ETO Task Force

Regular Meeting 03/02/2025

Tower Access Options

ISB – Vacuum and Cryogenics – Tower Vacuum

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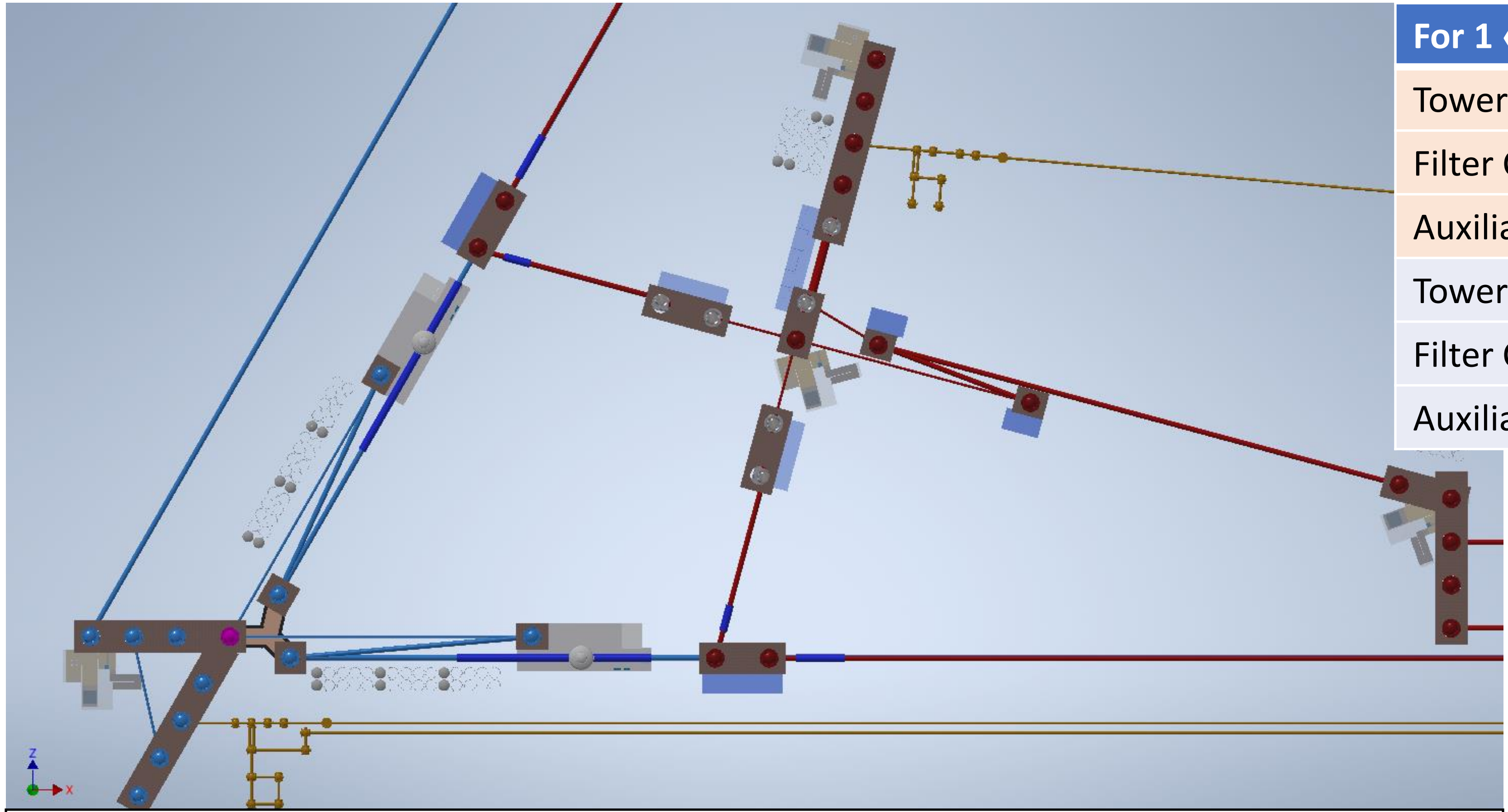
Introduction Tower Vacuum



Case of the Triangle layout, but applicable to the 2L layout

For 1 «corner»	
Tower HF	31
Filter Cavity «SQZ» Tower HF	12
Auxiliary Bench in Vacuum HF	20
Tower LF	22
Filter Cavity «SQZ» Tower LF	19
Auxiliary Bench in Vacuum LF	12

Numerous vacuum vessels of various sizes and designs, each requiring space for cleanrooms (with different specifications).

Introduction Tower Vacuum

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Interfaces with Civil infrastructures (Not exhaustive)

1. Vacuum chamber ground foundation
2. General environment HVAC, Ur%
3. Dust control in the experimental halls
4. Electrical power
5. Bridge crane
6. HVAC filtered air for chamber flushing + Clean Rooms
7. Base towers in-situ bake out (e.g.: 30 kW / tower x 1 week)
8. Separate areas for control electronics and noisy equipment
9. Storage areas for large parts (chamber rings, pipe links)
10. Access to the tower chambers: scaffoldings
11. Access to the Base of the Tower

Study of the logistic, access paths to the different halls, definition of assembly work areas and tools

Special safety constraints related to underground infrastructure

Access Mode Solutions

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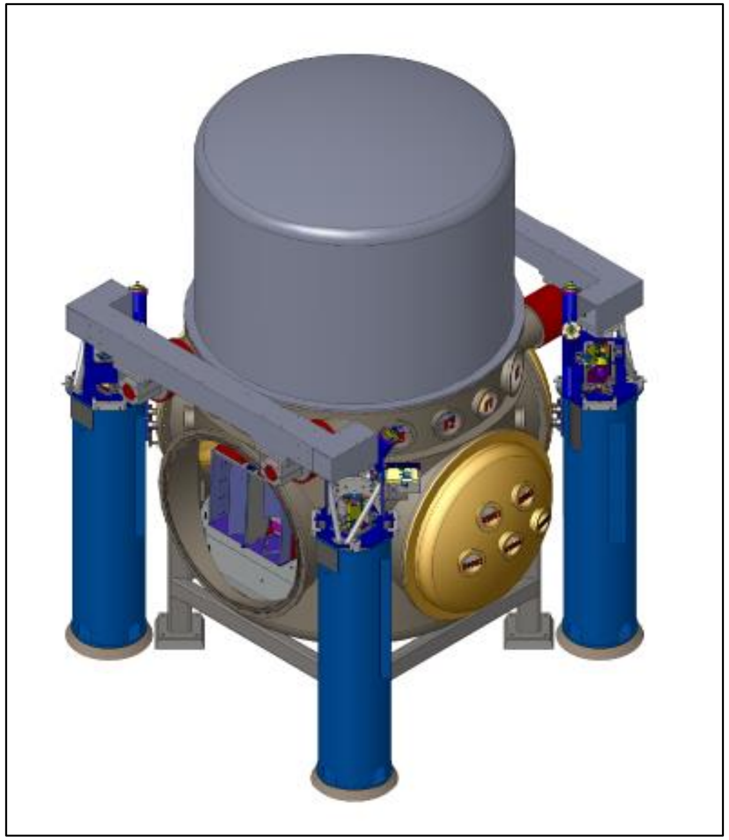
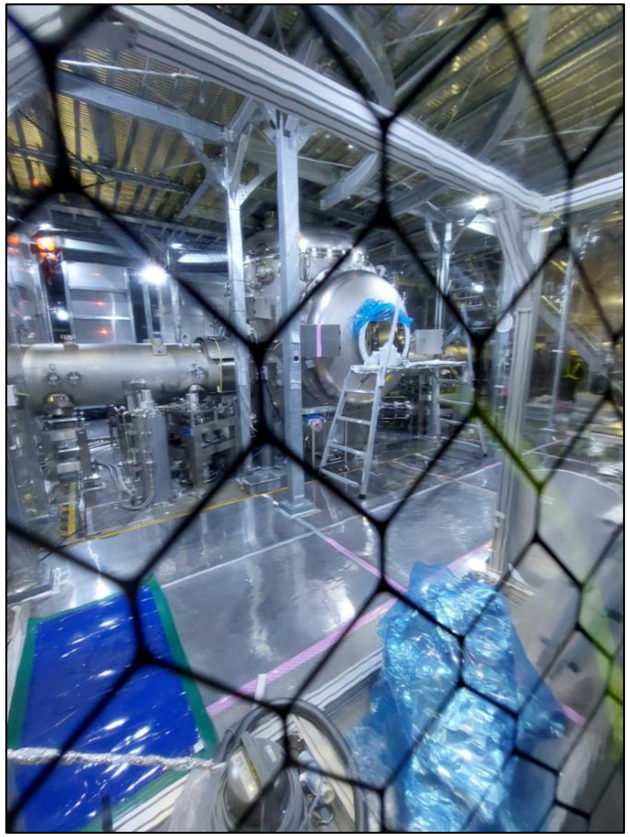


LIGO, Chamber Assembly

KAGRA – Bench Tower



KAGRA - Cryostat Lateral Access

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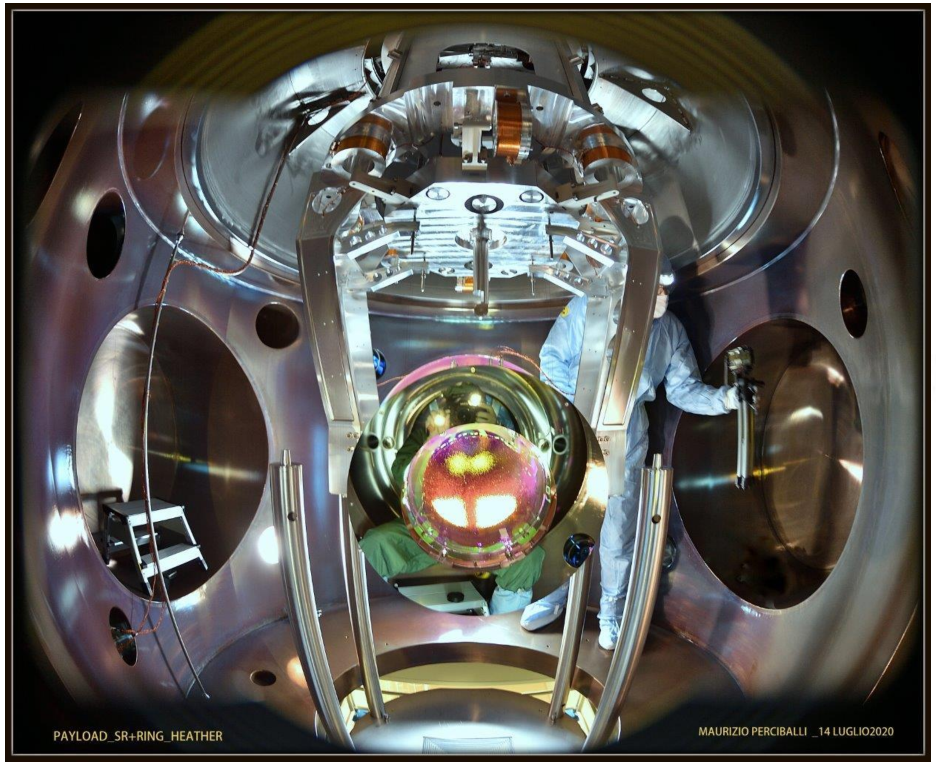
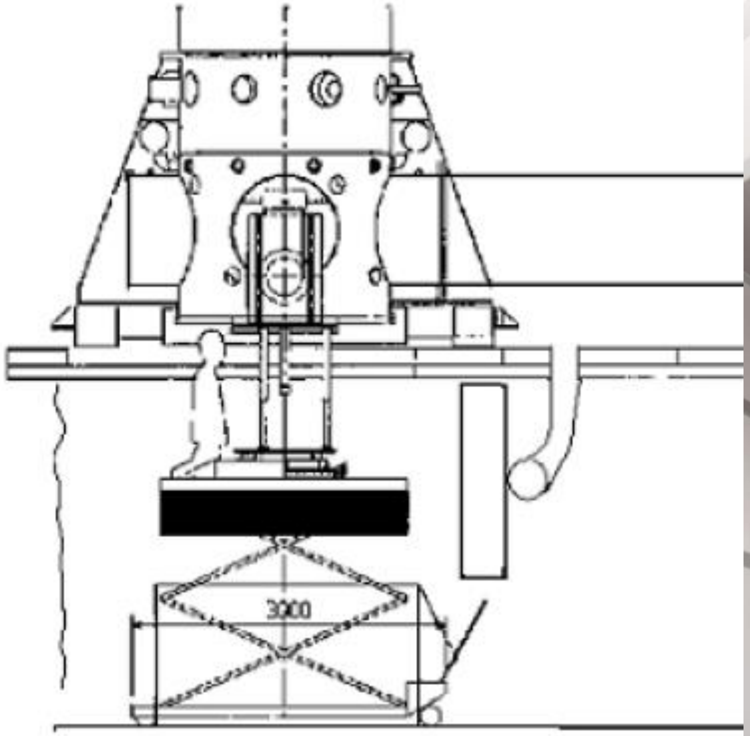
Access Mode Solutions



Virgo, Base Tower



Virgo – Payload Insertion

Virgo – Bottom Access

Access Mode Solutions

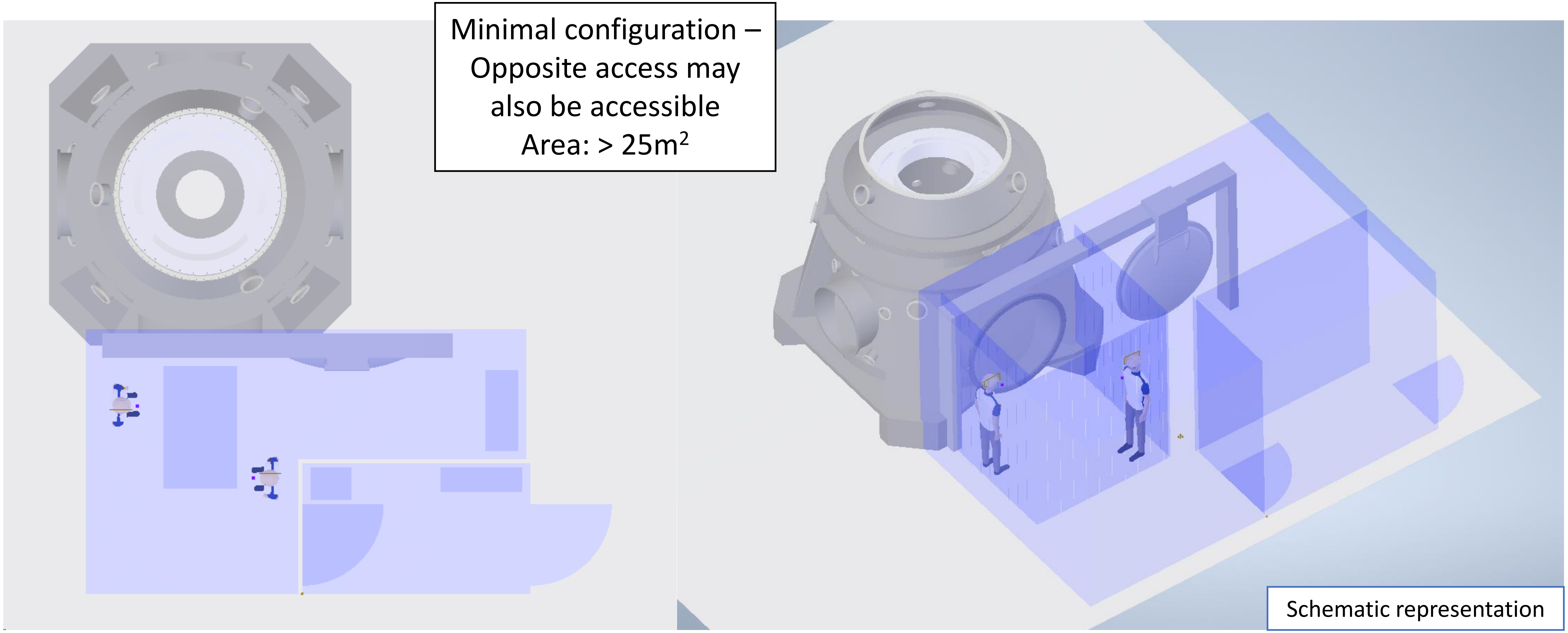
Purpose of the access is to:

1. Easy Insertion of the Payload / Bench
2. «Easy» intervention from one or two operators
3. Maintaining the cleanliness of the Payload / Optics on Bench

With constrains on:

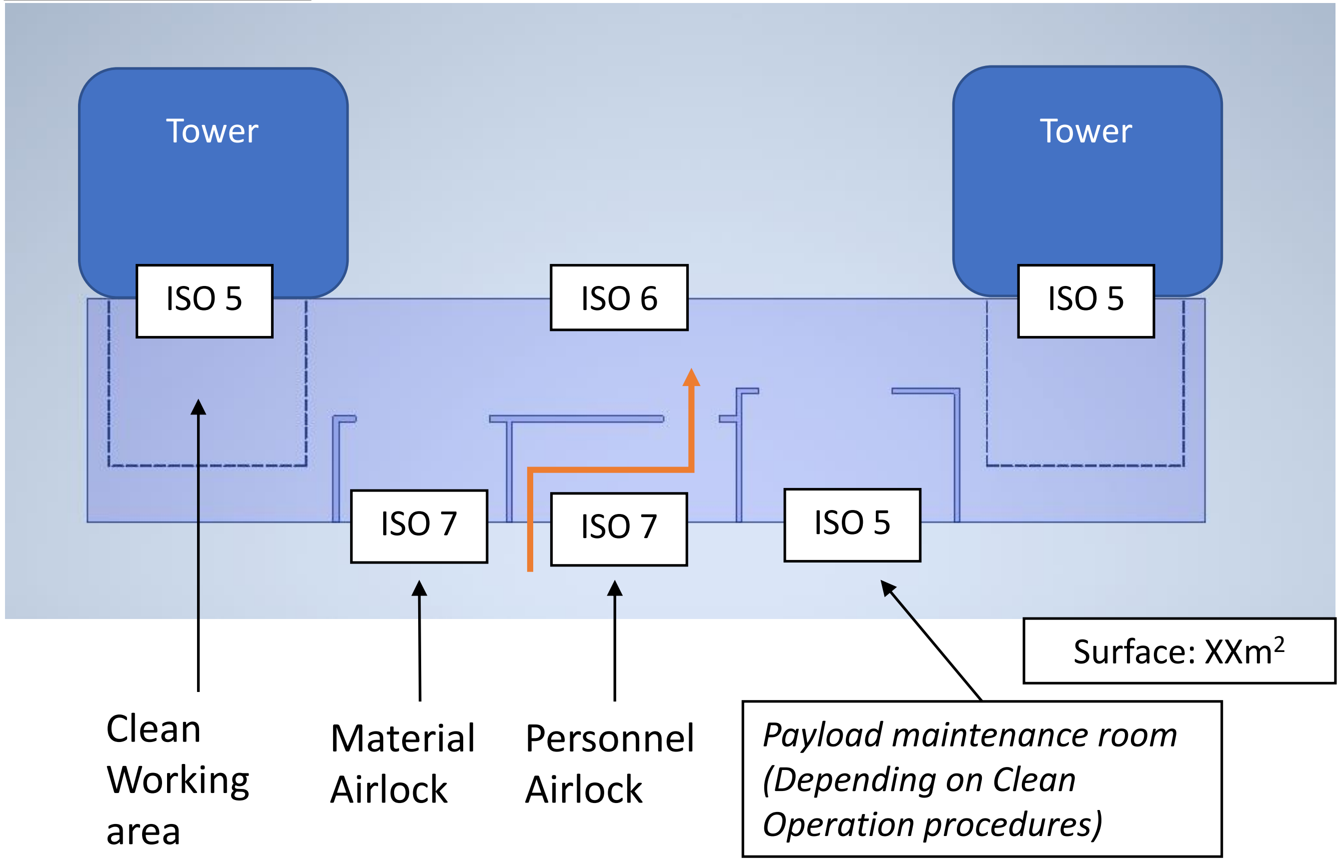
- Mechanical structure of the Tower
- Space around the Tower for Auxiliary Vessel / Links / Equipment
- Future upgrades
- Safety (Confined Space)

Tower with lateral Access



Tower with lateral Access

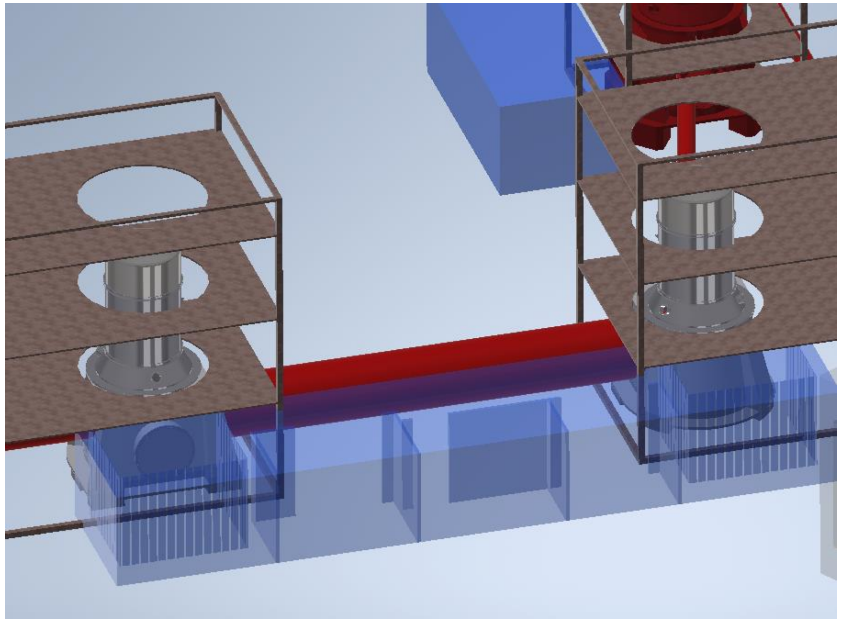
CR requirements
- In operation



Required space – Configuration may differ depending on the tower and tunnel available spaces

For several close towers, we can include one large volume for the Clean Room.

Size depending on selected towers.



EGO EUROPEAN GRAVITATIONAL OBSERVATORY

Tower with lateral Access

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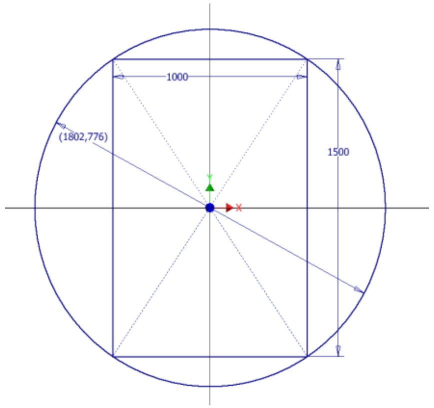
Benefits:

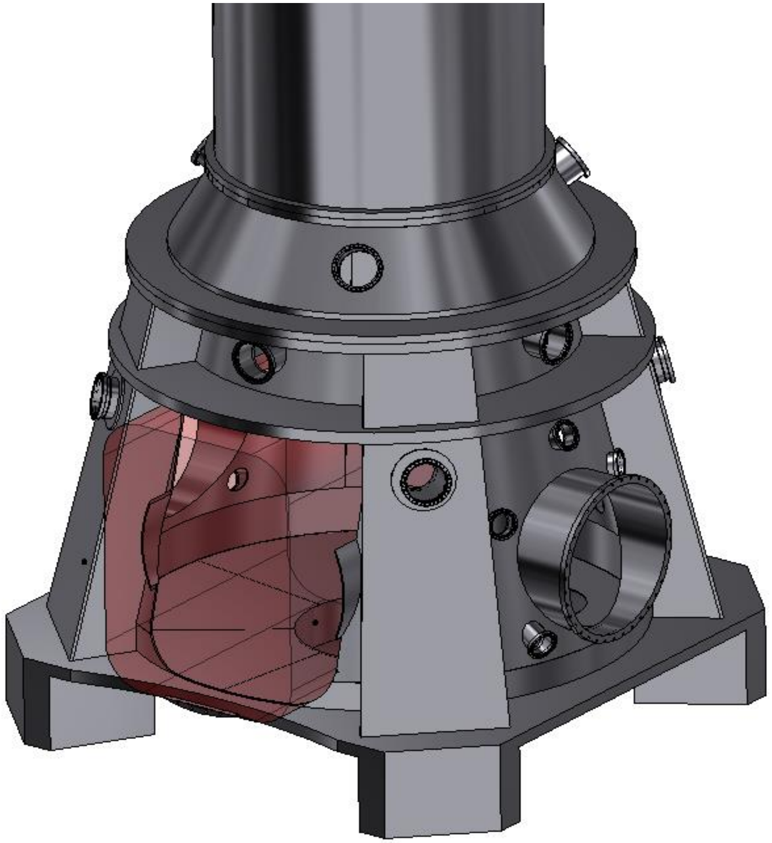
- More flexibility if towers are moved for more than several meters.
- No need for underground room: less complex cavern.
- Favourable for «small size» towers (work from outside), or for Bench Type.

Drawbacks:

- Very large opening depending on Payload / Bench: Compatible with a long-term view?
- Higher complexity of the chamber (mechanical / cleanliness)
- Invasive tooling to operate.
- Likely to open the opposite flange: need more space for cleanrooms, passage below/above the tubes.
- Less space for Auxiliary benches.

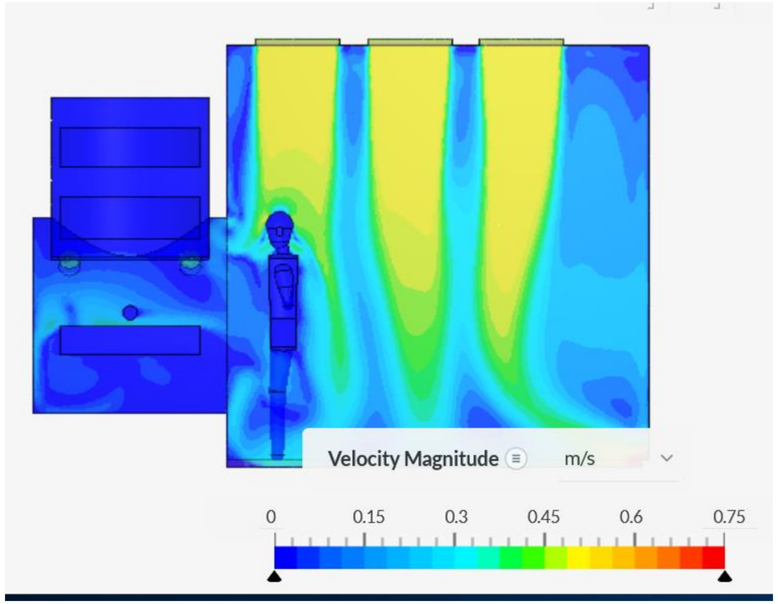
A Ø=2000 circular port is not feasible (with a tower footprint of 4*4 m^2).
A 'rectangular' port of 1500x2000mm might be possible, with challenging cost, sealing, dust control.



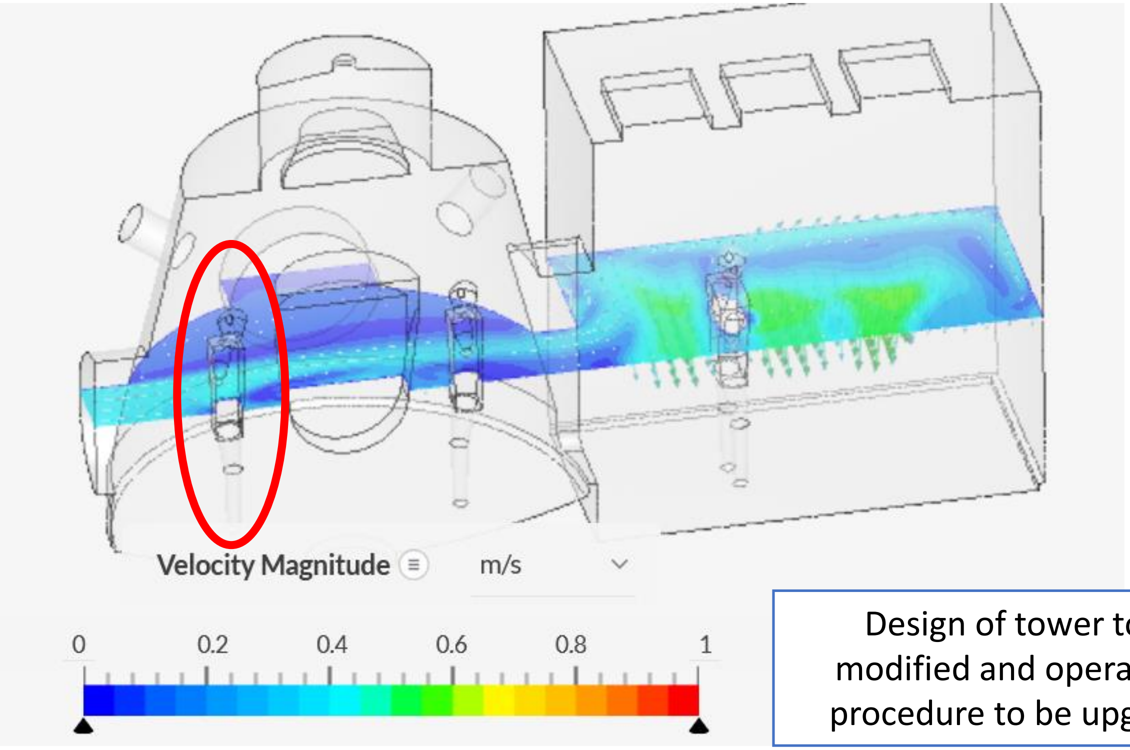


Tower with lateral Access

Lateral opening: Adapted for small vacuum chamber



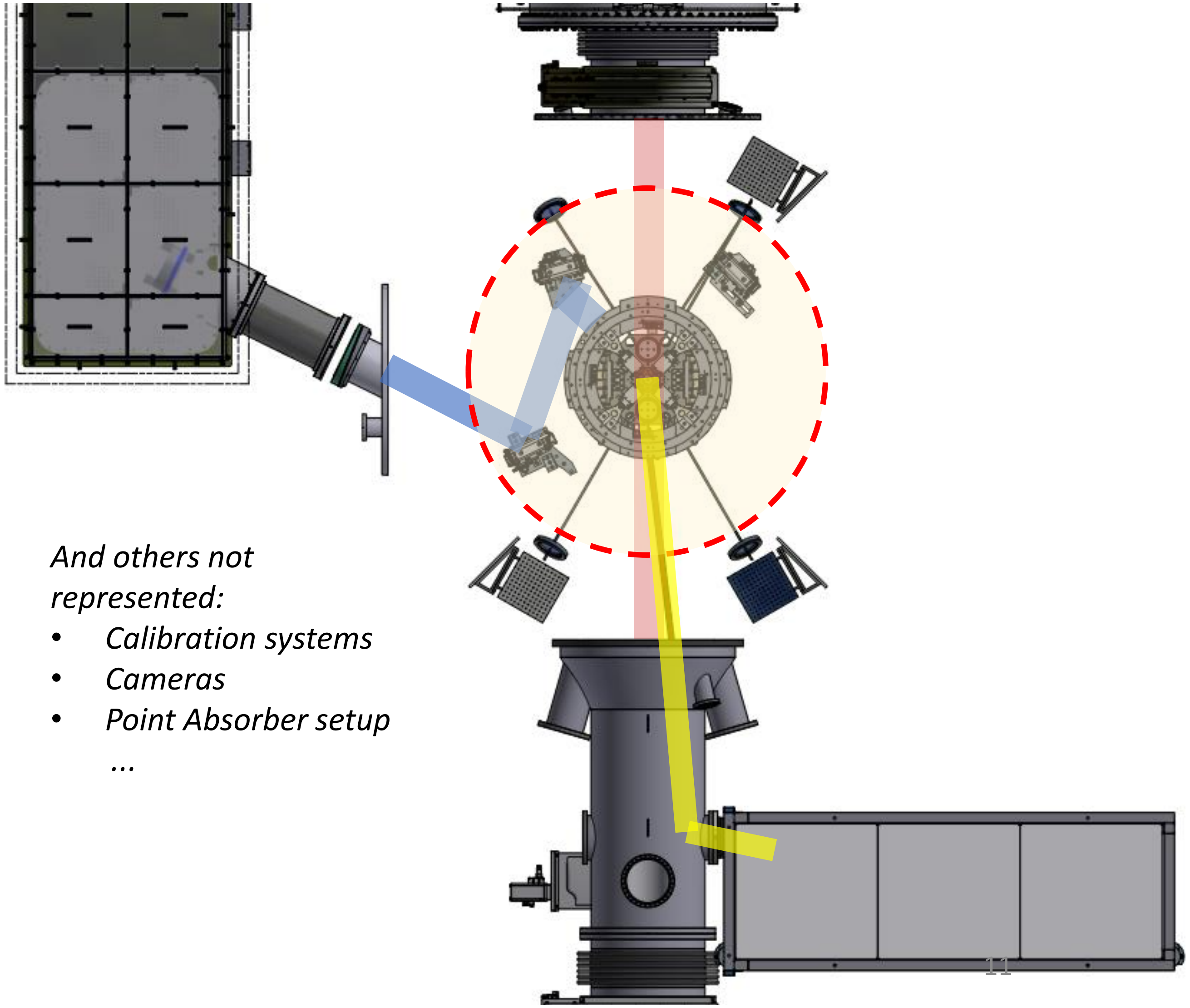
Cleanliness problem rises with laminar horizontal flow (having less large eddies)



Design of tower to be modified and operational procedure to be upgraded

Space required

- **Determination of chambers apertures and of space needs adjacent to towers**
  - Main beam size and position, height to floor, wanted chambers apertures
  - Stray-light baffling strategy and wanted chambers apertures (affect links, main valves…)
  - Optical benches guess sizes and positions – In-vacuum and external ones
  - Estimated types, size and number of viewports. Features of the viewports to be defined as well, related to safety.



And others not represented:

- *Calibration systems*
- *Cameras*
- *Point Absorber setup*

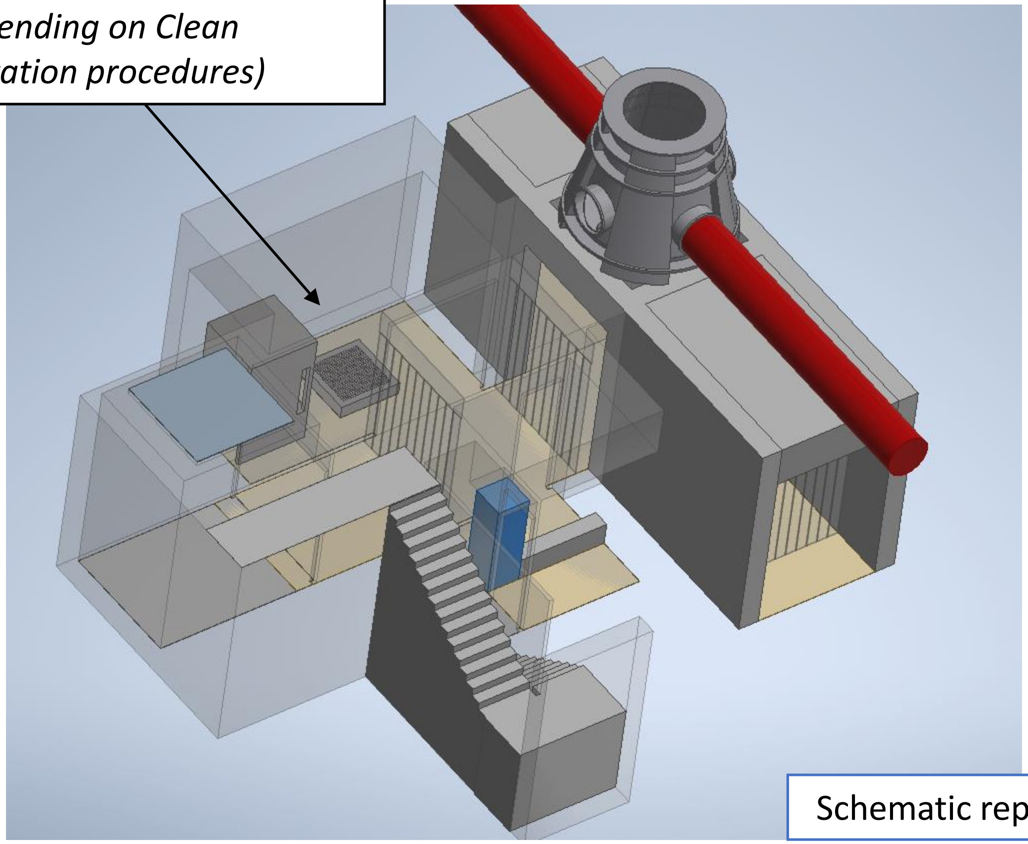
…

Tower with Bottom Access

Benefits:
- Easy access for large Payload.
- No interference on surface, to install auxiliary benches / equipment.
- Clean air flow from top to bottom: less turbulences.
- Best use for groups of towers: Underground floor, bringing to a main Clean Room, with corridor to reach several Towers.

Drawbacks:
- There is a need to dig deeper and reinforce the underground room: more complex cavern.
- Less flexibility in case the towers must be moved several meters – on Beam axis - (although feasible if thought at the beginning).
- Small flexibility (~ 1m) in transverse axis.

Payload maintenance room (Depending on Clean Operation procedures)



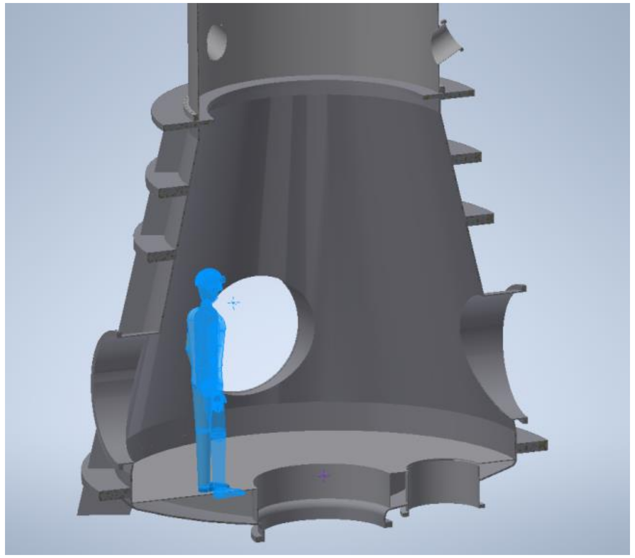
Schematic representation

Material Airlock + Personal Airlock + Working Area ISO5 + ISO6 (Minimal configuration).
Area: ~ 70m^2 (included below the tower)

Tower with Bottom Access

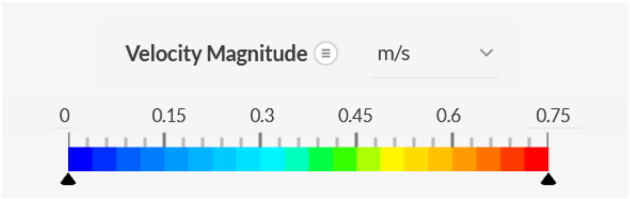
Solution adapted to large and high payload

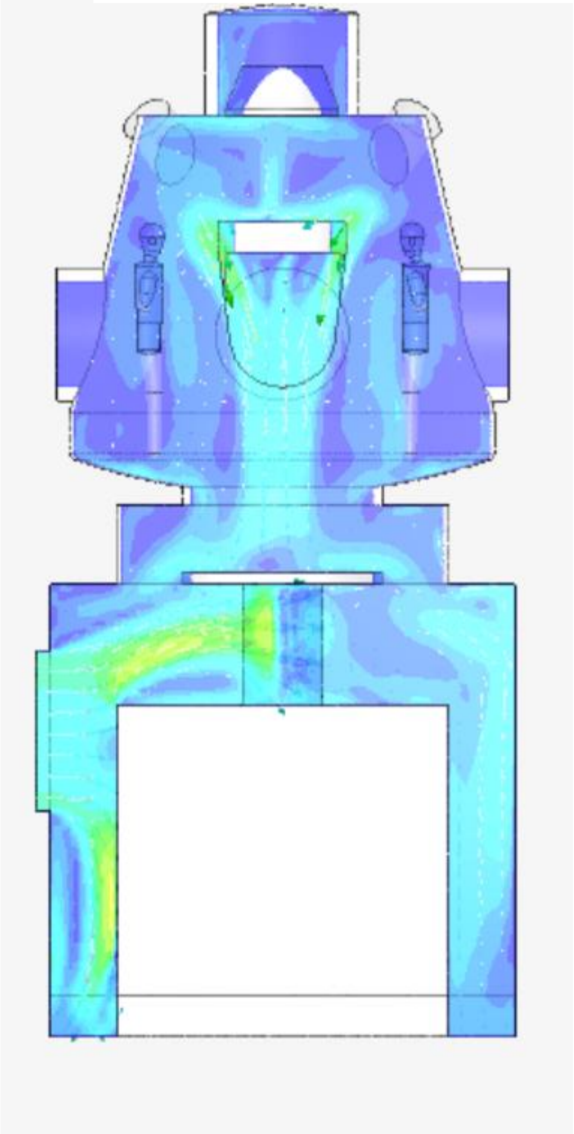
Cleanroom height is defined by the max. expected payload length



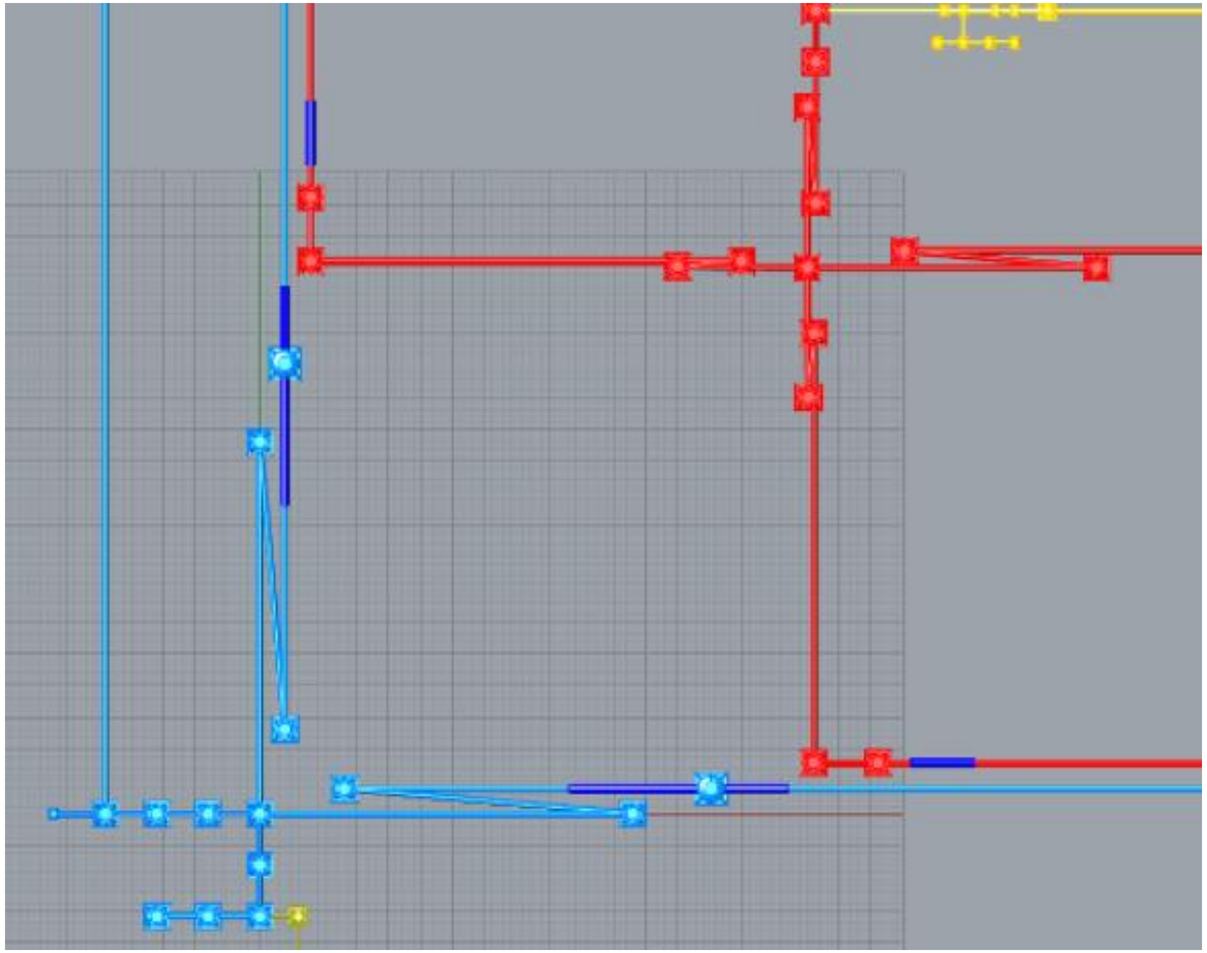
Solution with an opening for safety exit

Vertical laminar air flow for less eddies and possibility of work all around the Payload





2L configuration



Proposal:

Having a solution with:

- Bottom access for the «crowded area» + Beam Splitter + CryoTower
- Lateral access for the others + FC «SQZ» and minitowers

Questions :

- Cost of more complex galleries?
  Is the cost this high even in the case of a 15m high cryo-tower (instead of 20m) or with the double cavern?
- Future upgrades, payload size?
- Flexibilities on displacement of towers?