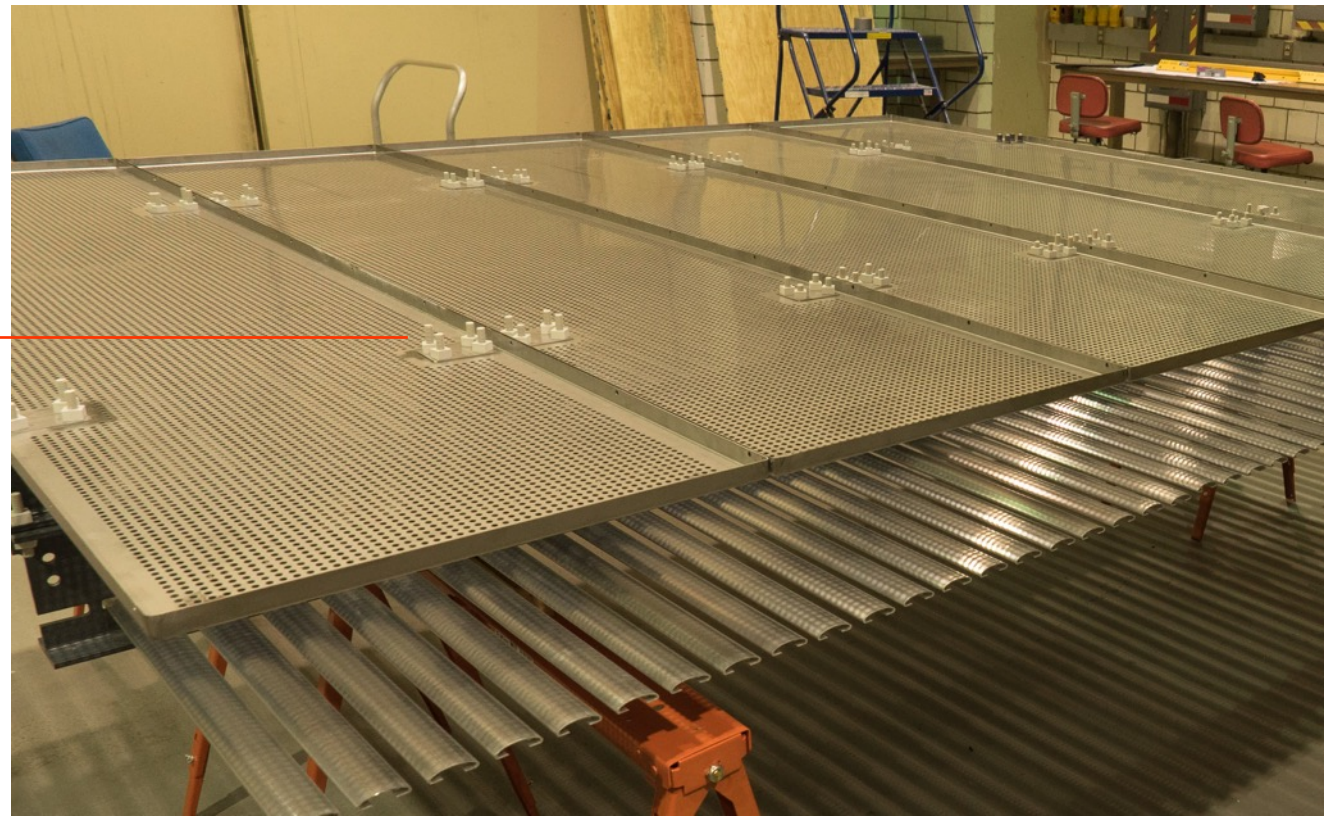
- Same map as at the bottom
- All sensors at the same height
- Need to understand system to hold the cables
- This might be an option



New information

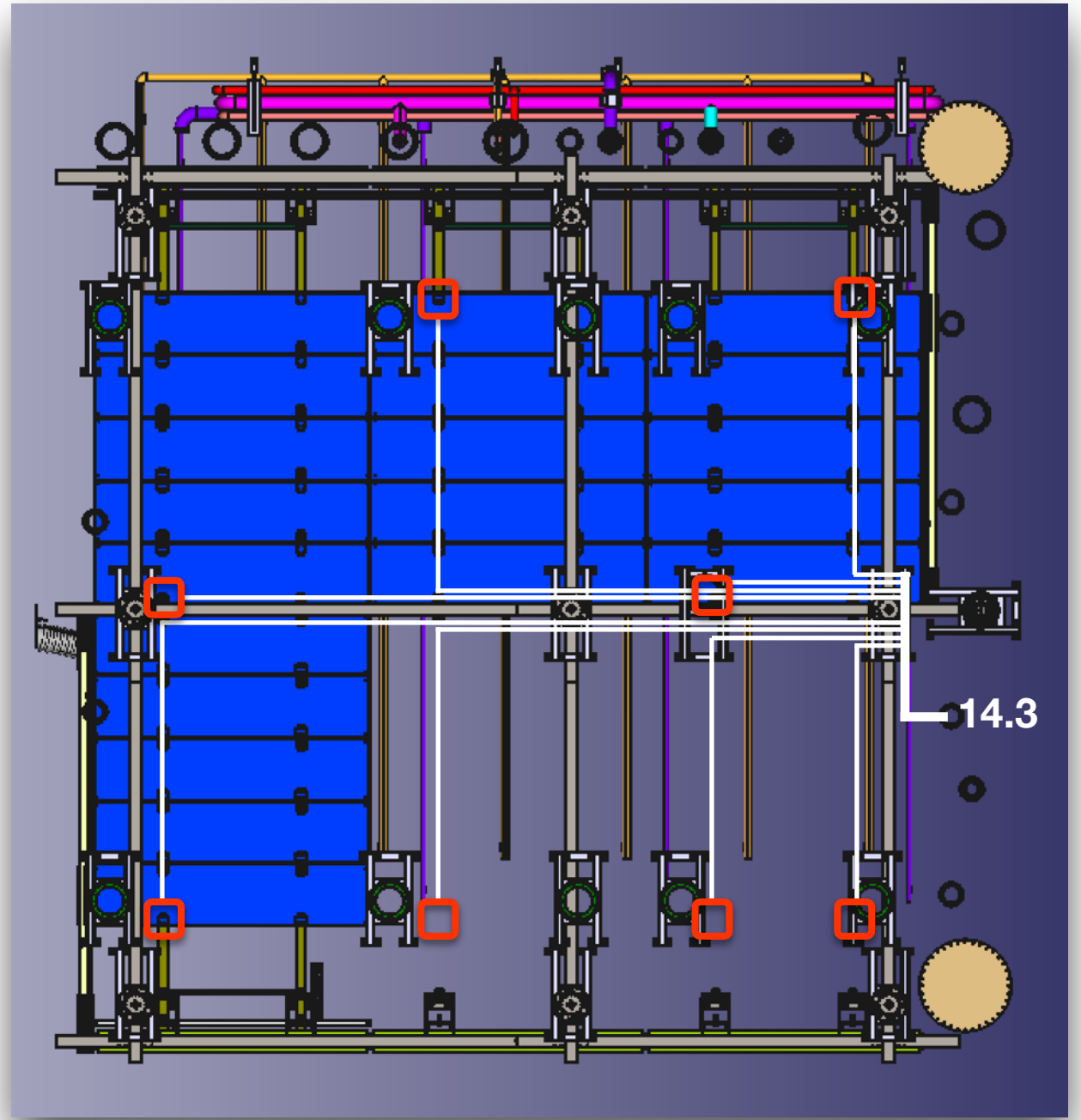
- I presented our plans for GPs at yesterday's CPA and FC meeting
  - Ground planes are all covered by holes
  - They are 3 mm think so there is no way of screwing things there
  - There are FR4 screws used to connect two GP modules (image). This would be their preferred anchoring point for sensors and cables



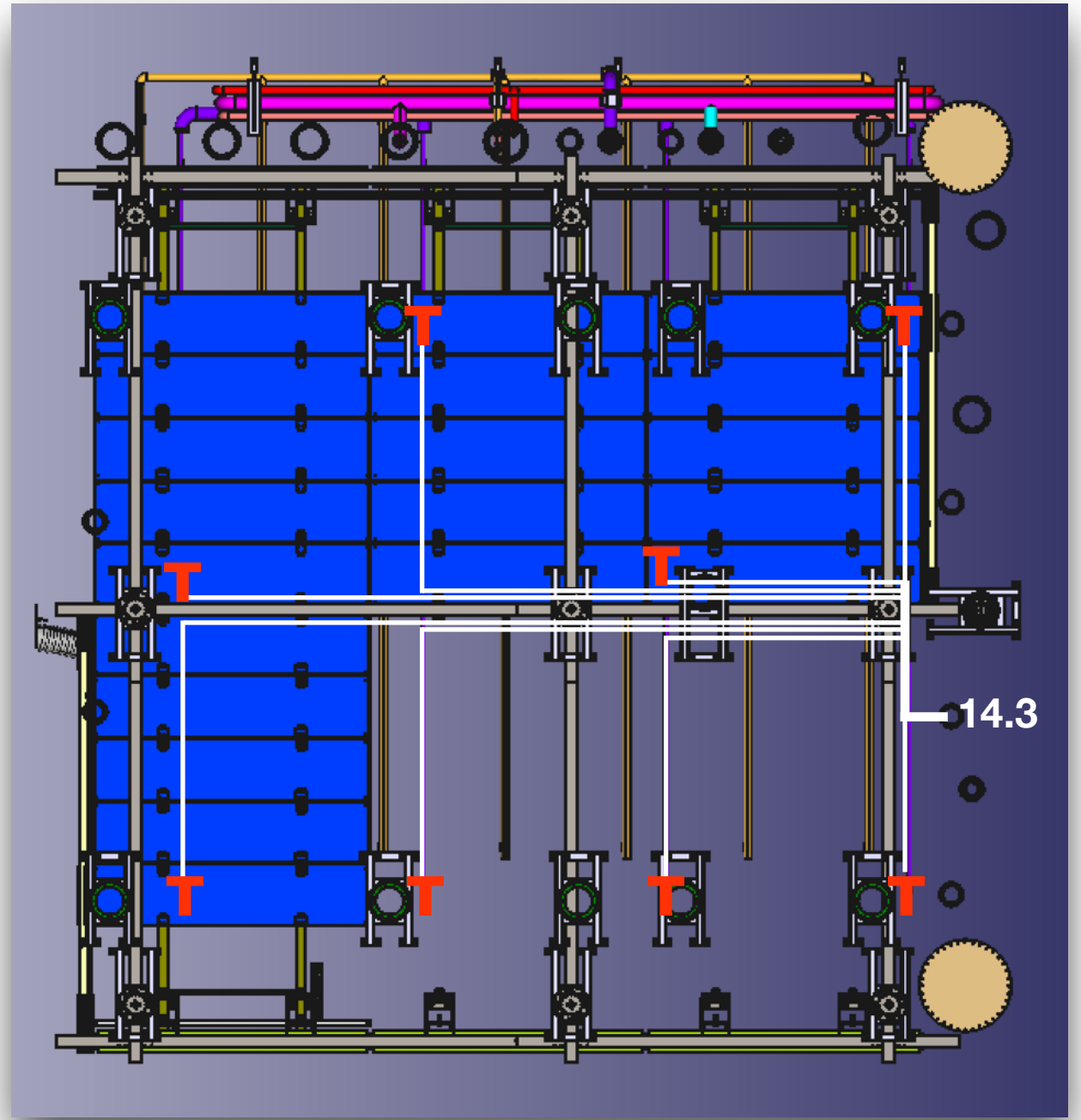


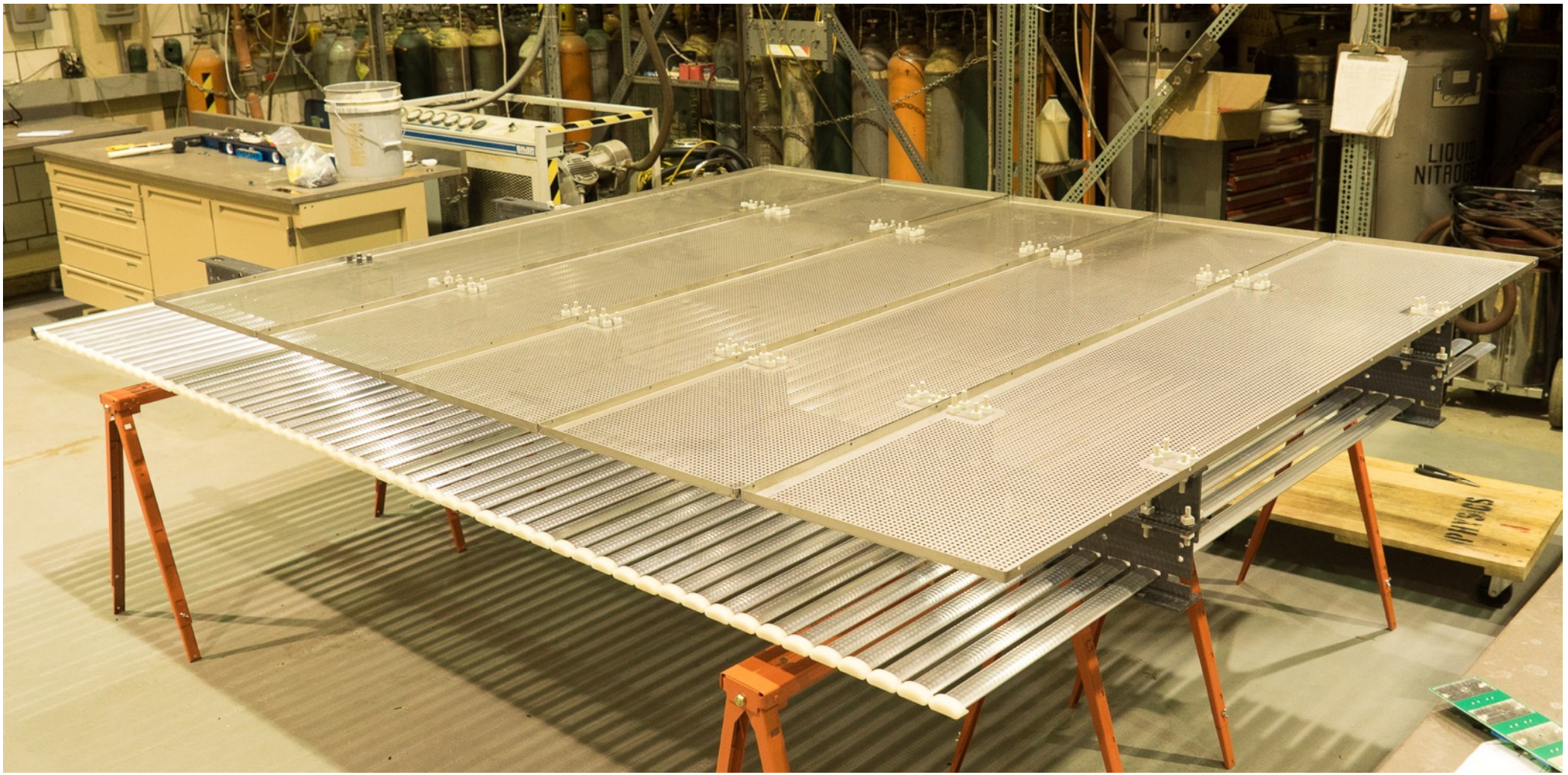
new configuration

- New configuration using the FR4 screws as anchoring point for cables and sensor's support



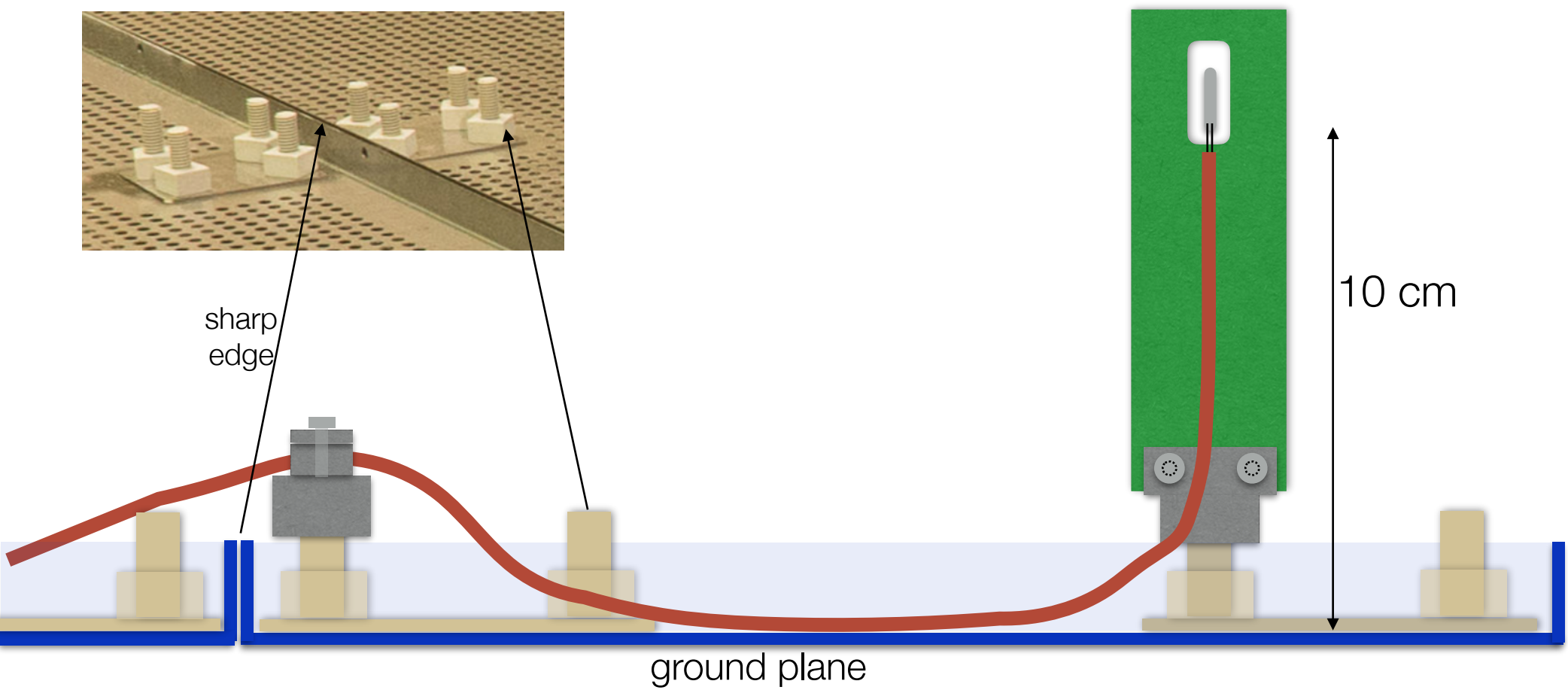
old configuration




LIQUID
NITROGEN

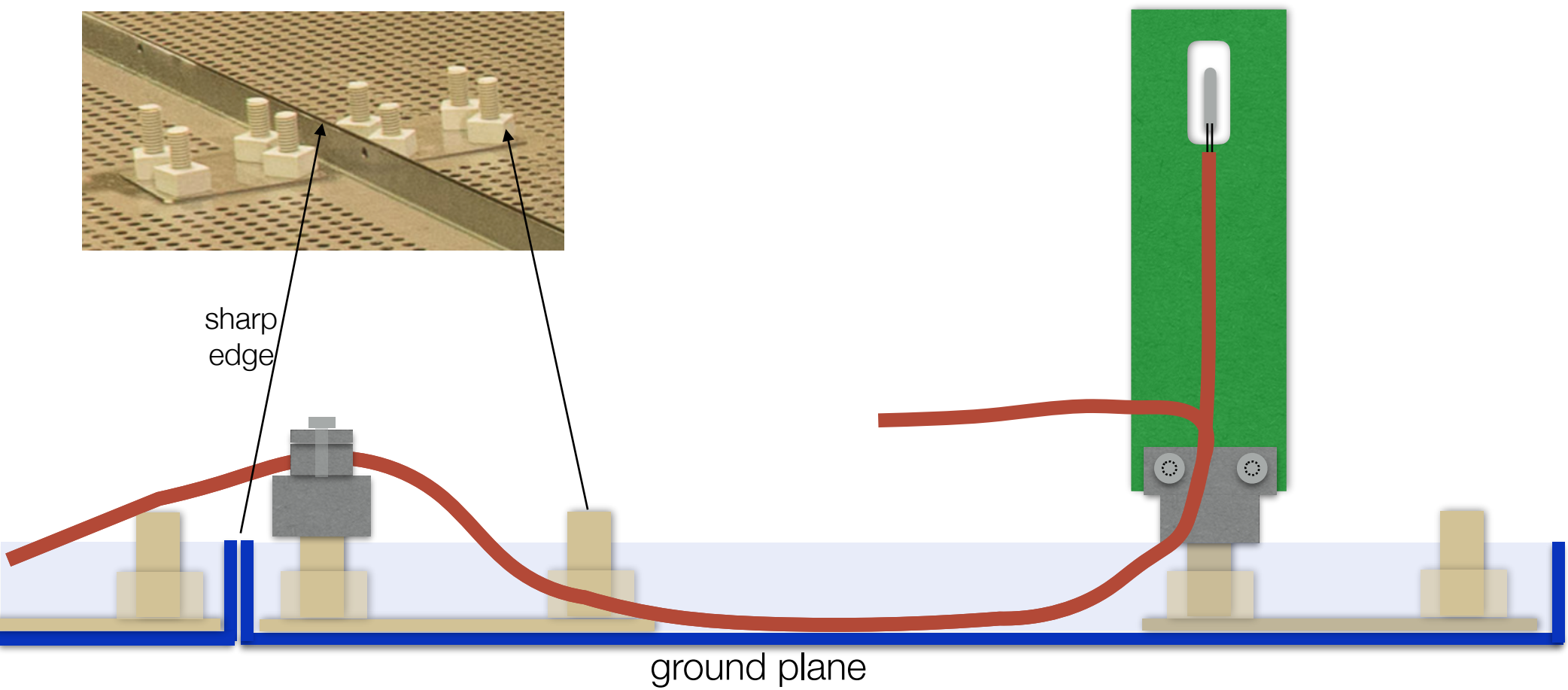
Sensor's support

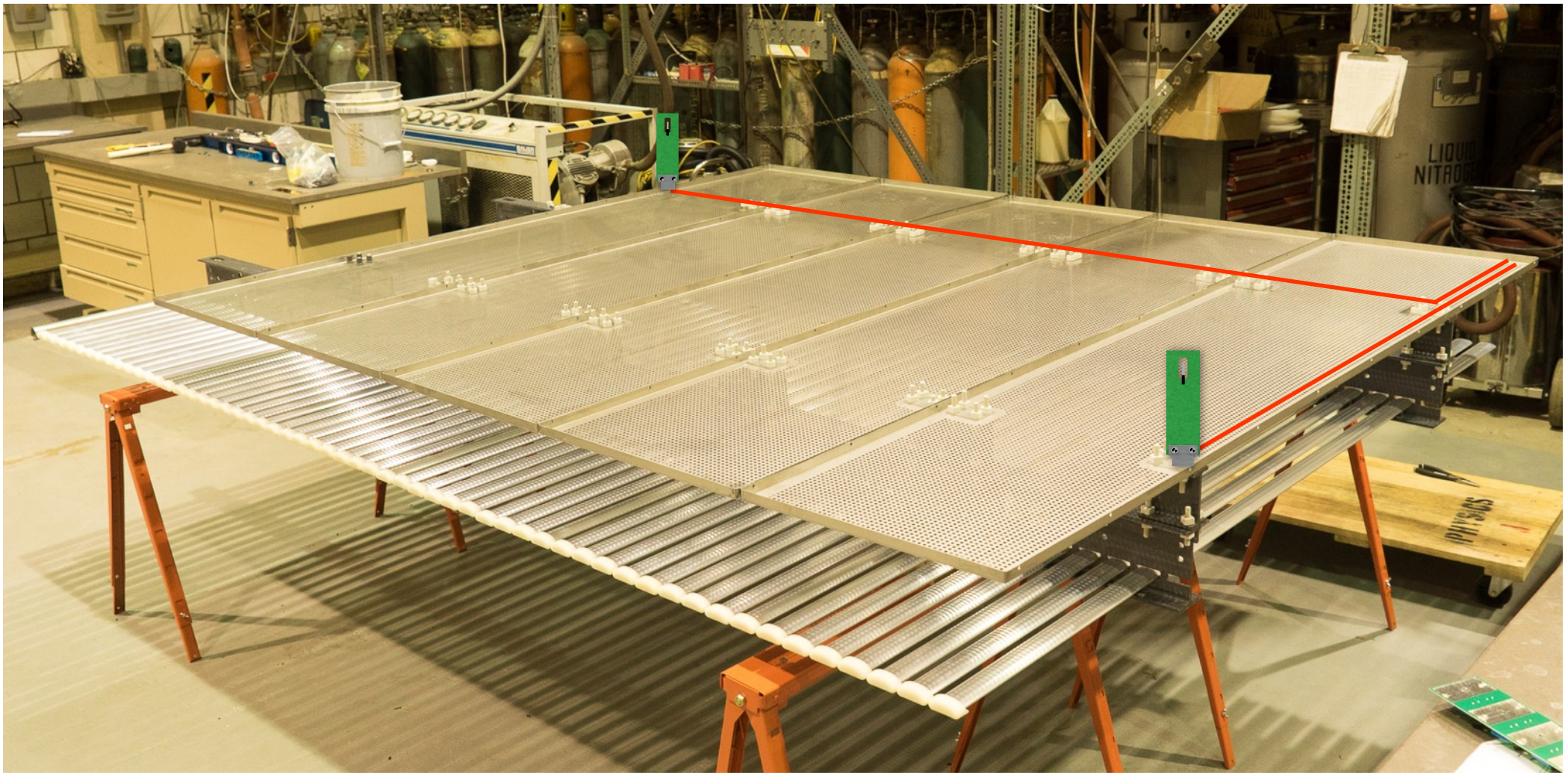
- To minimise the temperature bias produced by ground planes keep sensors at some distance from them (~10 cm)
- Must be careful with sharp edge between GP modules



TCO clearance

- It is probable that there is not enough clearance in the TCO for sensor's supports perpendicular to the GPs
- If this is finally the case we may have to rotate them




LIQUID
NITROGEN

- The edge of each plate is quite sharp. There is risk of damaging the cable. It is recommended to install anchoring points in each transition between modules