ProtoDUNE-SP integration meeting
02/02/2017

Temperature measurements

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Introduction

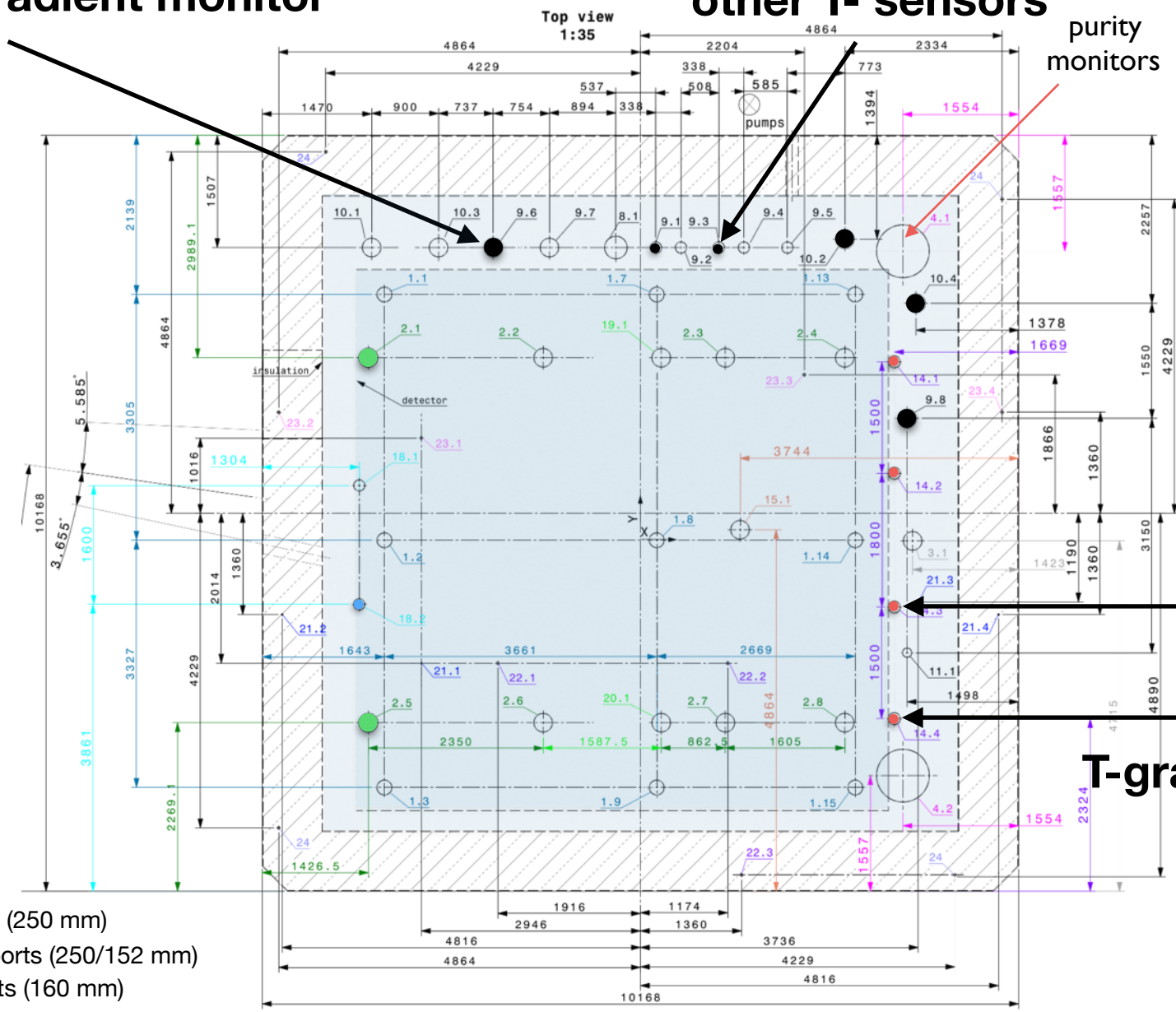
- The aim of this talk is to have some discussion about additional sensors on the APA sides and get opinions from experts
- We don’t even know whether that is desirable/possible …
- We will also discuss some possible tests in the cold box

Cryostat ports

Hawaii T-gradient monitor

other T- sensors

purity monitors



other T- sensors

Valencia T-gradient monitor

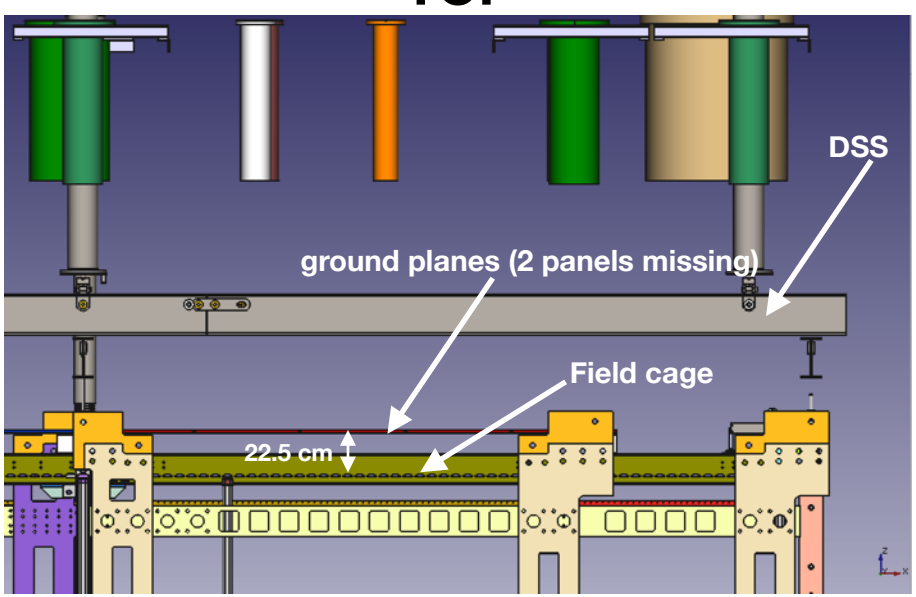
Other T-sensors

- T-gradient monitors only cover 2 fixed xy positions at different heights
- If the aim is to verify/benchmark the fluid dynamics simulations we better have some redundancy and try to cover most of the volume with sensors. However, we should take into account:
  - benefits of additional sensors
  - extra cost
  - risks: noise, mechanical complications, cabling, etc
- It is not yet clear how many additional sensors will be installed and where. For the moment we are trying to identify **mechanical elements** where those sensors could be attached to
- We could use ports **9.3** and **14.3** to extract the signal from those additional T-sensors
  - Ideally the same ports for the cameras

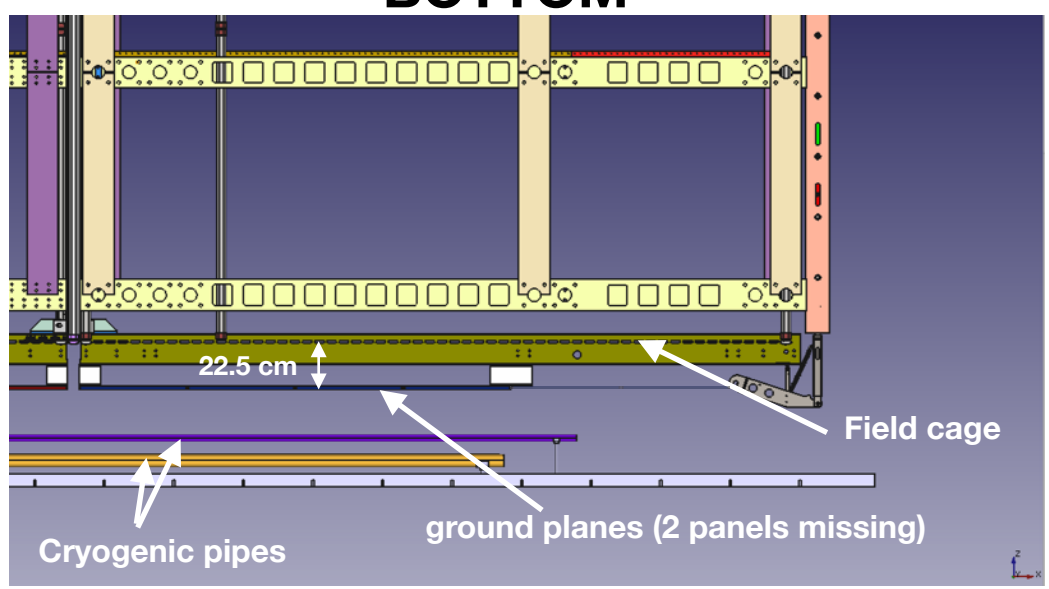
TOP and BOTTOM

- Relatively easy since we can use the ground planes
- To avoid thermal interference put the sensors at some distance (~10 cm) from the ground planes
- According to linda there should be no problem in screwing few supports
- We are certainly talking about <20 sensors (top+bottom)

TOP

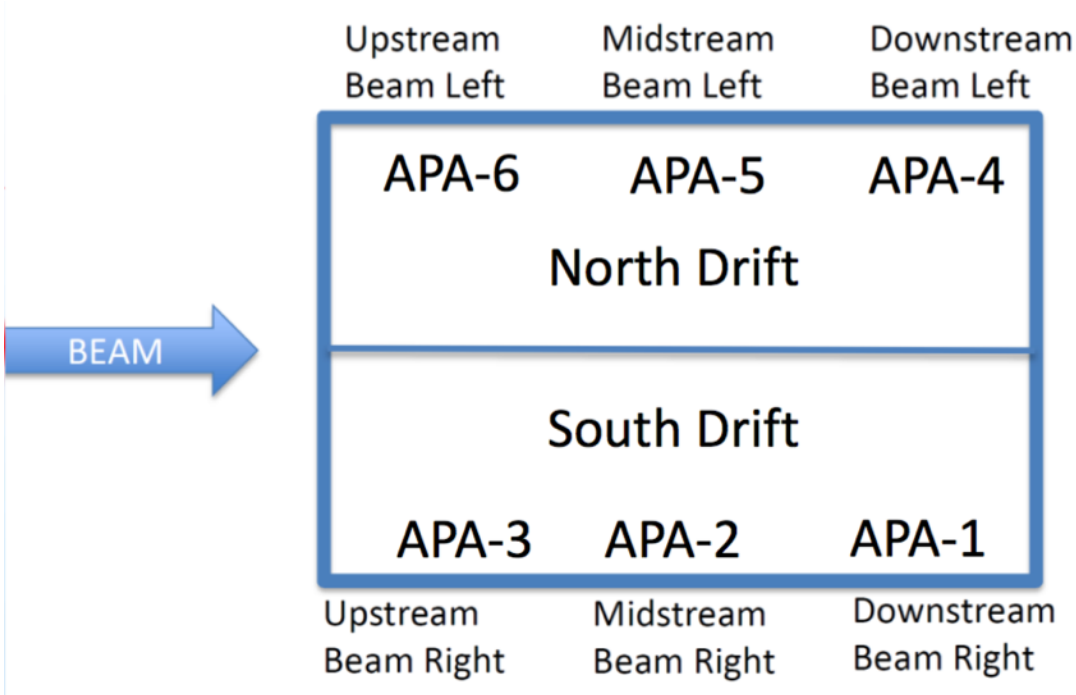


BOTTOM



SIDES

- FC End-Wall sides very complicated:
  - We would need E-field shielding for sensors and cables. Probably an overkill
- APA sides:
  - APA frames: In principle there is only space to attach things on the corners
  - Cryogenic pipes in north drift



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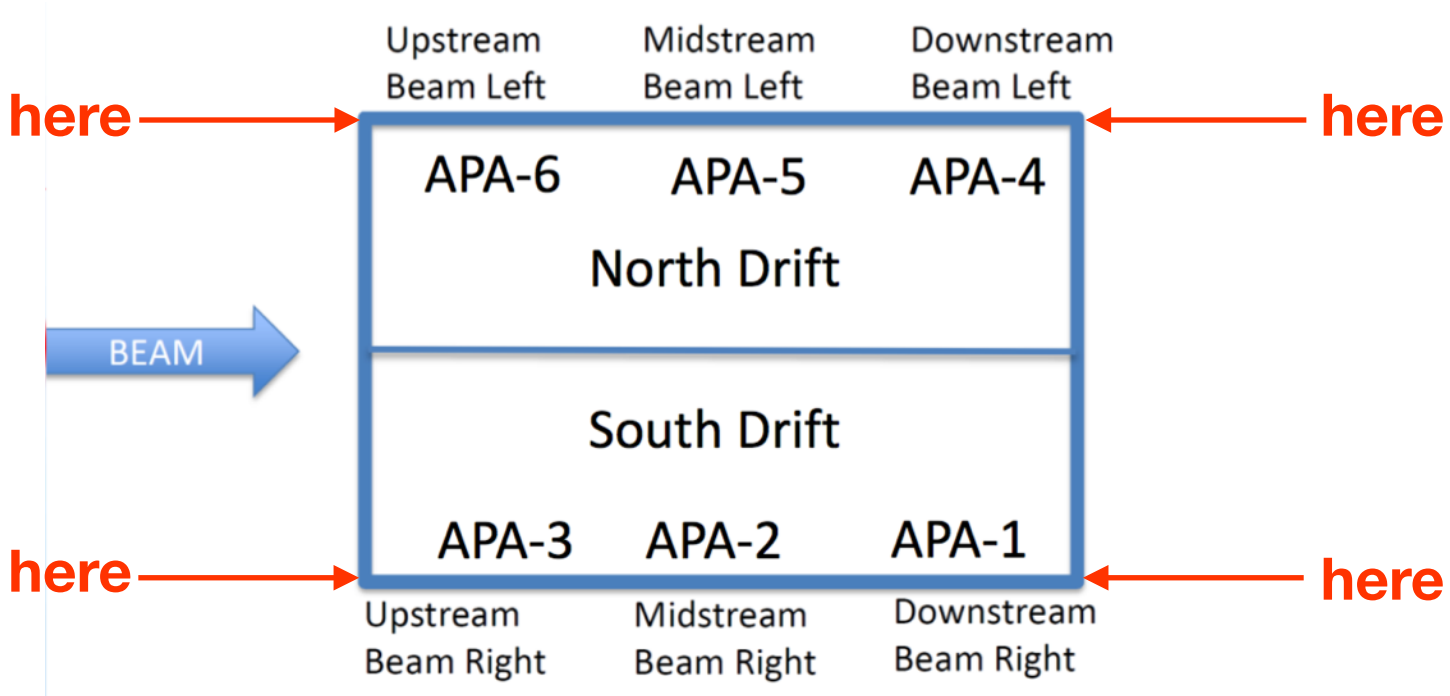
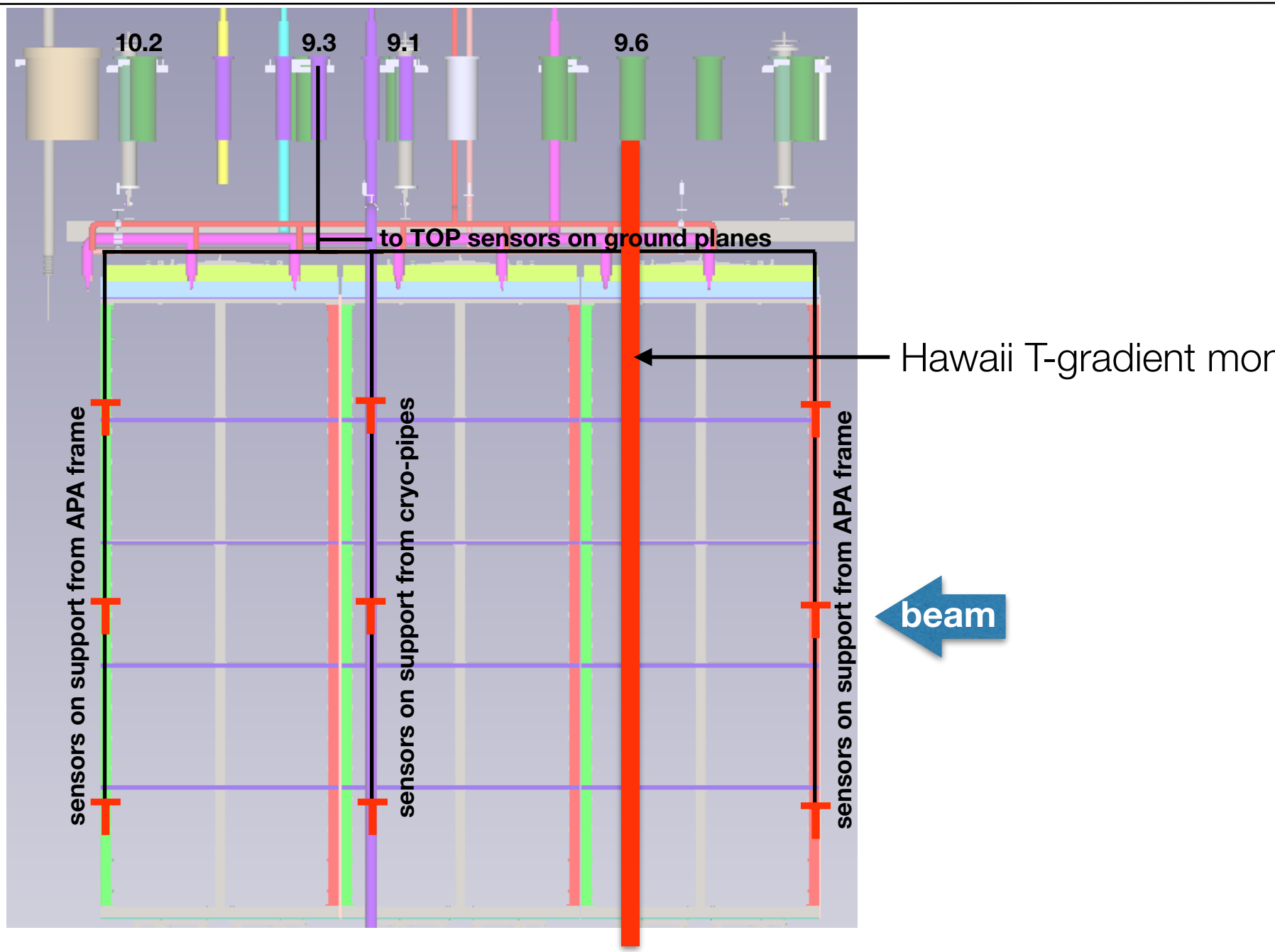
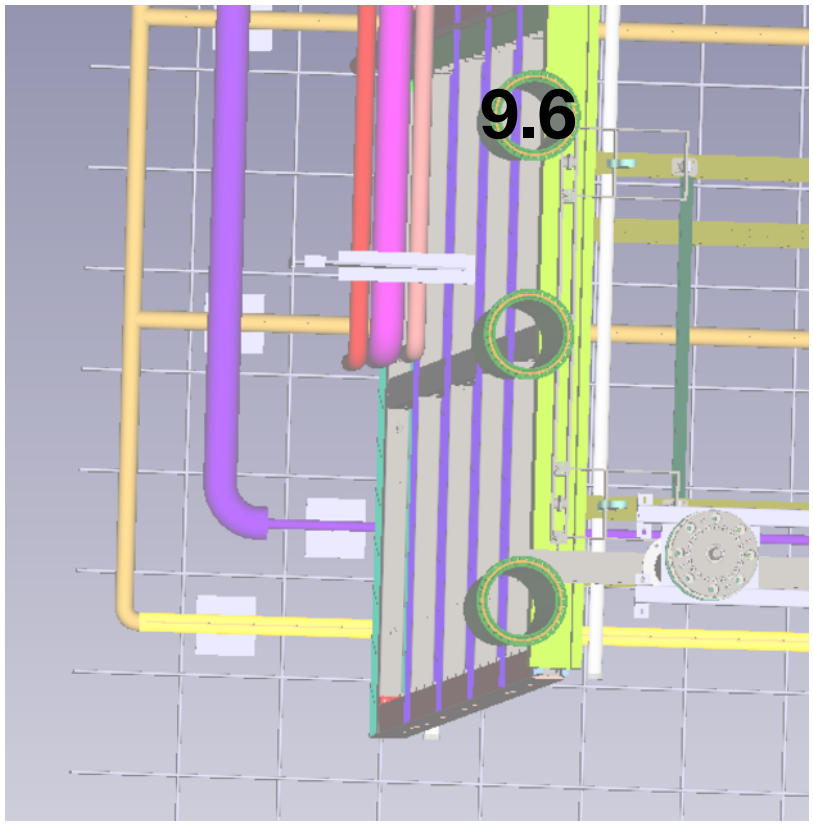
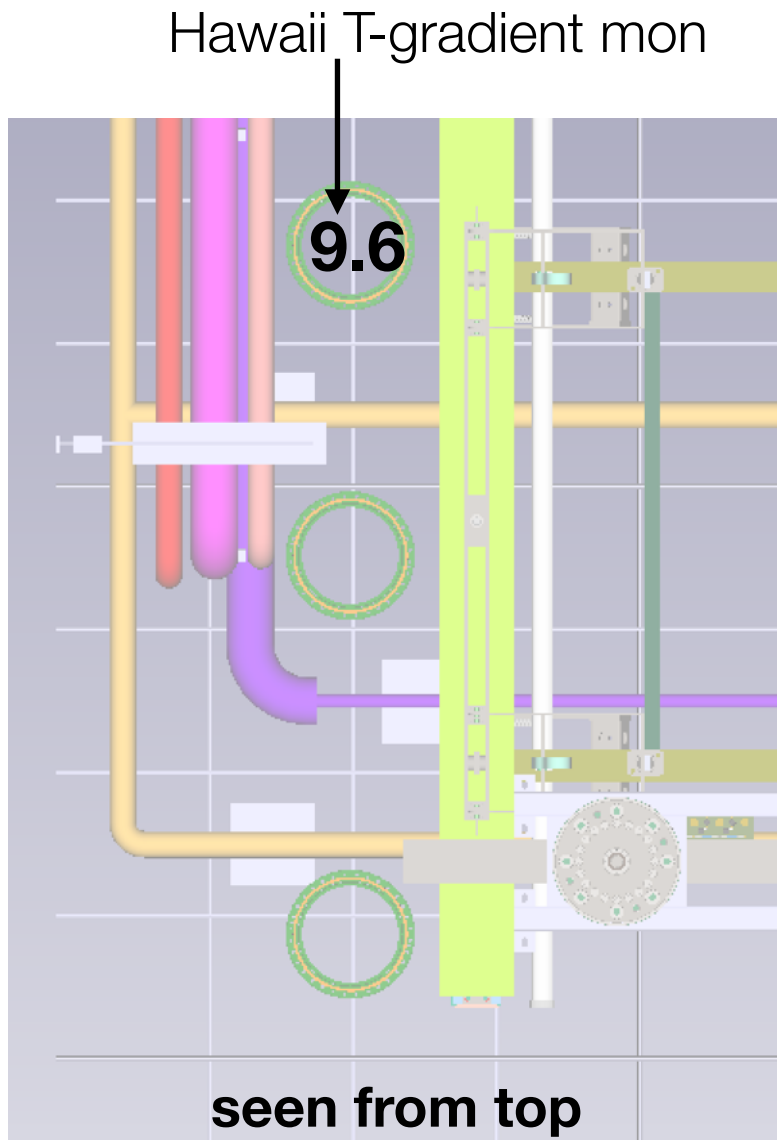


APA-north side



- Can we screw something to the APA border ?





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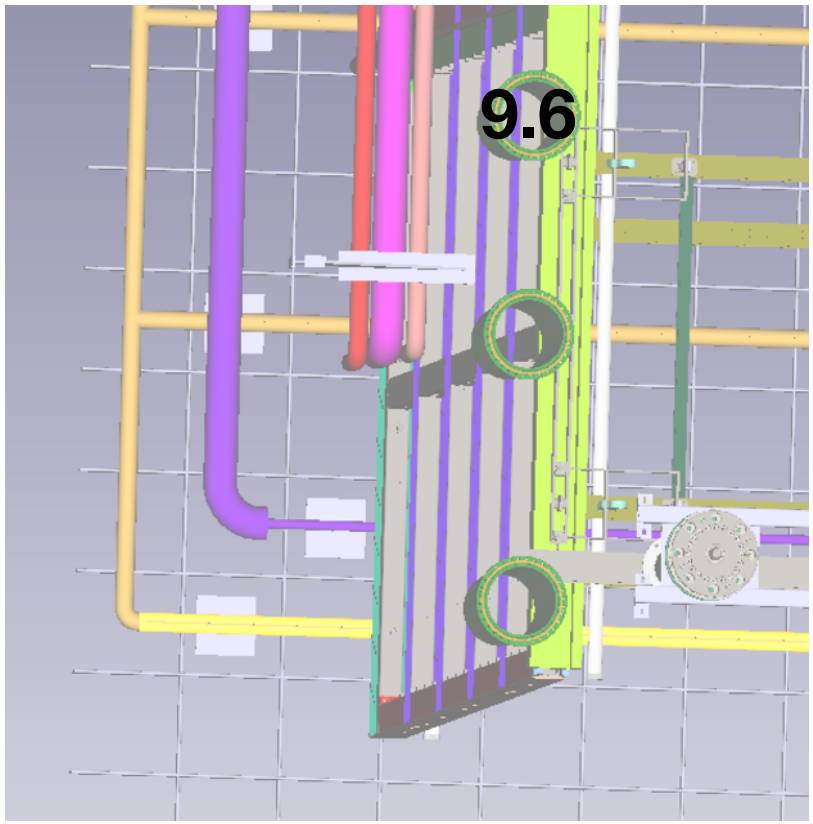
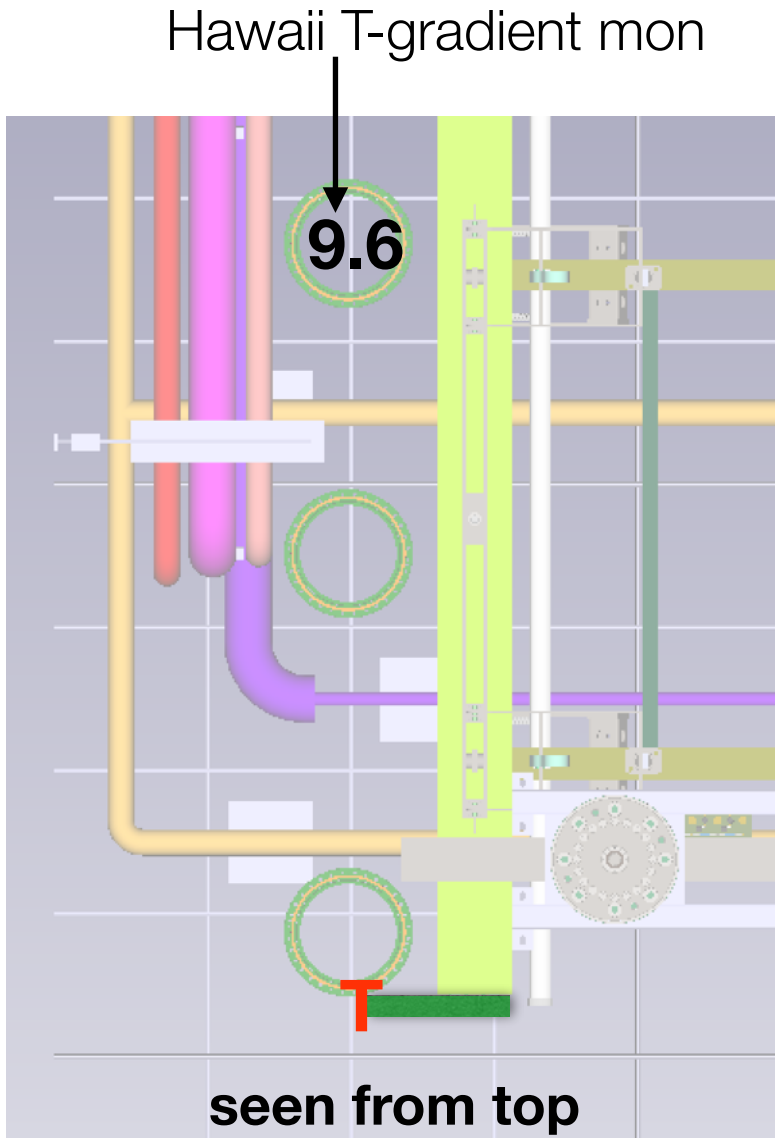
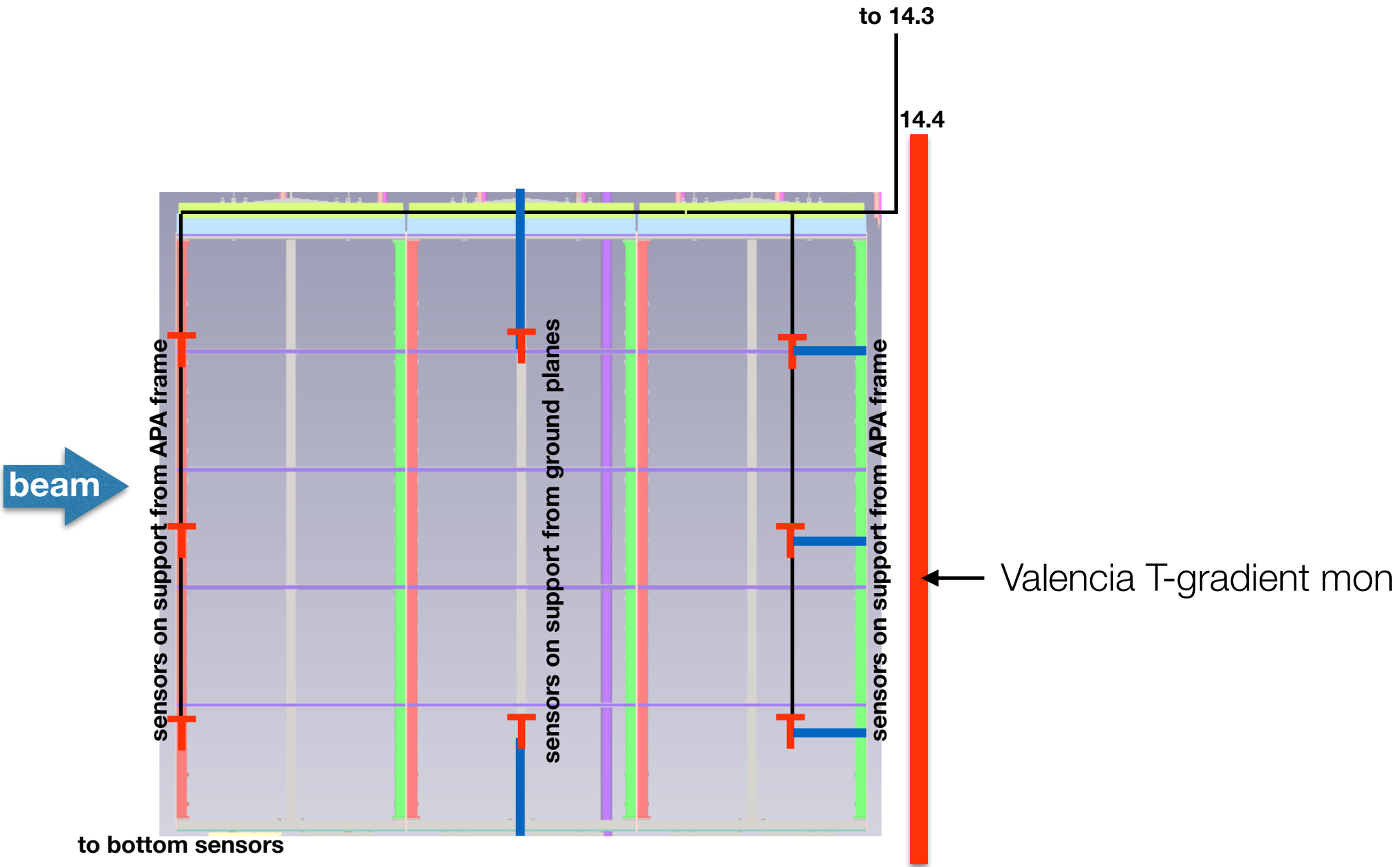
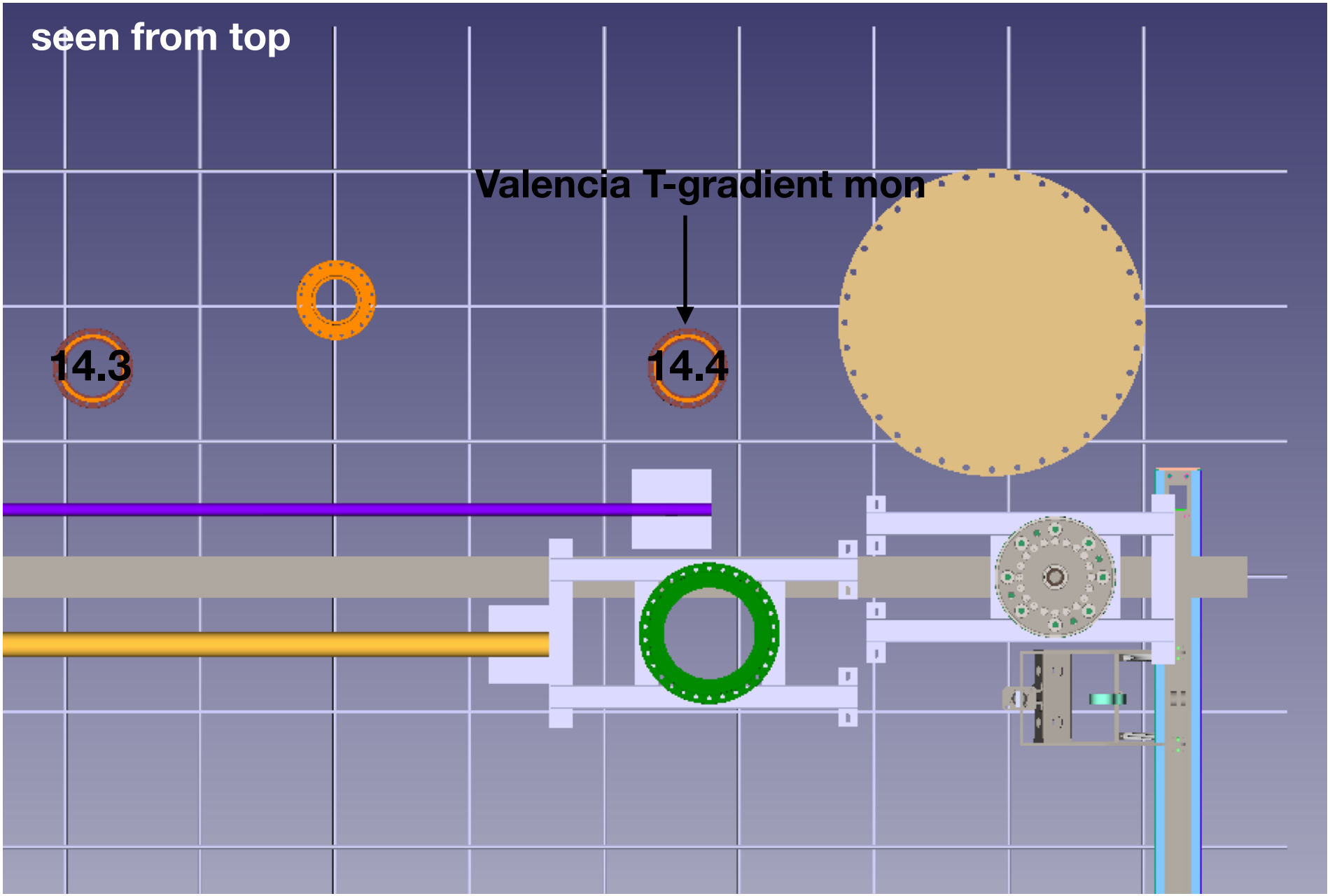
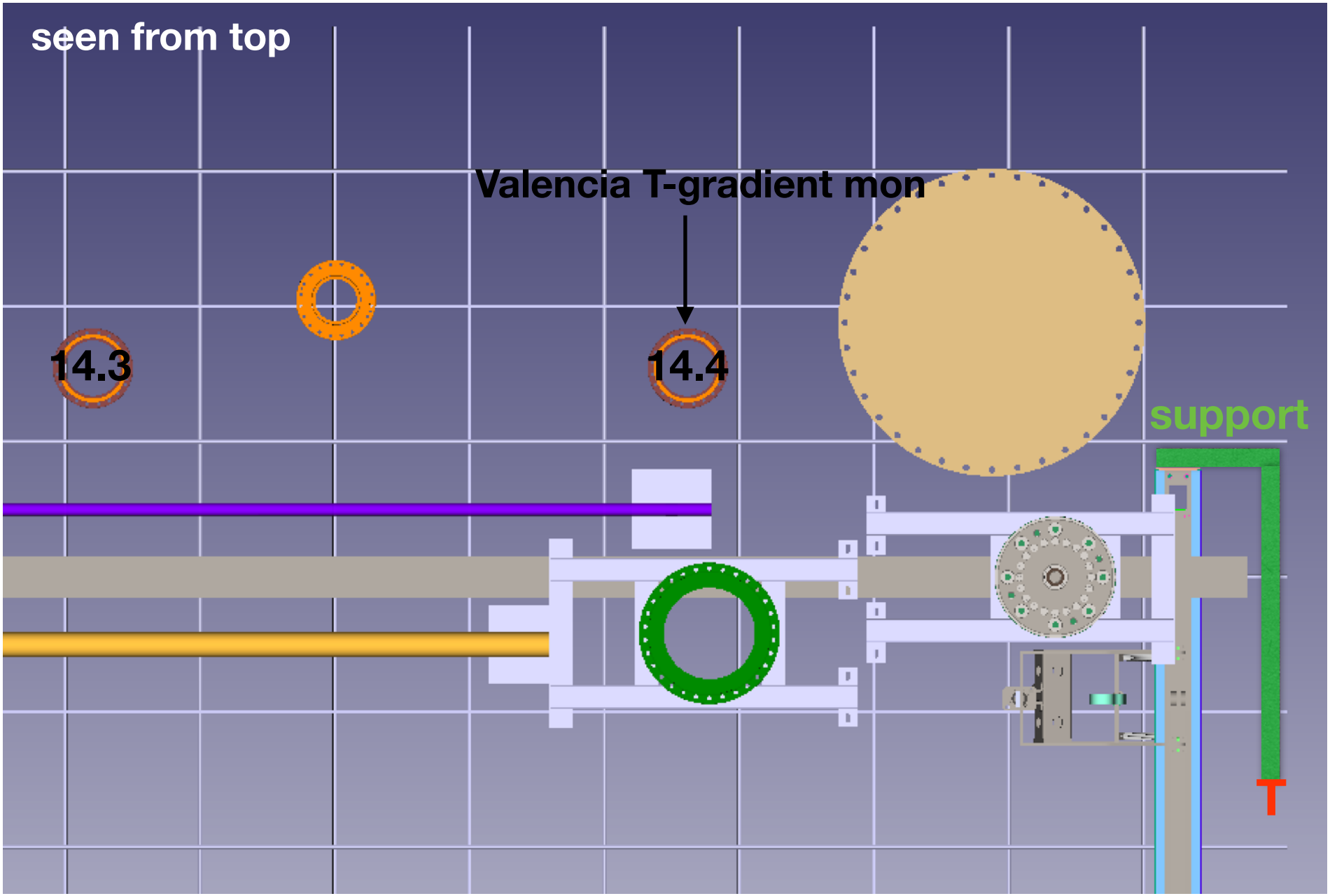




APA-south side




seen from top
Valencia T-gradient mon
14.3
14.4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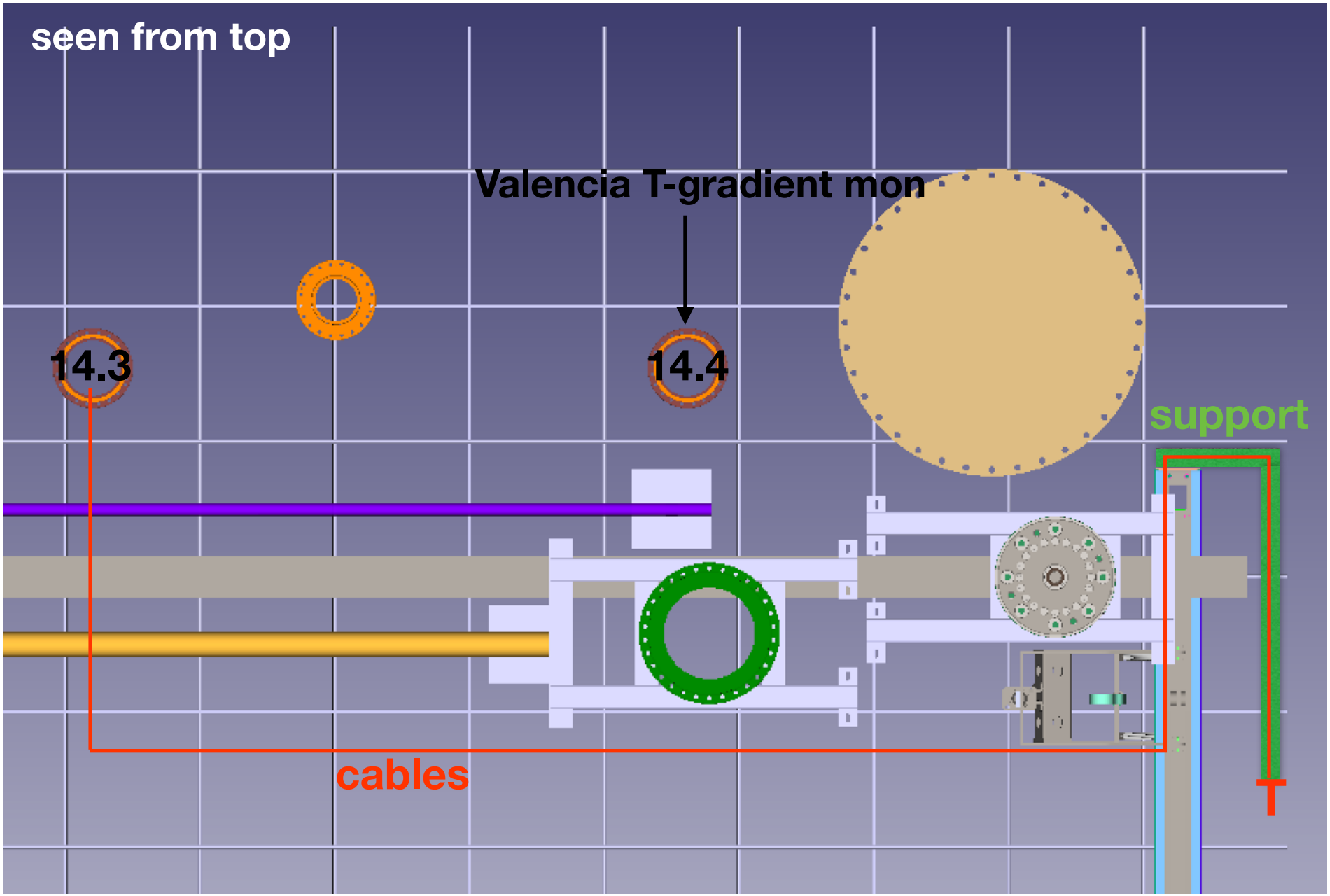
14.3
14.4
support
T


seen from top
Valencia T-gradient mon
14.3
14.4
support
cables
T

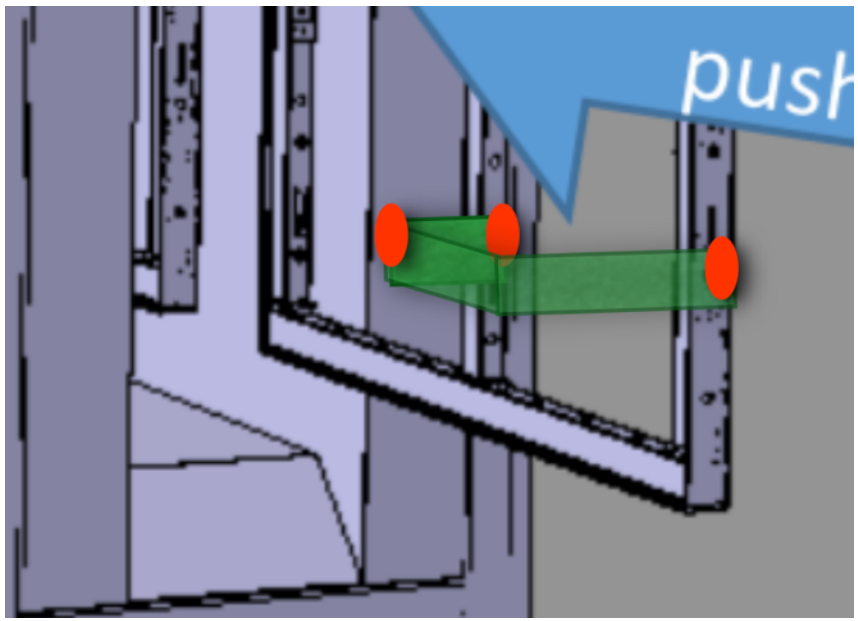
elements to consider

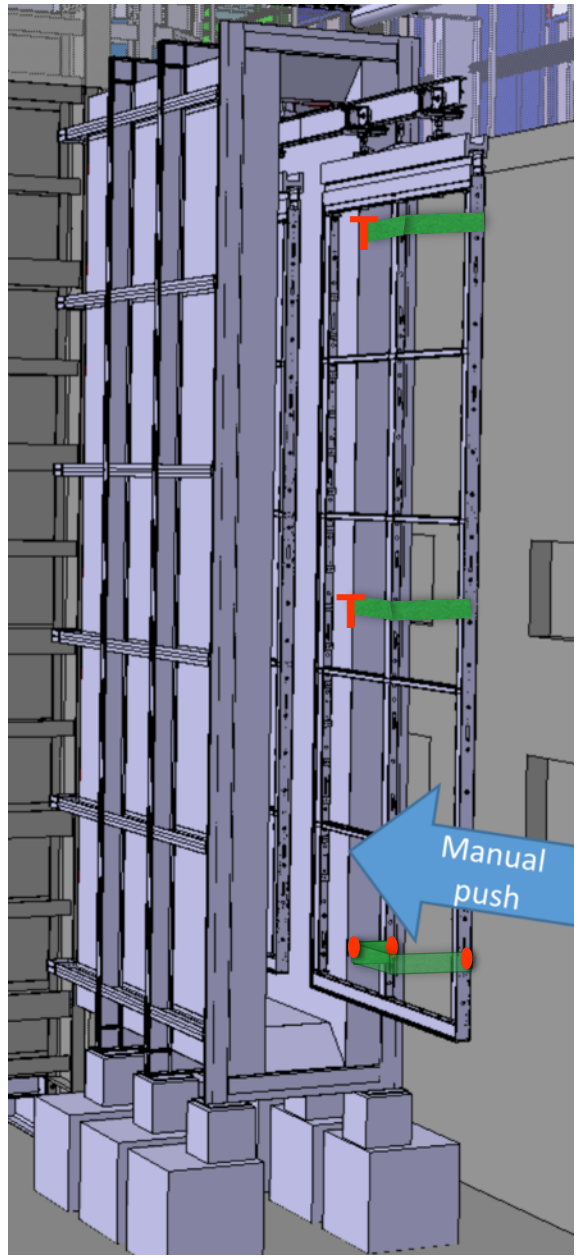
- Under discussion whether to install few sensors in the APA frame (**touching the frame**) to test behaviour during **cool-down process** (at least in the first APA)
  - There is a risk of introducing noise that we should understand
  - but notice that this will be used only during cool down and warm up, when TPC readout is not expected, so there should be no problem
- We should also understand wether using the frame to hold sensors at some distance (~10 cm) is possible or not
- There is an option of testing both things at the **cold box** (ongoing discussions with Andrea Zani et al.) by installing few sensors and cables at different distances from the APA

Cold-box tests motivation

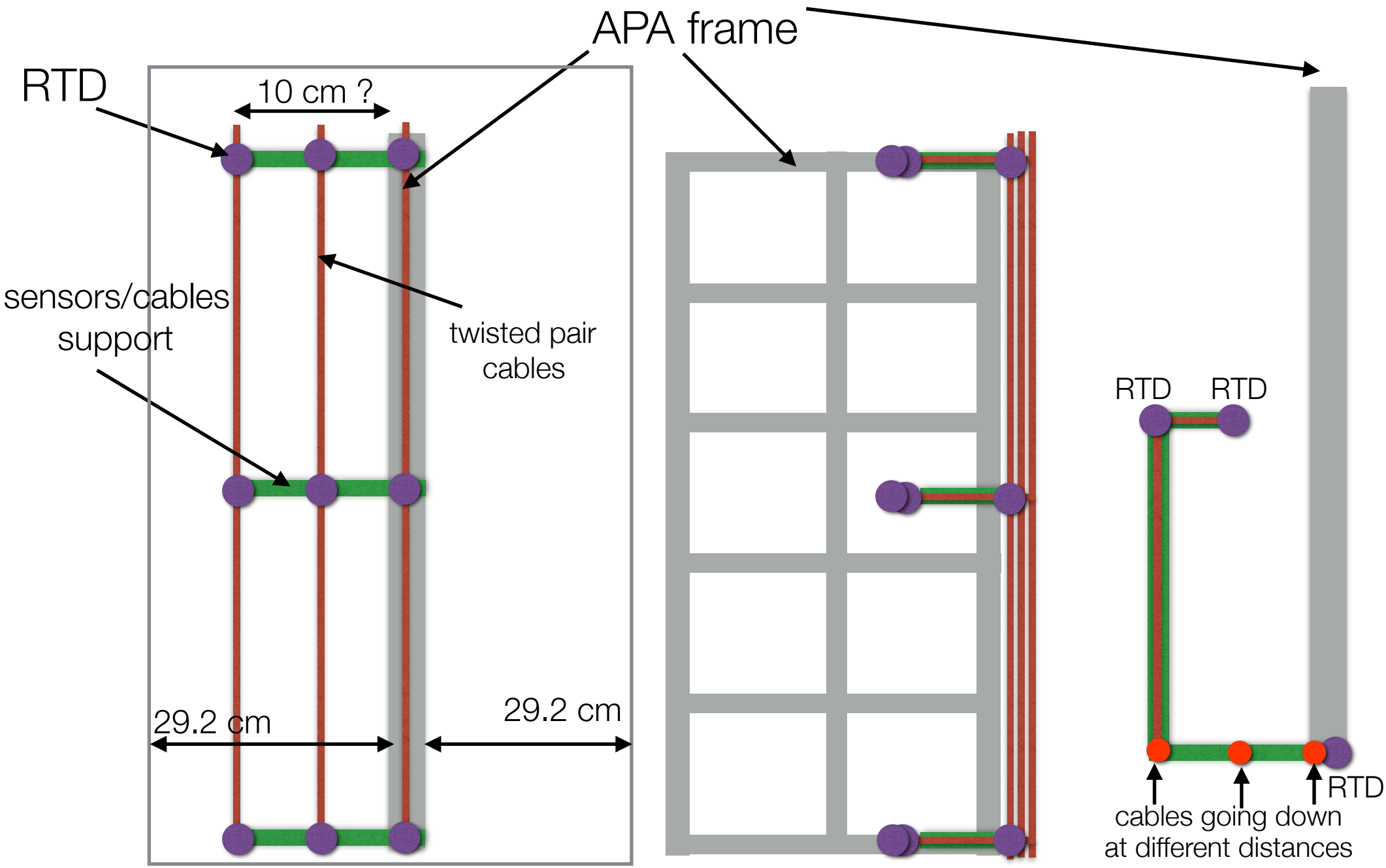
- Cold box monitoring
  - 1k precision needed
  - Sensors at different heights
- Test the full chain for temperature readings of ProtoDUNE
  - **Same sensors**: We can buy them now and reuse them later in ProtoDUNE
    - We could use uncalibrated sensors (1K precision, 100$ each)
  - **Same cables**: teflon jacketed twisted pair ribbon(?) cables
  - **Same readout electronics**: NI + current source by Xavier Pons (Lehman's team). To be reused later in ProtoDUNE
- Test noise induced in APA frame by sensors and cables:
  - Install sensors/cables at different distances
  - Switch on one set of sensors (at a given distance) at the time and check noise

- Sensors would be installed near the open side
- May be a U-shape support with three sensors at different distances:
  - one touching the frame
  - another one at 5 cm
  - another one at 10 cm



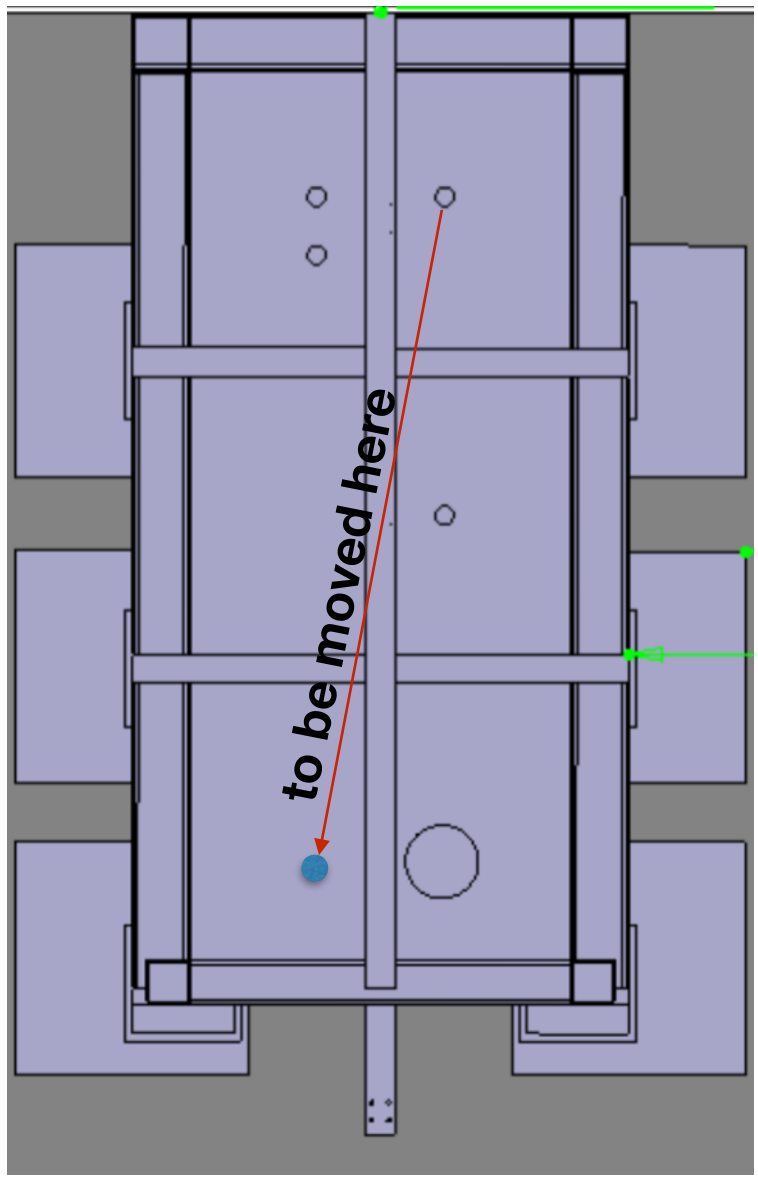


Possible configuration



Cold-box ports

- ⌀63 mm chimney but could have a ⌀100 flange if needed
- A single SUB-D 50pin connector should be sufficient for 12 sensors



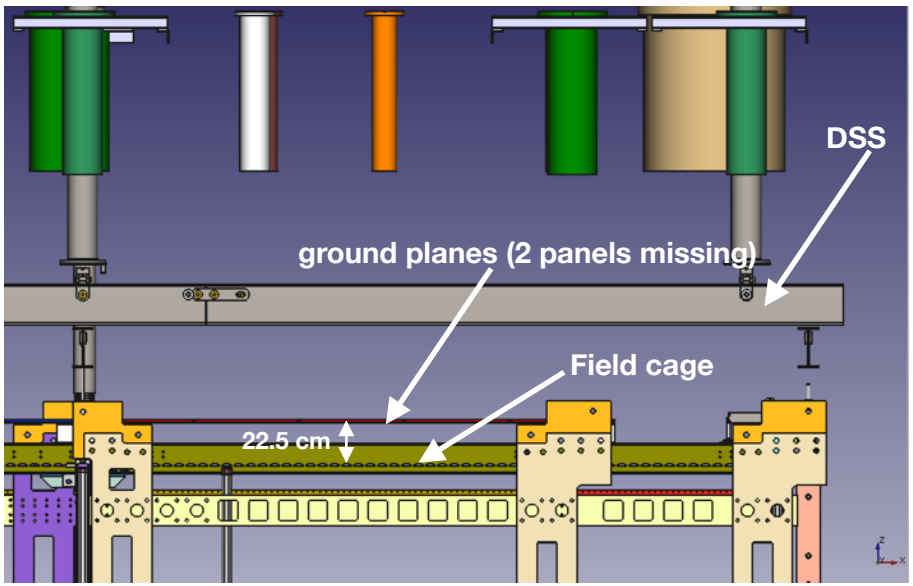
Schedule

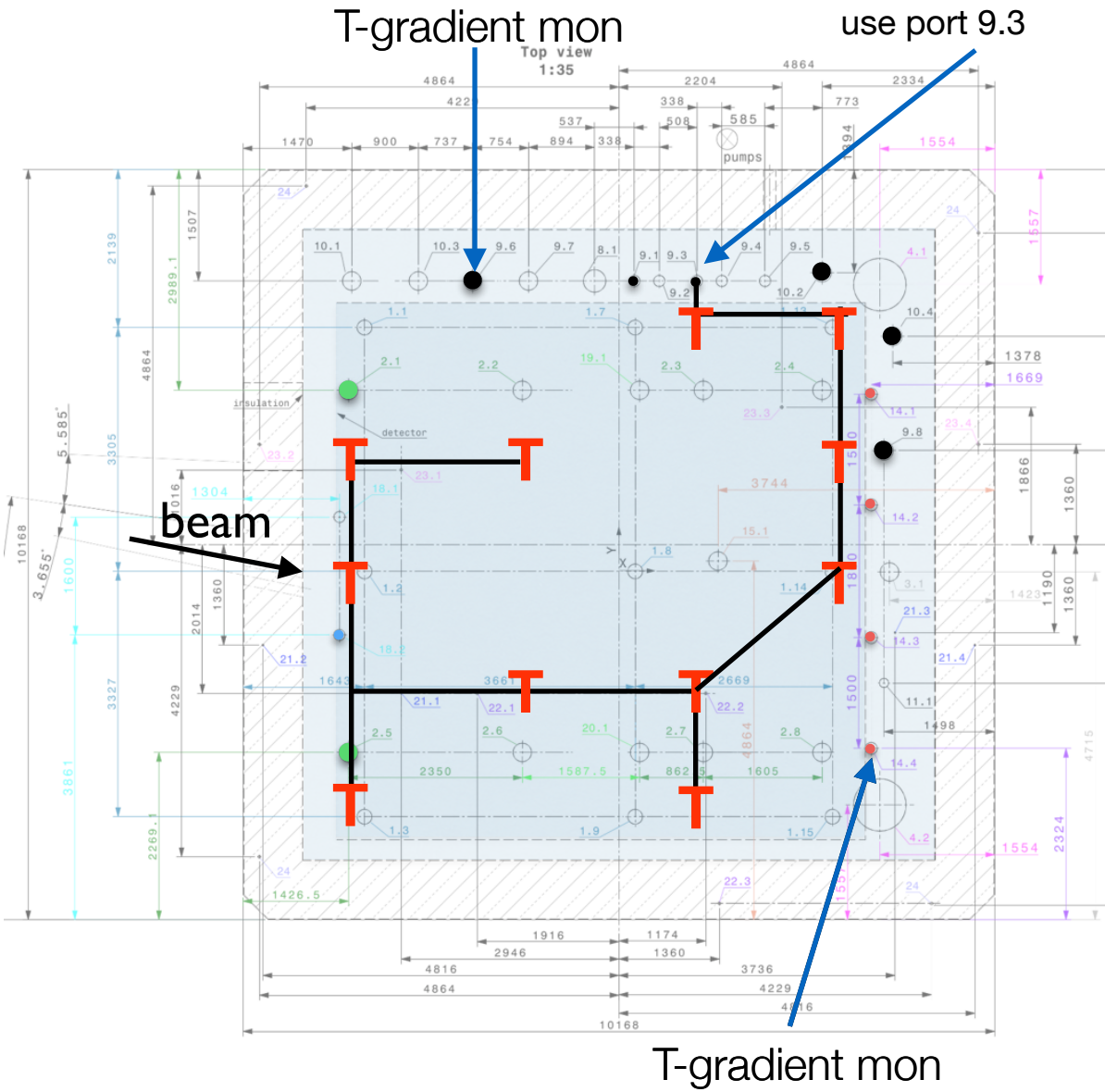
- In the case it is finally decided to do those tests in the cold box
  - Is it mandatory to have the system ready for the first APA (end may) ?
  - Os can we wait for the second APA (end august) ?

backup

TOP

use ground planes





LAr

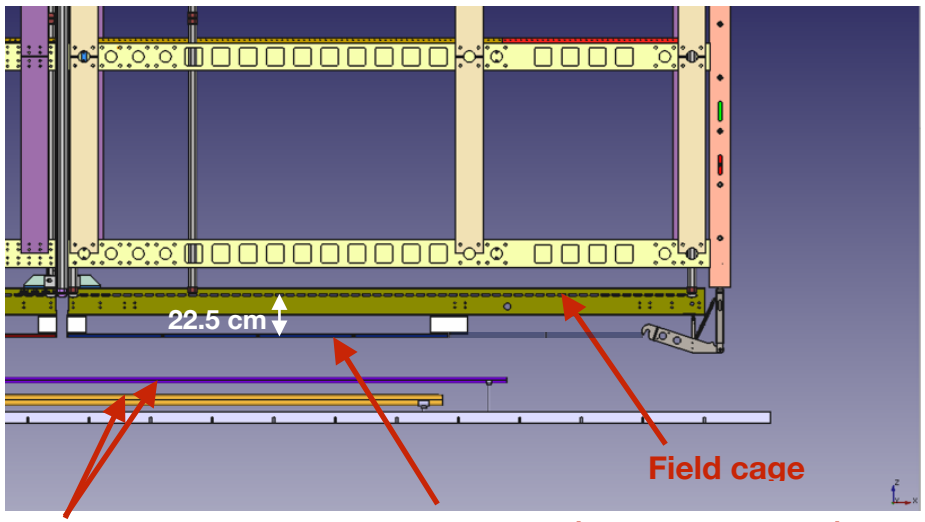
FC

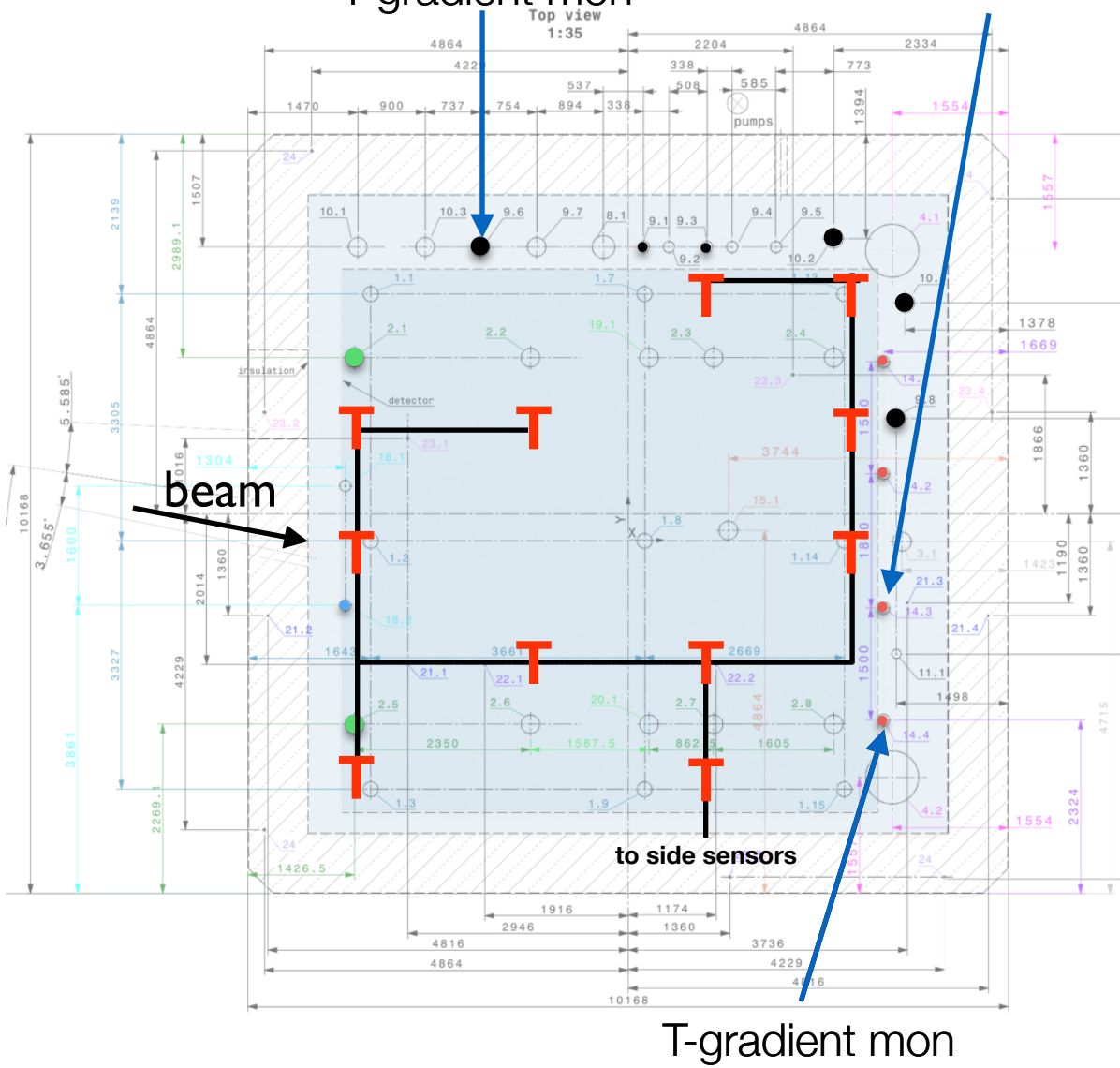
9.1 to be shared

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

BOTTOM

use ground planes





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