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CAOS VACUUM SYSTEM

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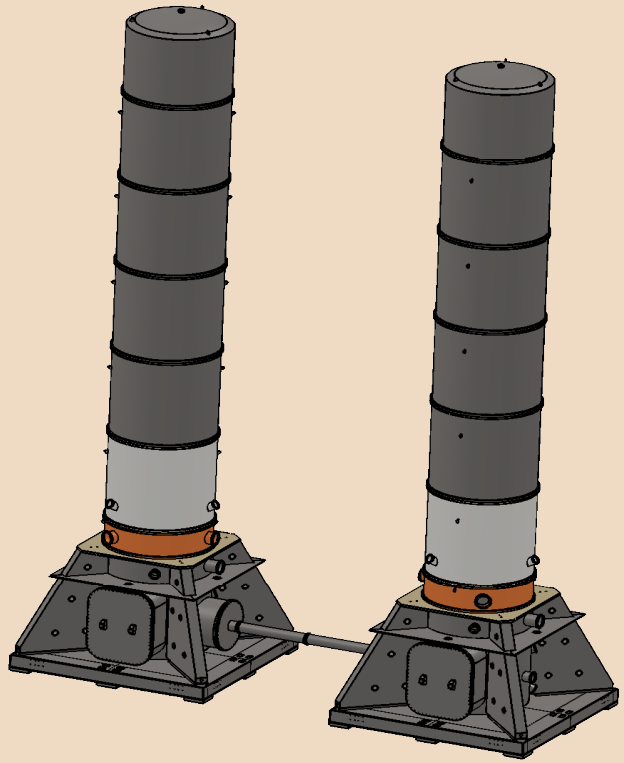
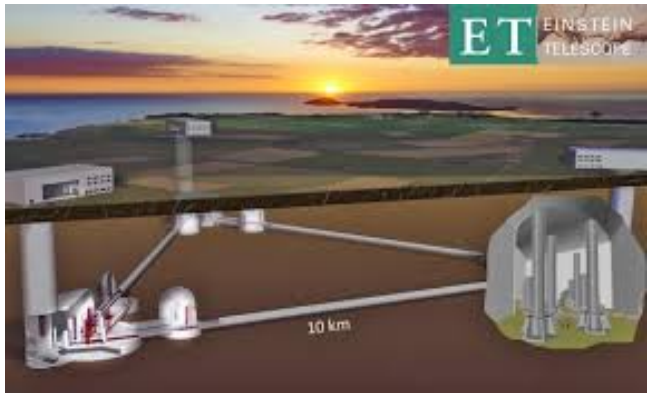


CAOS-ETpathfinder workshop 2024/09/10

CAOS vacuum system

VIRGO knowledge



VIRGO knowledge

Characterization and possible improvements

ET-HF towers prototype

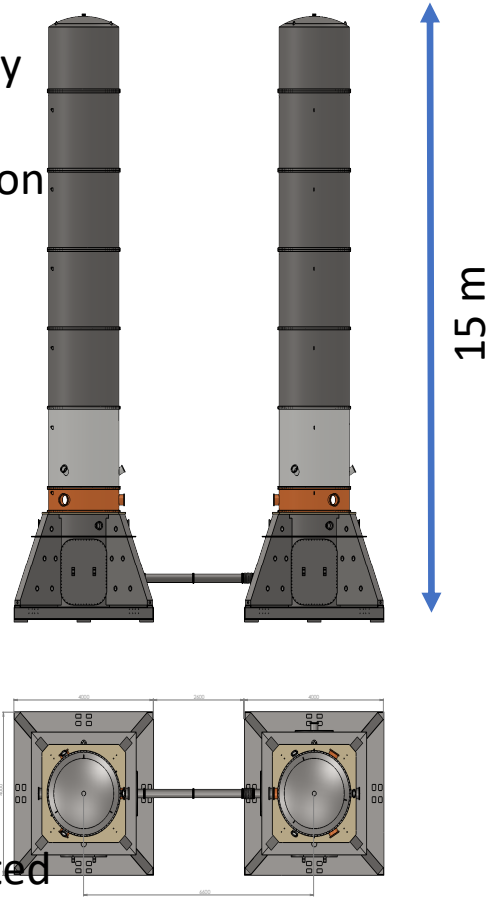
CAOS Laboratory vacuum system

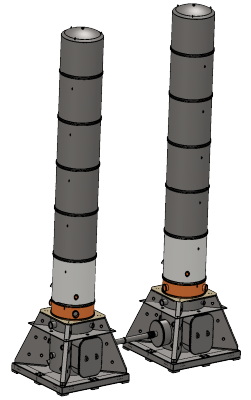
The CAOS vacuum system consists of two towers to host a Fabry-Perot cavity suspended to an ET “full size” Super Attenuator.
In the future the system will be upgraded to three towers to host a Michelson interferometer.

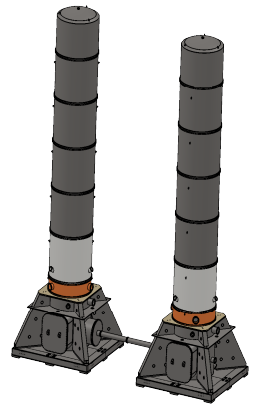
The towers characteristics are:

- 15 m tall
- ~ 20 tons weight each
- AISI 304 SS
- Operational pressure: 10^{-7} mbar
- Volume ~ 100 m^3
- Surface ~ 200 m^2
- Lateral access
- Distance between center axes: 6.5 m
- No separation roof between mirror and SA chambers (can be implemented later)

Call for tender 1.2 Meuro for design and production of two CAOS towers

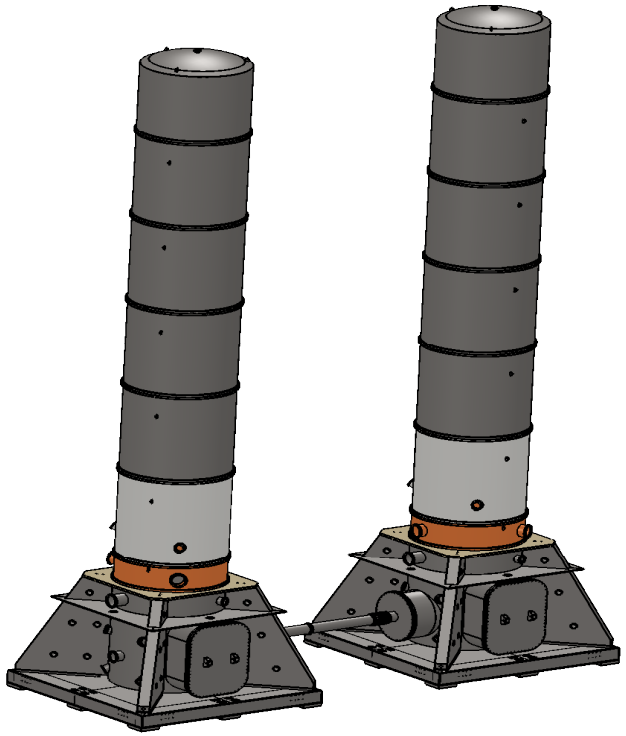






The towers are designed to accommodate the SA but can also function independently as test benches:

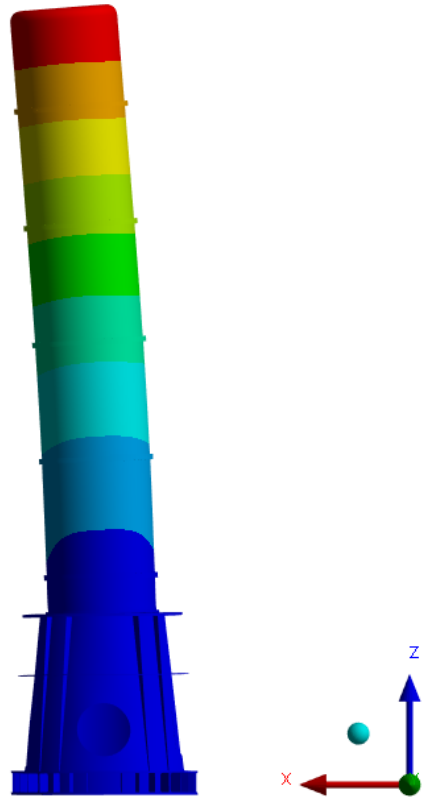
- Expand the available space for operations within the towers.
- Explore methods to increase tower rigidity.
- Evaluate lateral access.
- Engineer the airflow system for use during maintenance (***F. Bianchi***).
- Optimize the balance between performance and cost.
- Develop a new design for tower anchoring.
- Enhance the interface between the SA safety structure and the vacuum tower.
- Conduct NEG pump testing in an SA environment (ongoing also at EGO).
- Refine the Finite Element Method (FEM) simulations of the towers, including virole flanges (***G. Capoccia***).
- Assess the feasibility of a payload robotic installation and manipulation
- .....



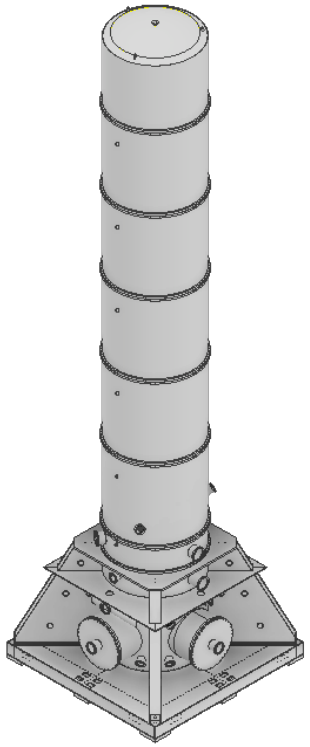
Base tower modification

- Increase space inside the base tower to make easier the large masses handling
  - More space to accommodate future development of the payload
  - Possibility to increase the marionetta-mirror pendulum length
  - Reduce thermal noise
  - Possibility to test solution with intermediate mass

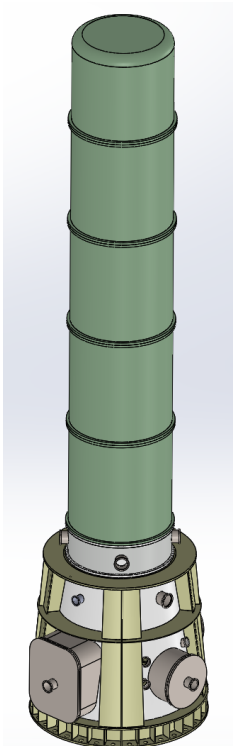
- Reduce the tower foot print
- Improve rigidity (increase fundamental mode frequency ~ +30%, goal f_0 > 15 Hz)
  - Make easier the large band loop on accelerometers at the SA base
- Lateral access
- Anchoring
- Dust control on mirrors during assembly and maintenance



Cylindrical vs Conical



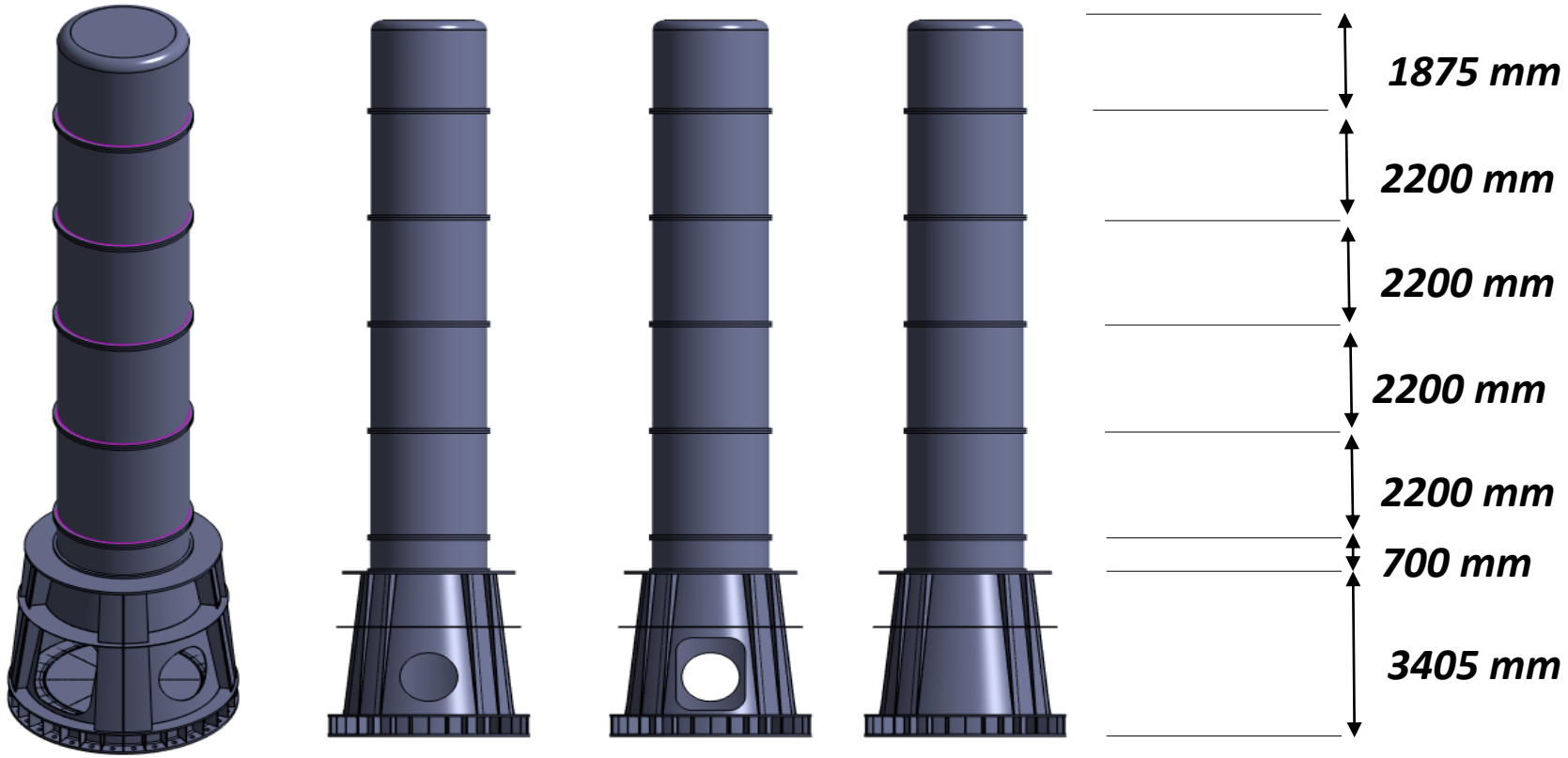
Virgo-like design



Conical design

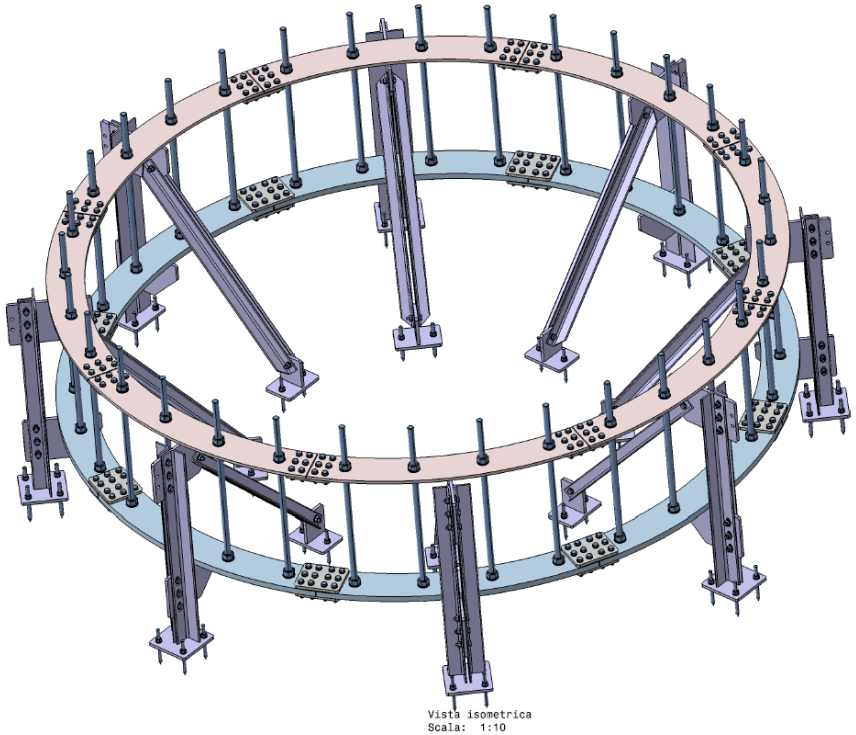
	Cylindrical	Conical
Tower height	14.85 m	14.85 m
Base height	2.7 m	3.4 m
Base footprint	4x4 m	3.5x3.5
# main virole	5	4
Main virole height	1.95 m	2.2 m
Main virole weight	1.15 t	1.67 t
Lateral Entrance	1.5x1.2 m	1.5x1.2 m
Base weight	15.82 t	14.42 t
Tower weight	23.23 t	20 t

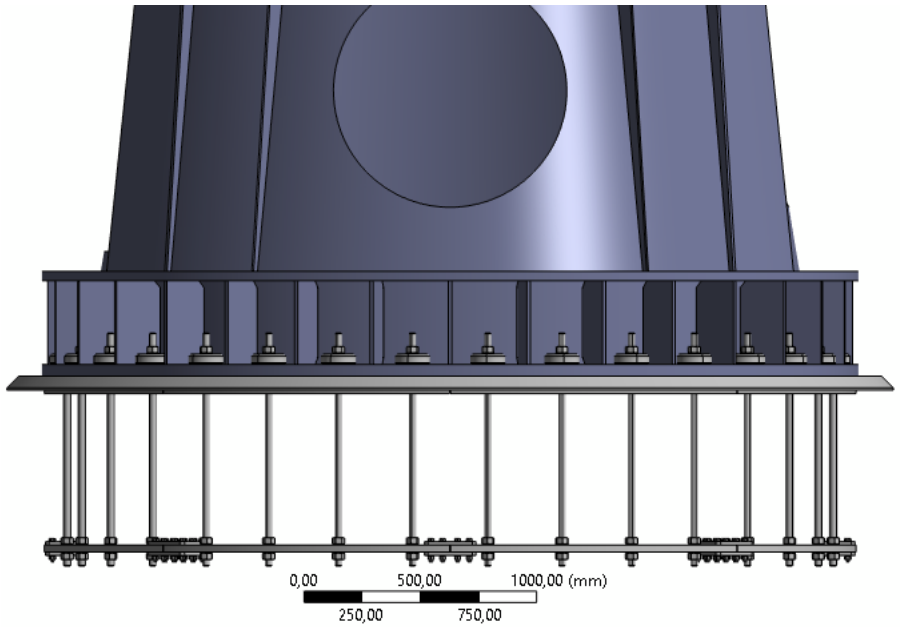
Conical design



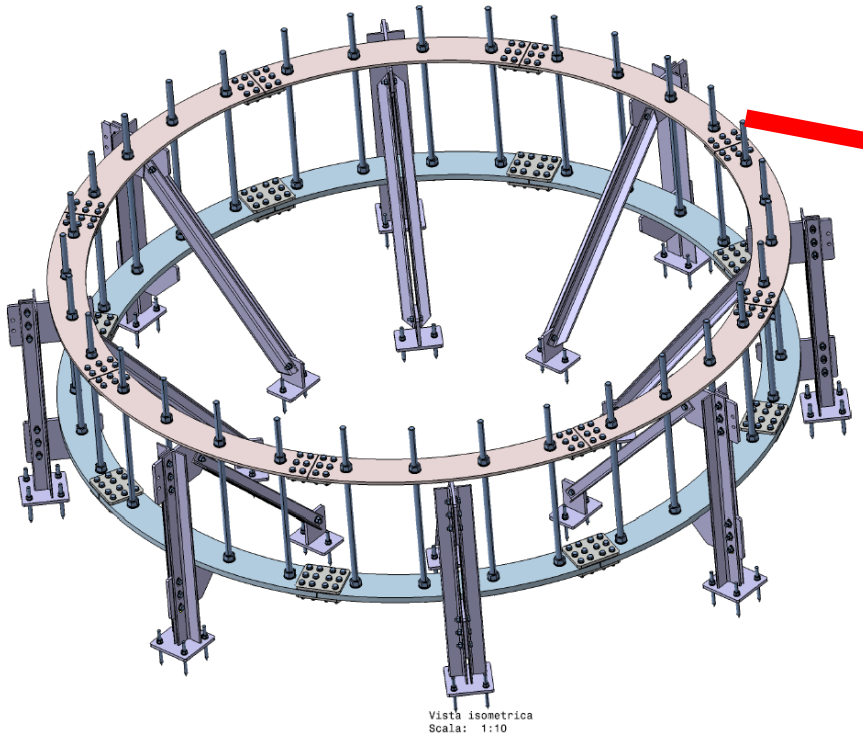
Tower base anchoring system

32 tie rods in a steel structure embedded in reinforced concrete (1.1 m thick)



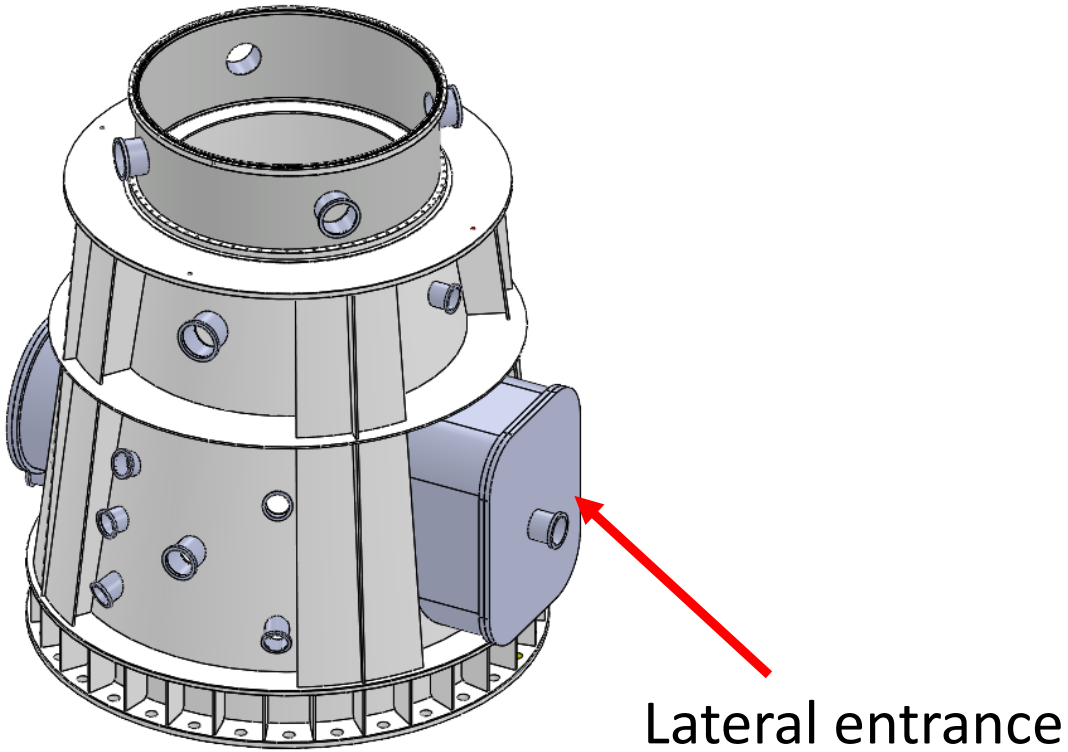


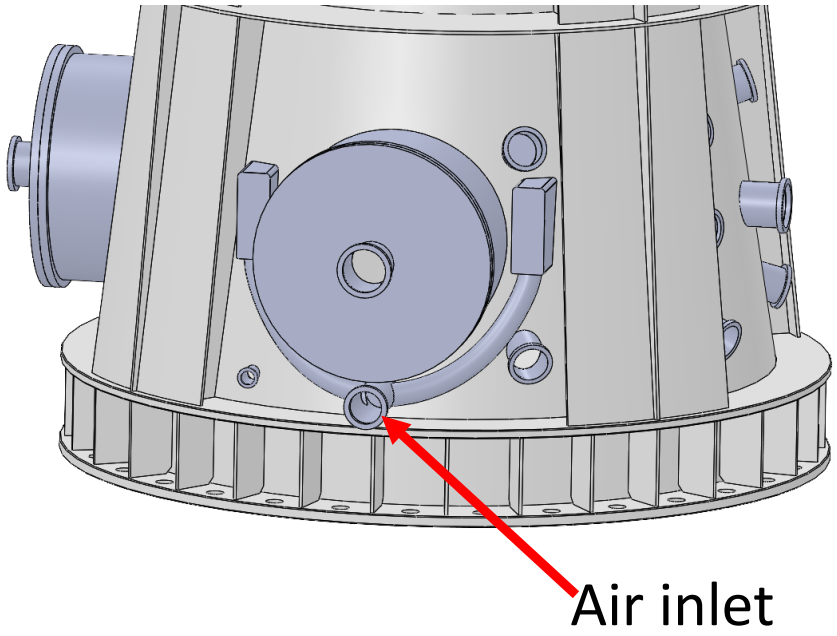
Tower base anchoring system



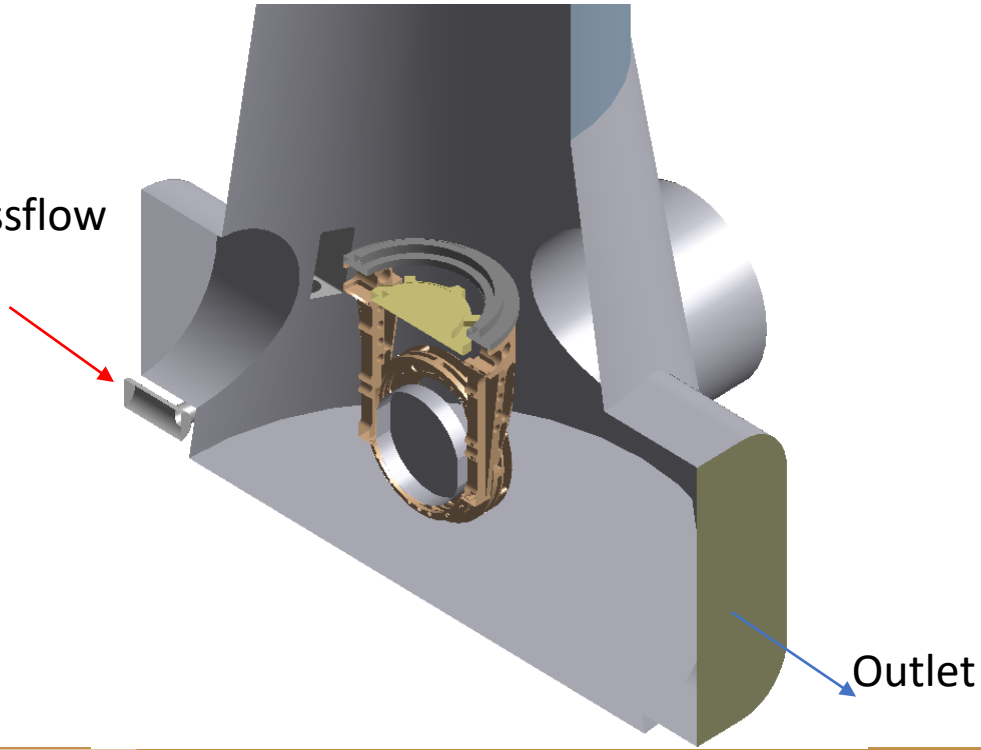
New design for inlet air

Credit: Francesco Bianchi

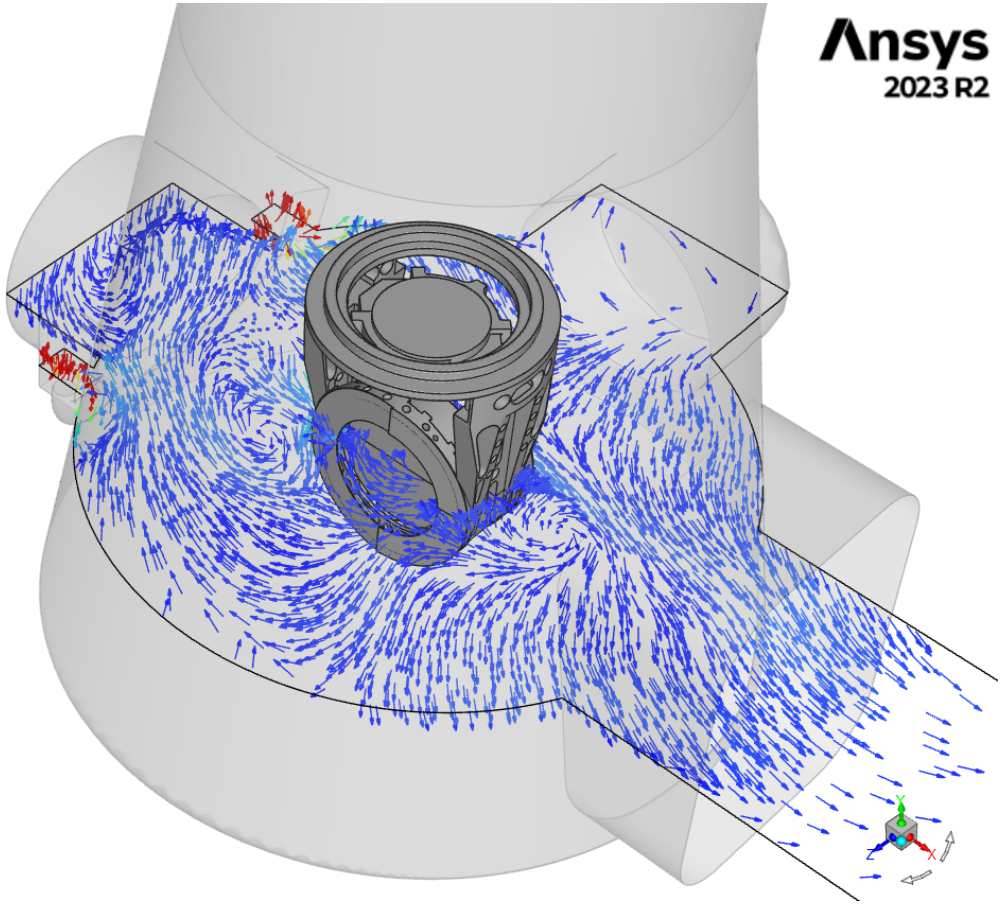




CFD analysis of airflow insid the CAOS towers

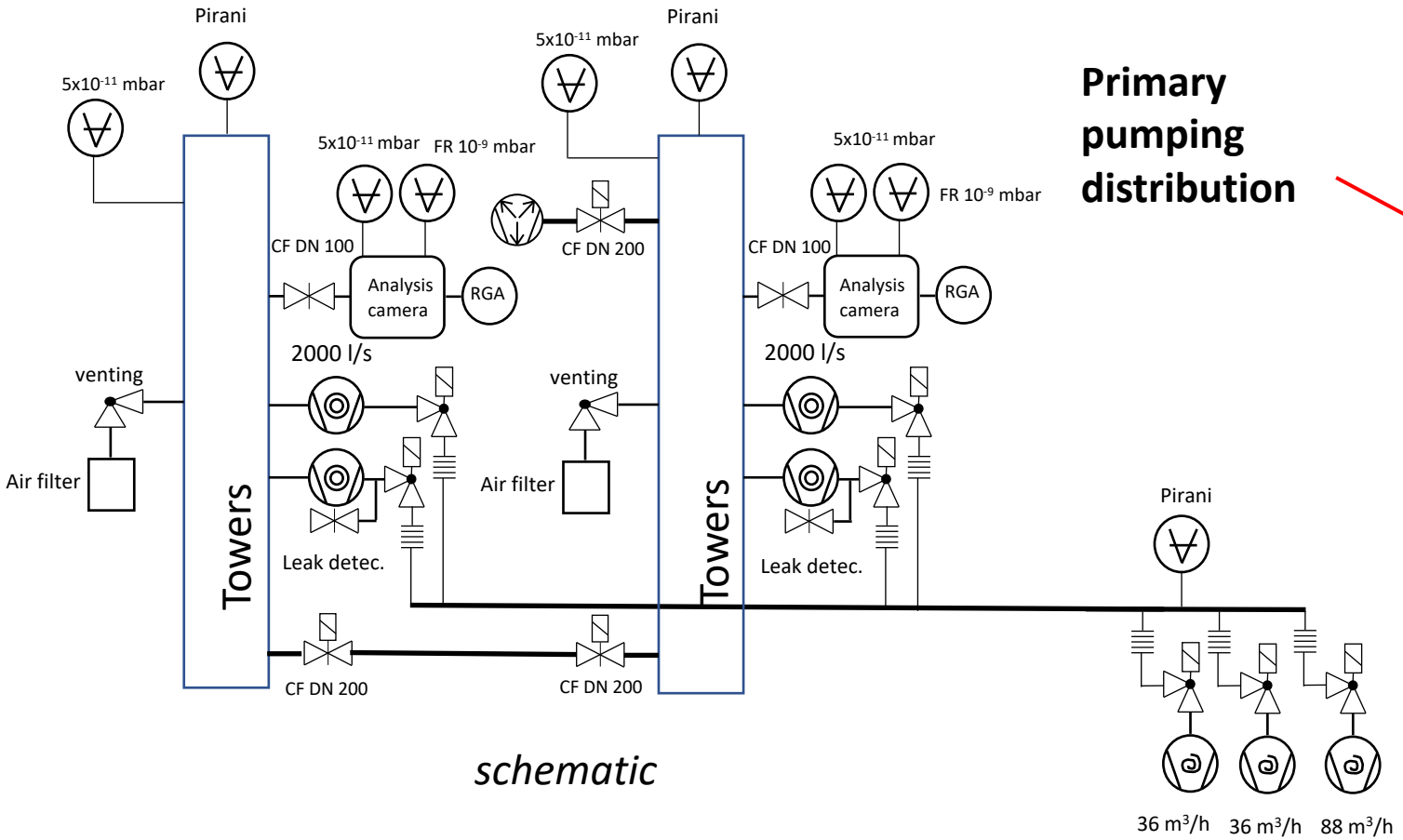


Ansys 2023 R2



Just started inlet optimization to reduce turbulent regime

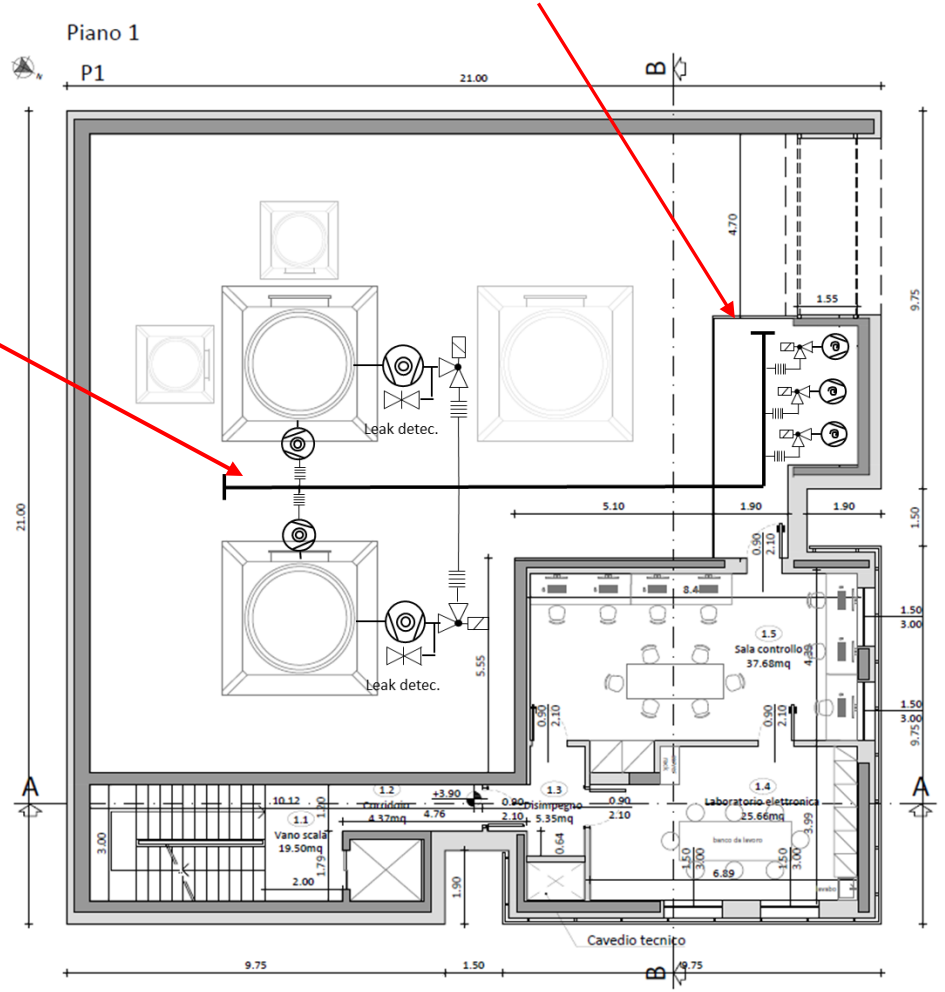
CAOS vacuum layout



schematic

Primary pumping distribution

Acoustic shield



Conclusion

- The CAOS vacuum system hosts the SA. At the same time it serves as a test bench.
- CAOS seeks to fully leverage the heritage of knowledge acquired in VIRGO
- Extensive collaboration with all CAOS subsystems to meet current and future requirements.
- Close cooperation with the ET Vacuum and Cryogenics - Tower division.
- We are tailoring the design of the CAOS tower to align closely with the needs of the ET-HF tower.
- Full scale prototype for ET-HF towers
- We are developing comprehensive simulation tools, validated against a full-scale real system, to aid in the design of the ET-HF towers, in case modifications are necessary.

Thank you