



Istituto Nazionale di Fisica Nucleare
Laboratori Nazionali del Gran Sasso

LNGS cryogenic facilities

Antonio D'Addabbo
LNGS-INFN, 20 March 2024



Cryogenics at LNGS

Cryogenic applications are playing a major role in the development of the next generation of experiments

The advantages of low temperatures in particle detection and the quantum computing industry strongly boosted the millikelvin sector

LNGS is investing large economic and human resources to develop the **Advanced Cryogenic Laboratory** to increase the cryogenic application at different temperature scales



Advanced Cryogenics Lab

The Advanced Cryogenics Laboratory (Acryl) is a set of new facilities mainly funded by PNRR resources:

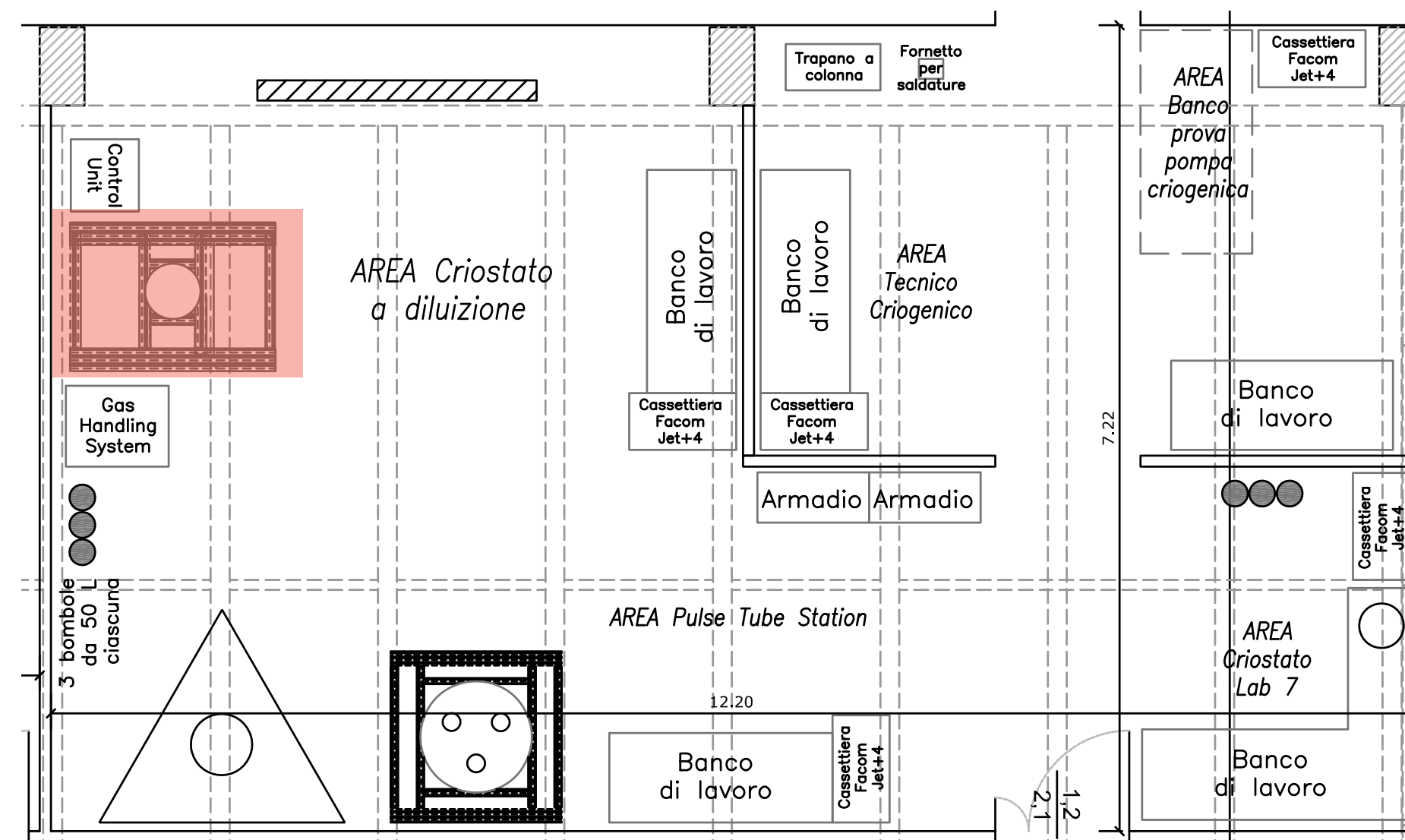
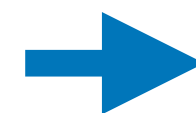
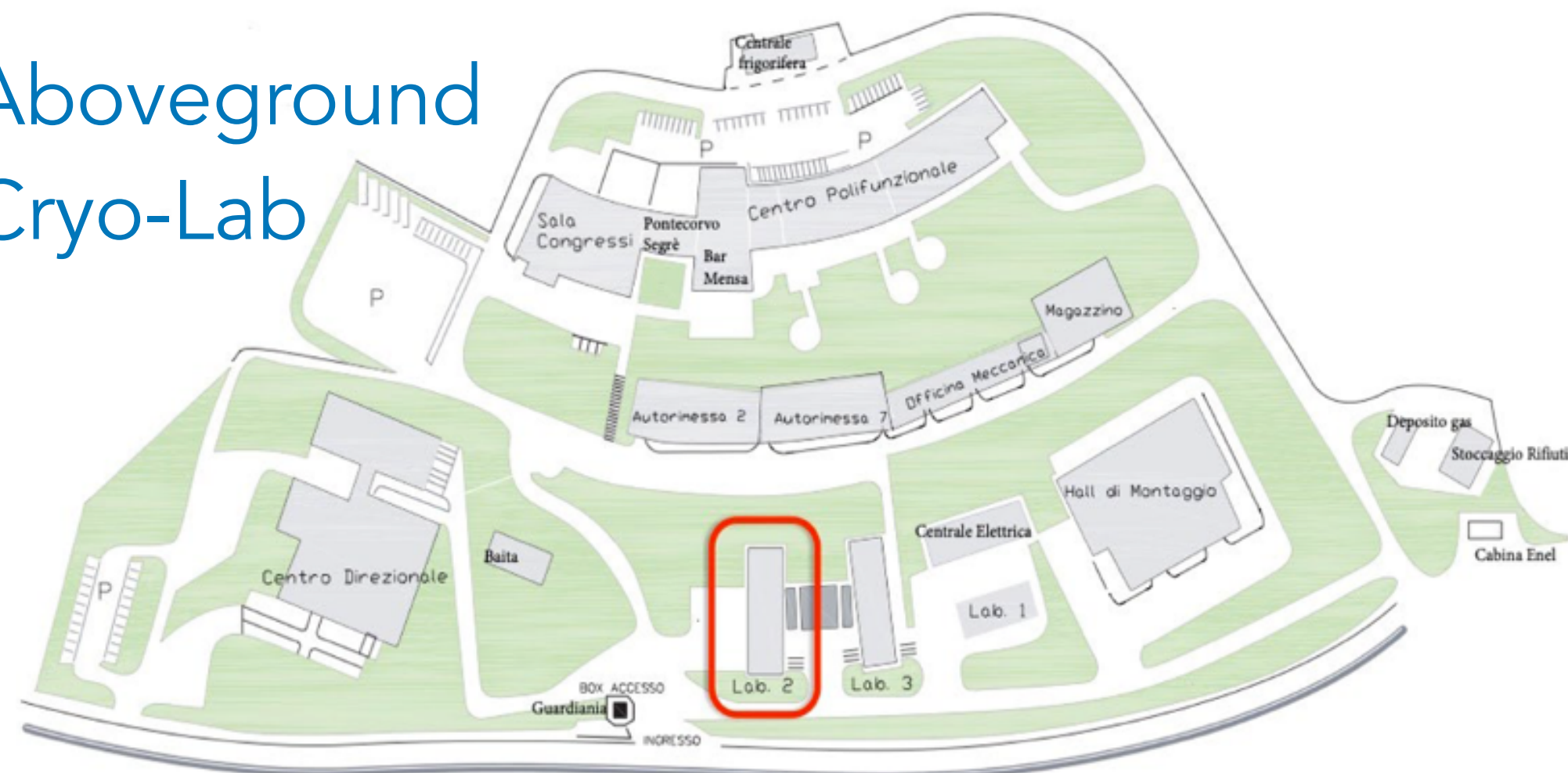


- **CRYO-Lab**: an integrated aboveground cryogenic hub for R&D at different temperature scales
- **CRYO-P**: a cryogenic underground platform for mK applications

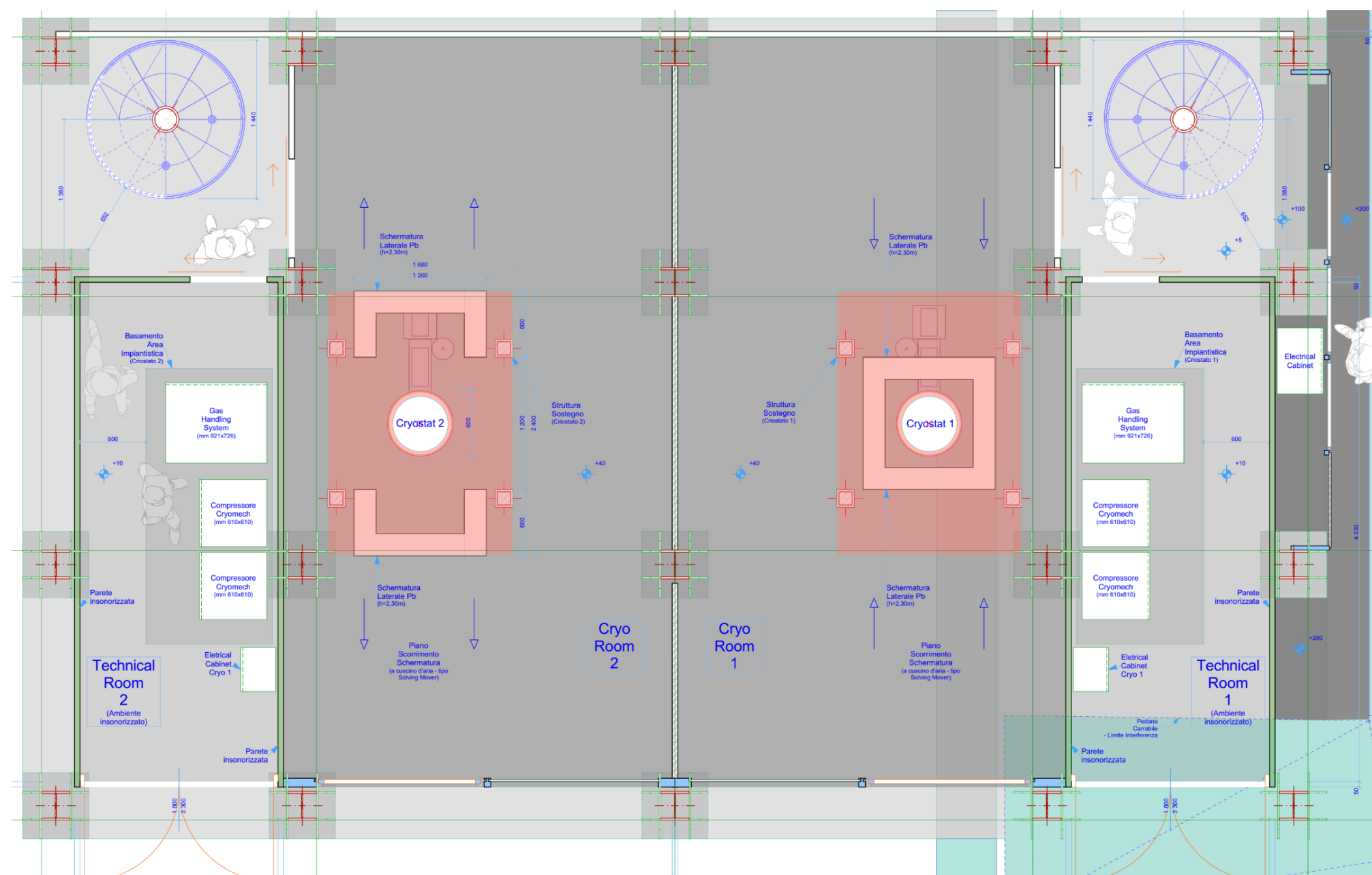
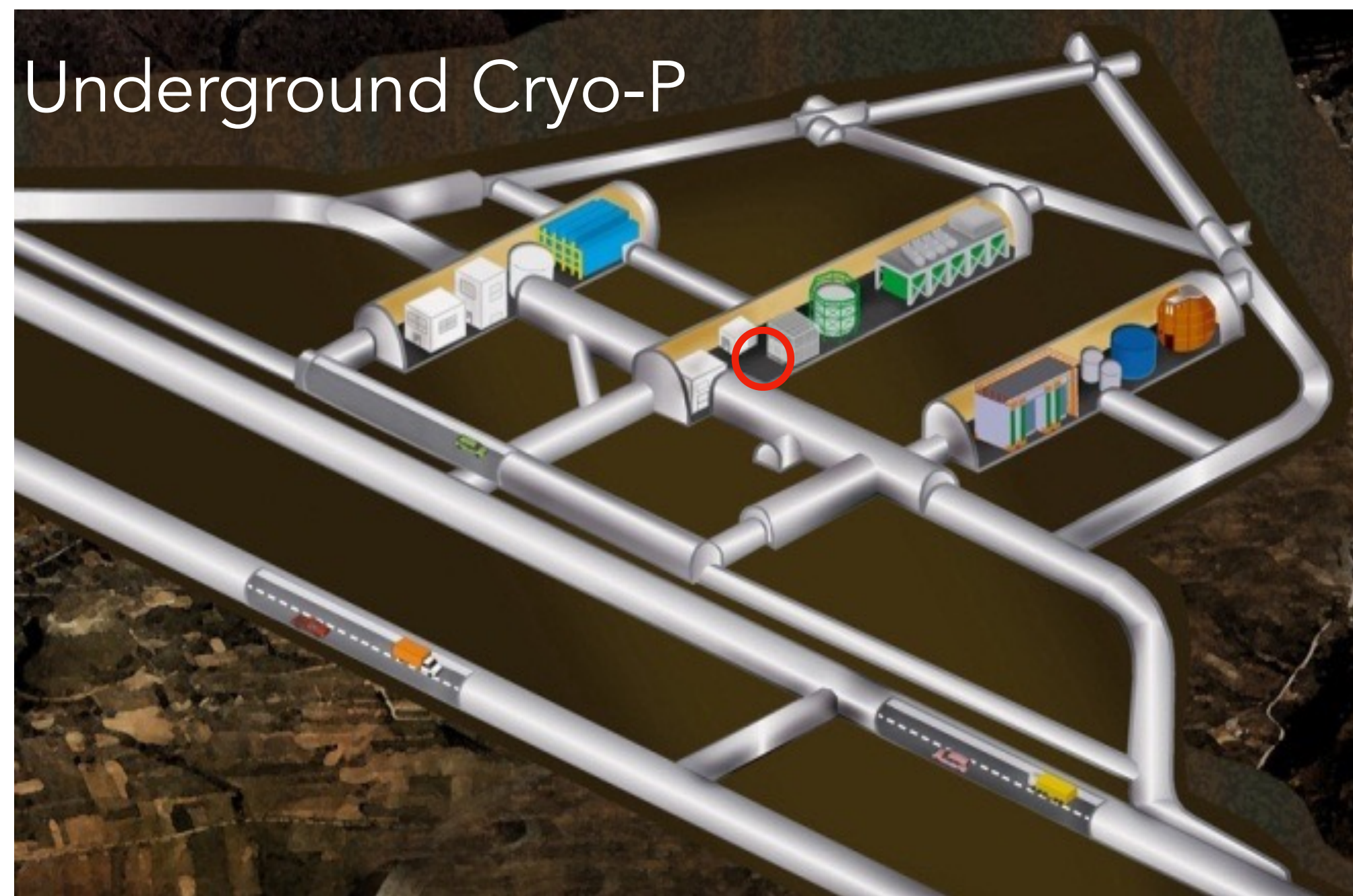


3 new dilution cryostats

Aboveground Cryo-Lab

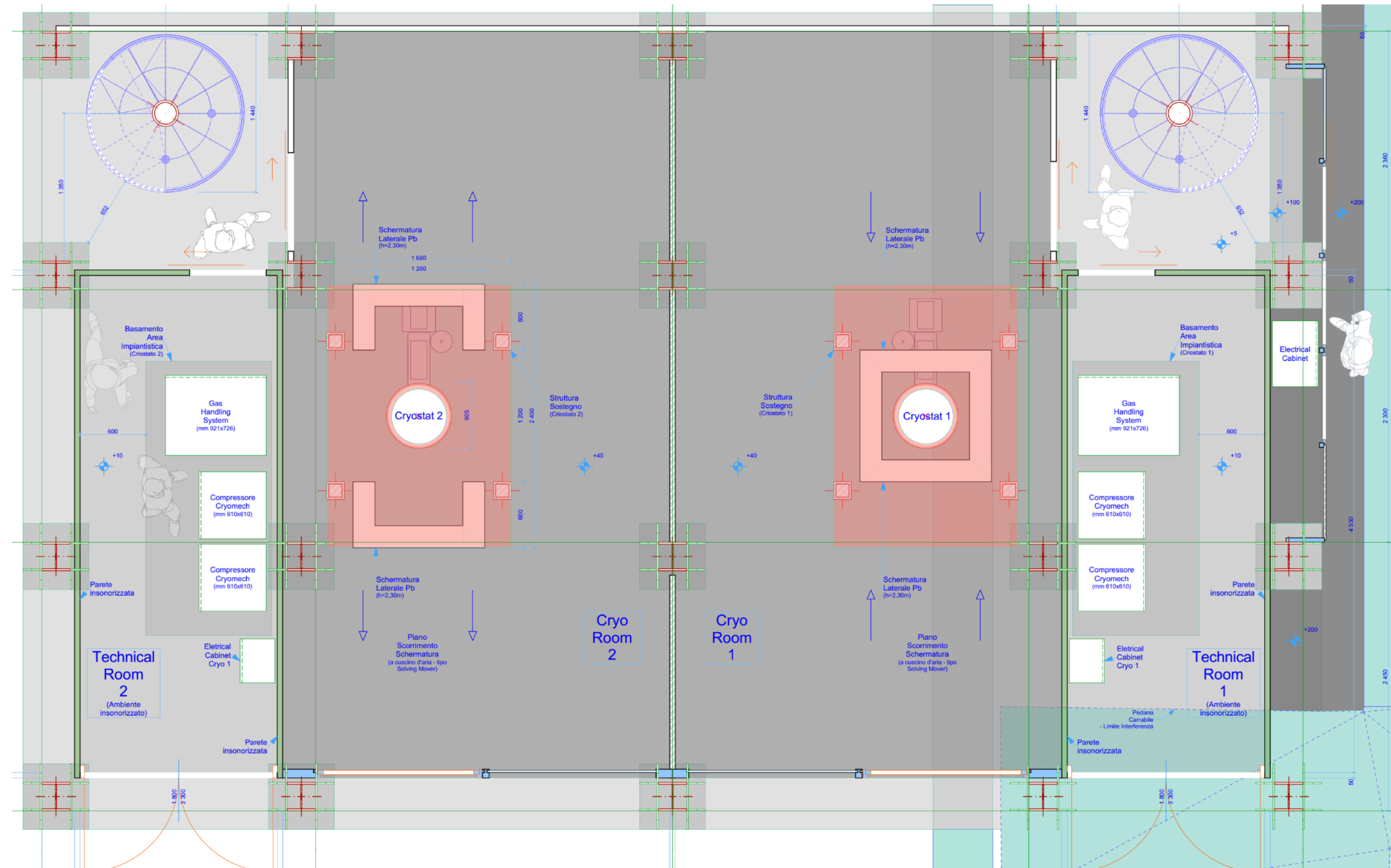


Underground Cryo-P



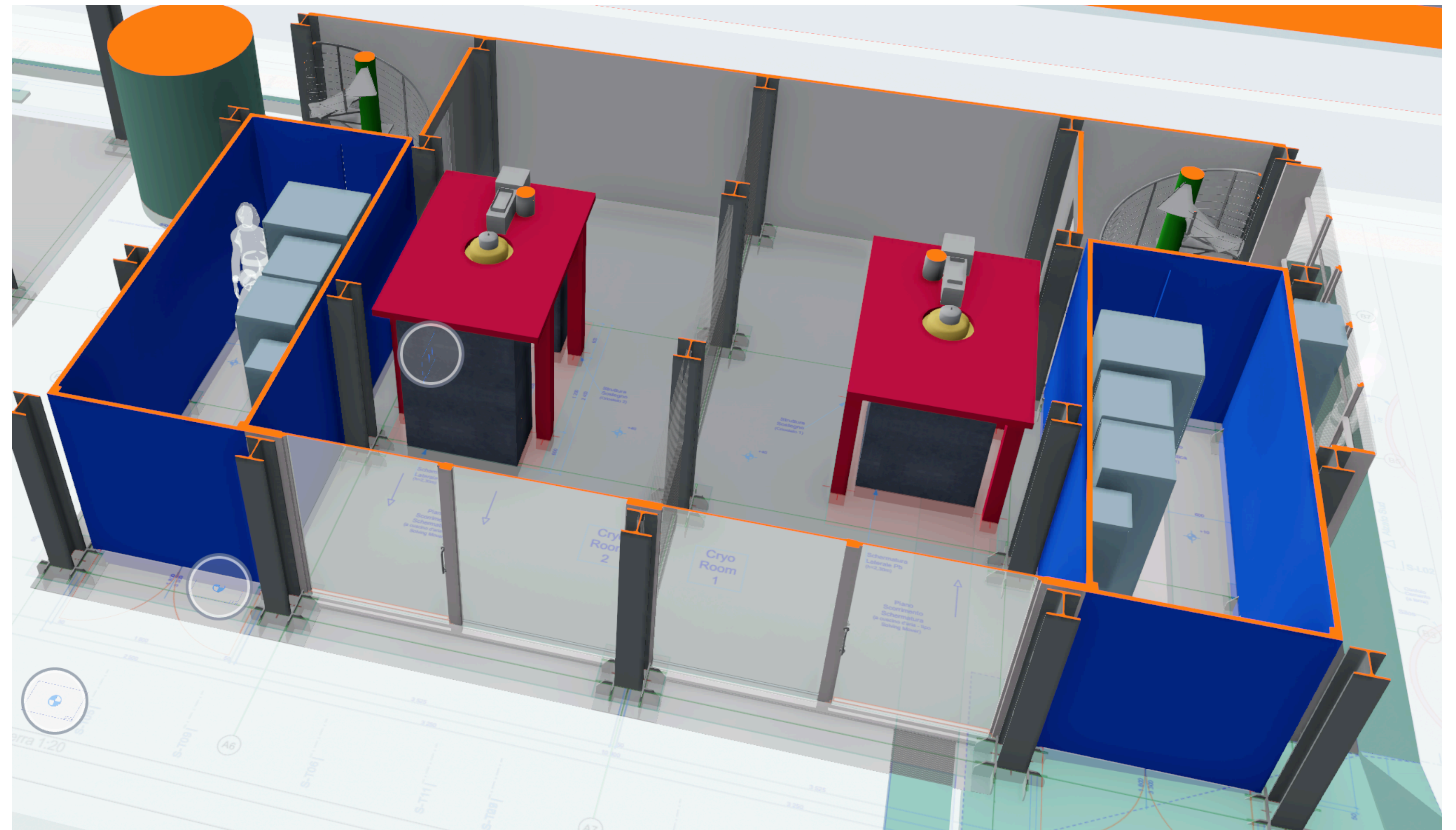
Cryo-P: an underground facility for mK applications

- Two separated experimental areas open to scientific community
- Each equipped with:
 - one dry (PT-based) dilution cryostat
 - sliding room T lead shieldings
 - "service" room for ancillaries, compressors and vacuum systems
 - 1 ton crane
 - 1st floor balcony with working stations
- 2nd floor with control room, small workshop and clean room



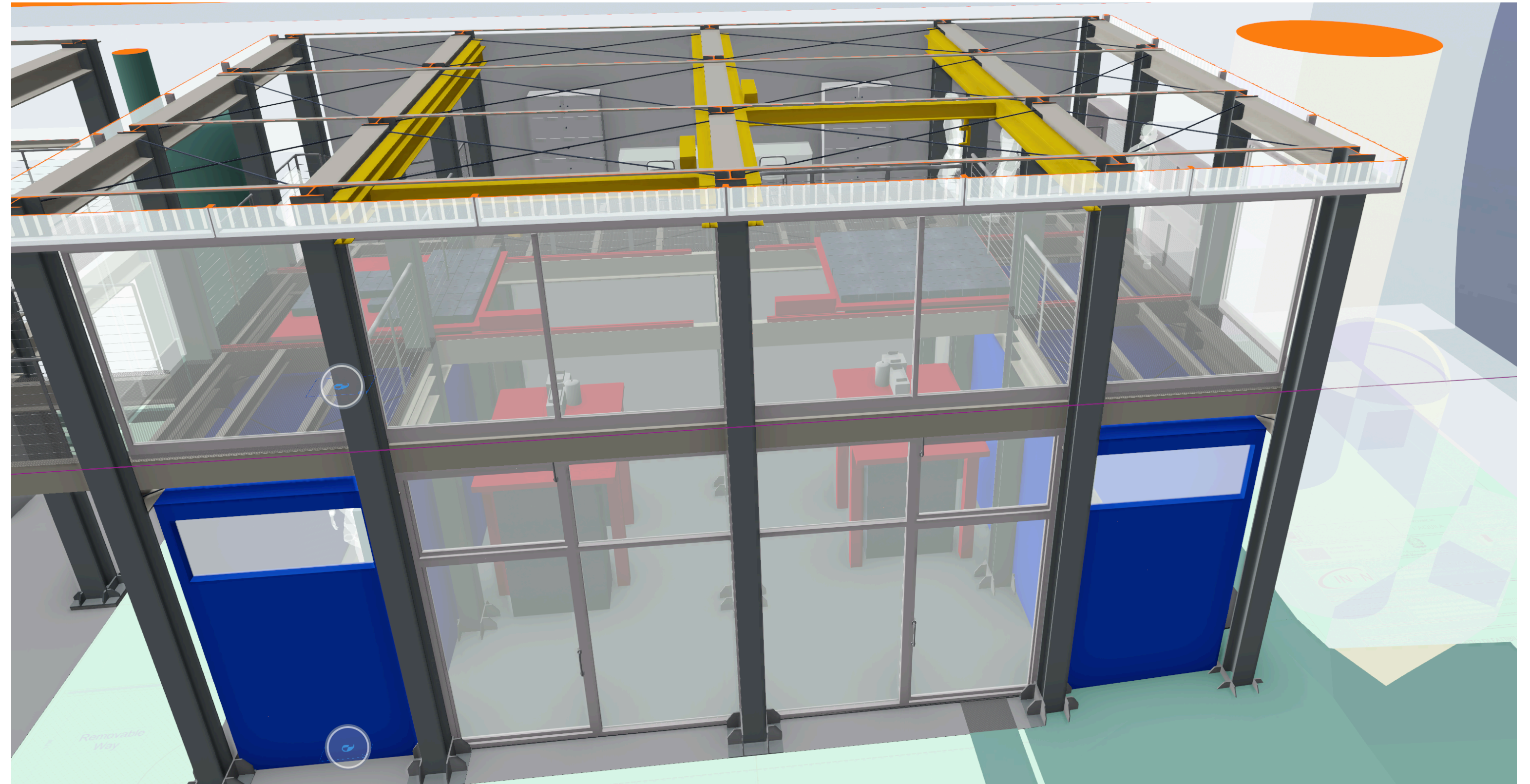
Cryo-P: an underground facility for mK applications

- Two separated experimental areas open to scientific community
- Each equipped with:
 - one dry (PT-based) dilution cryostat
 - sliding room T lead shieldings
 - "service" room for ancillaries, compressors and vacuum systems
 - 1 ton crane
 - 1st floor balcony with working stations
- 2nd floor with control room, small workshop and clean room



Cryo-P: an underground facility for mK applications

- Two separated experimental areas open to scientific community
- Each equipped with:
 - one dry (PT-based) dilution cryostat
 - sliding room T lead shieldings
 - "service" room for ancillaries, compressors and vacuum systems
 - 1 ton crane
 - 1st floor balcony with working stations
- 2nd floor with control room, small workshop and clean room



Cryo-P: an underground facility for mK applications

- Two separated experimental areas open to scientific community
- Each equipped with:
 - one dry (PT-based) dilution cryostat
 - sliding room T lead shieldings
 - "service" room for ancillaries, compressors and vacuum systems
 - 1 ton crane
 - 1st floor balcony with working stations
- 2nd floor with control room, small workshop and clean room



Cryo-P cryostats

Common features:

- low-background:
 - roomT side and top lead shielding
 - mK top lead shielding hanging below the MC
 - selected materials for vessels and elements in the experimental volume
- single vacuum chamber
- ≥ 6 optical fibers
- ≥ 20 RF lines with LNA, attenuators and circulators
- additional DC wiring (≥ 144 twisted pairs)
- control software



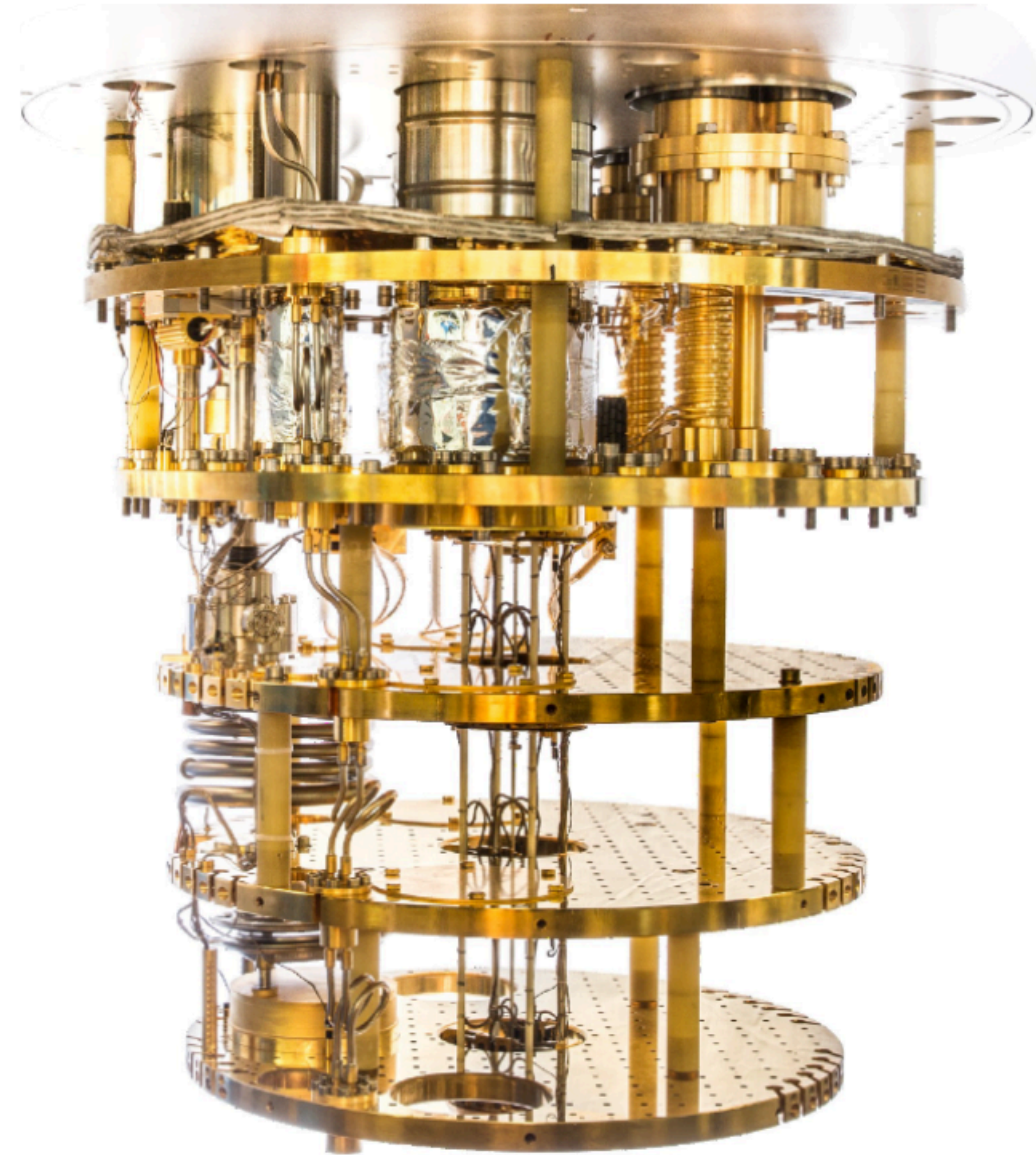
Leiden cryostat

“Large” or “Leiden” cryostat:

- by Leiden Cryogenics
- 50 cm diameter x 100 cm height
- two PT425-RM by Cryomech
- 25 μ W @20 mK
- base T \leq 8 mK
- < 2 weeks to base T
- suitable for 6-12 months runs
- expected delivery: Sep 2024
- expected commissioning: early 2025
- (2025-2028) CUPID, CRESST and SQMS
- (2028->...) opened to scientific community

Specials:

- \geq 400 kg mass at base T
- lifting table



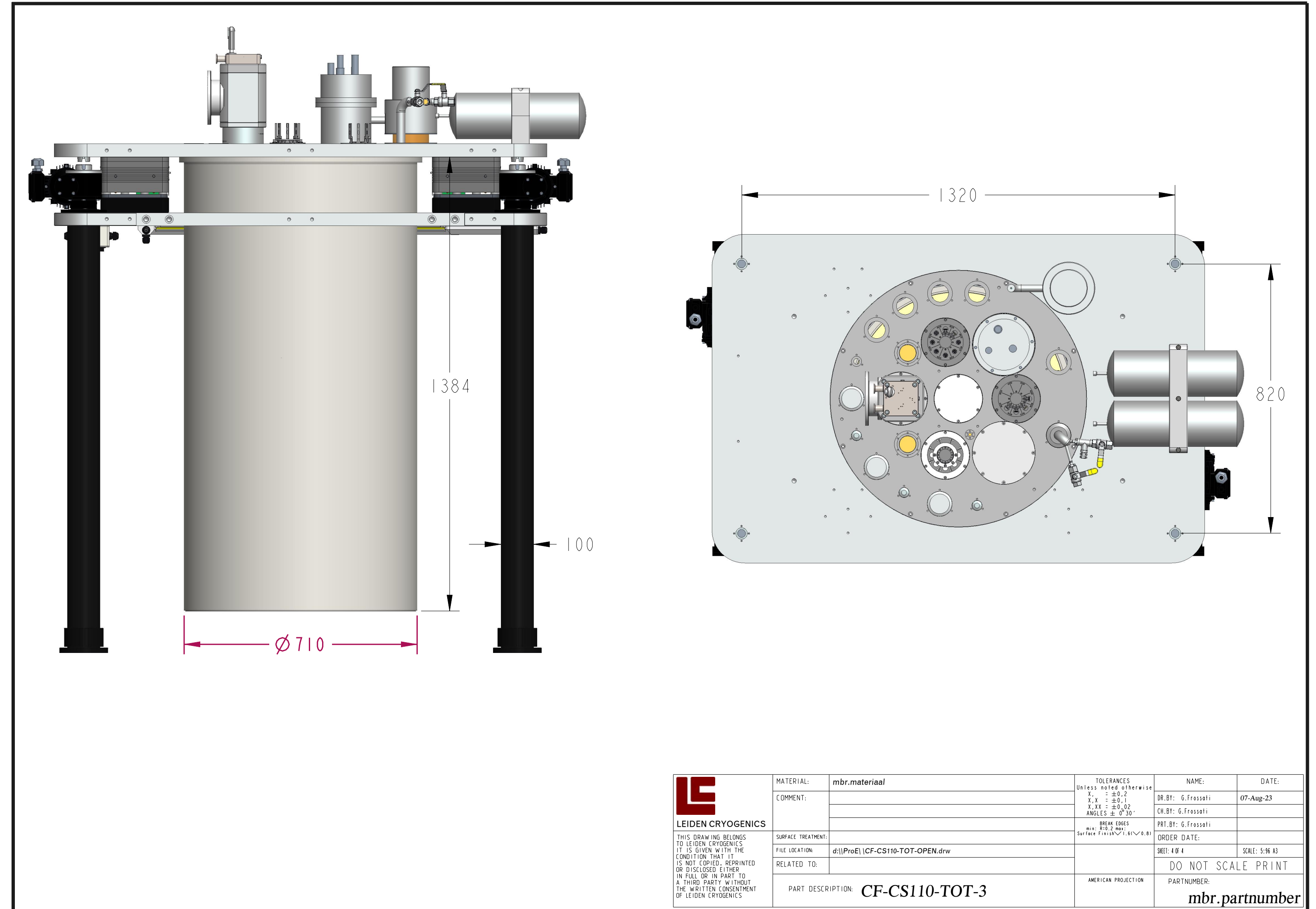
Leiden cryostat

“Large” or “Leiden” cryostat:

- by Leiden Cryogenics
- 50 cm diameter x 100 cm height
- two PT425-RM by Cryomech
- 25 μ W @20 mK
- base T \leq 8 mK
- < 2 weeks to base T
- suitable for 6-12 months runs
- expected delivery: Sep 2024
- expected commissioning: early 2025
- (2025-2028) CUPID, CRESST and SQMS
- (2028->...) opened to scientific community

Specials:

- \geq 400 kg mass at base T
- lifting table



: 192

192

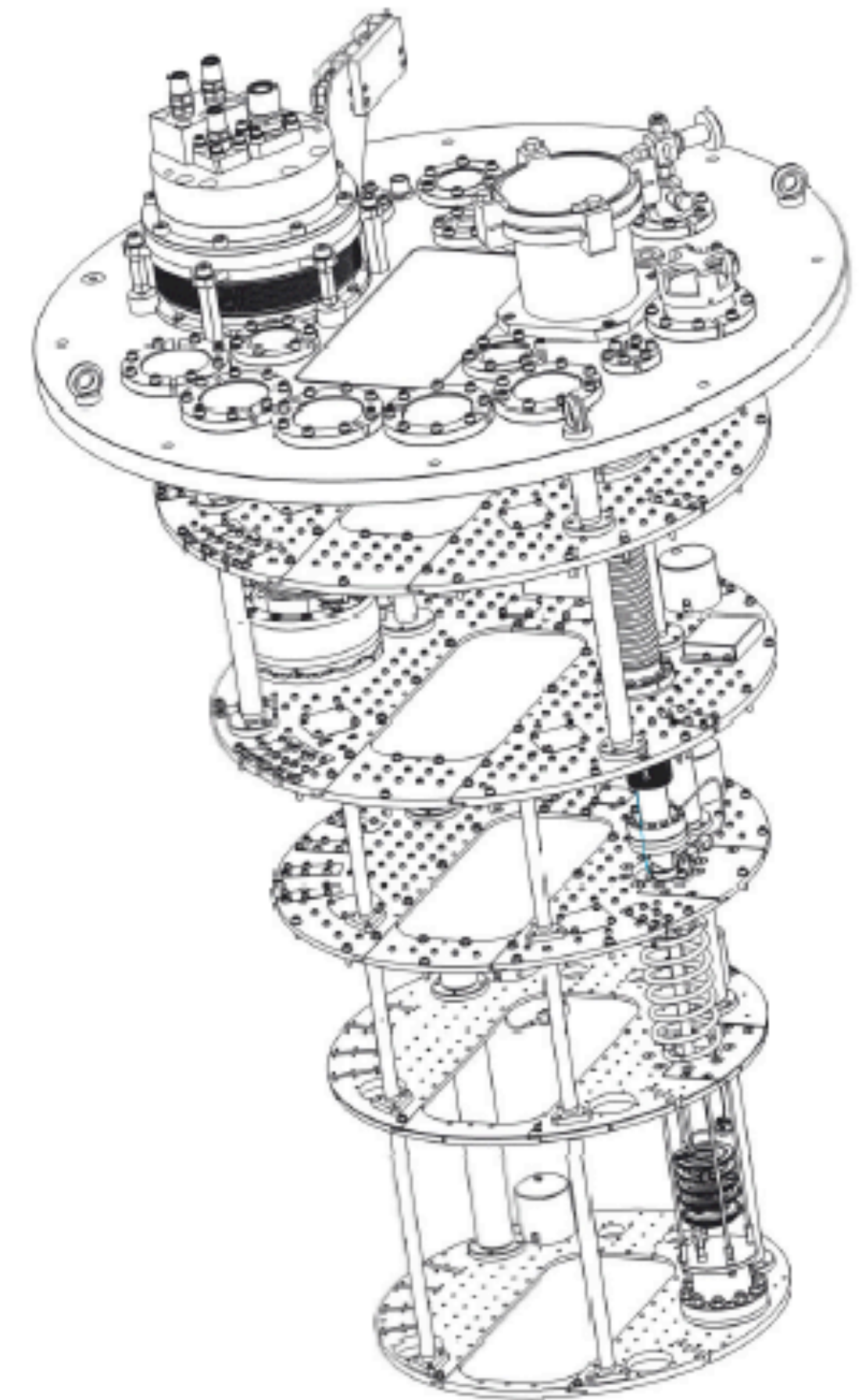
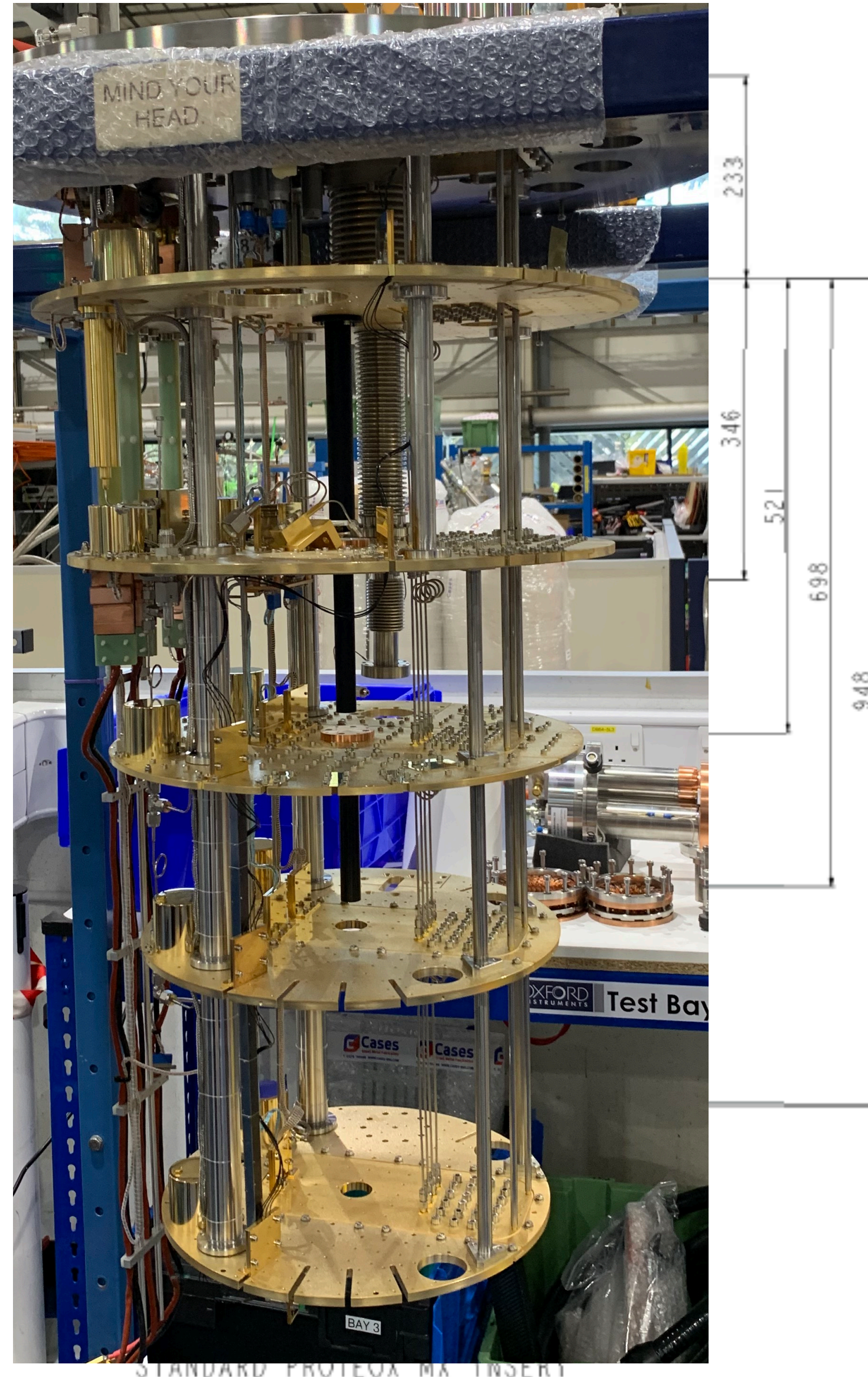
Oxford cryostat

“Small” or “Oxford” cryostat:

- by Oxford Instruments
- 36 cm diameter x 40-50 cm height
- one PT425-RM by Cryomech
- $>10 \mu\text{W}$ @ 20 mK
- base $T \leq 10 \text{ mK}$
- < 10 days to base T
- suitable for 3-6 months runs
- expected delivery: Nov 2024 - Mar 2025
- expected commissioning: mid 2025
- (2025->...) opened to scientific community

Specials:

- $\geq 220 \text{ kg}$ mass at base T
- secondary insert
- 12 T magnet
- sample loader



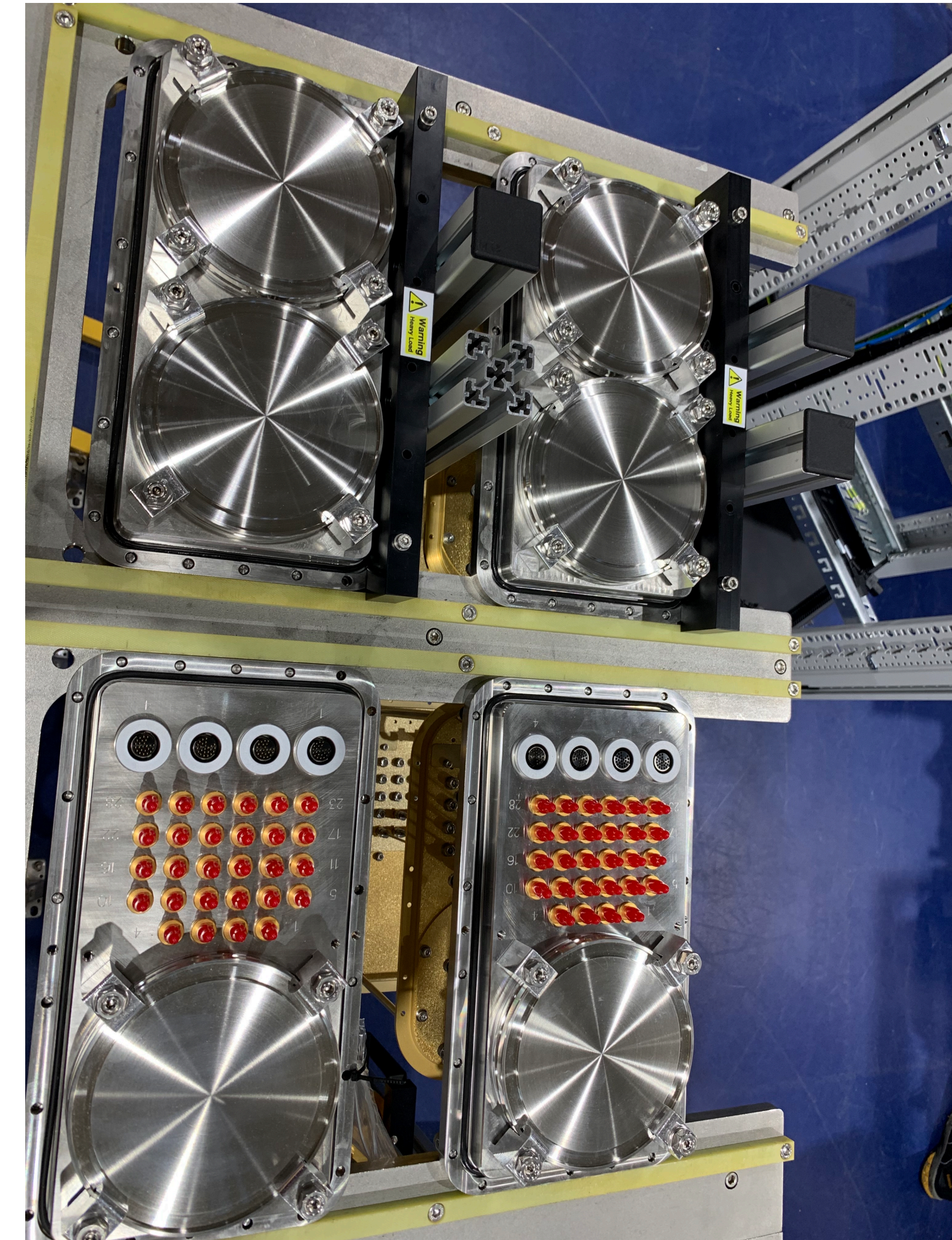
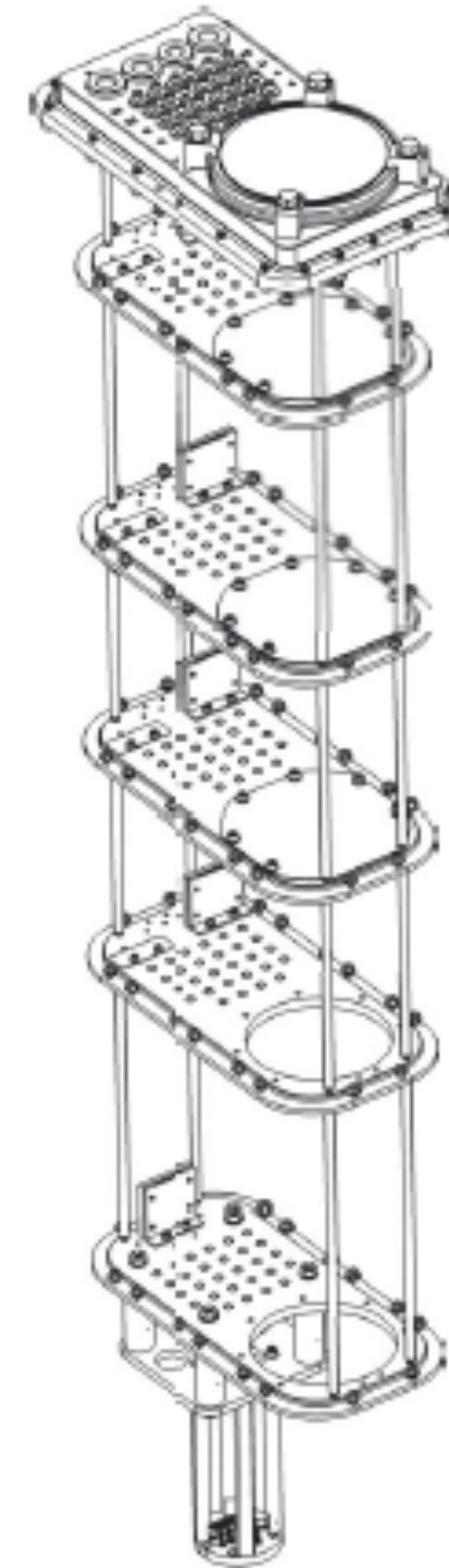
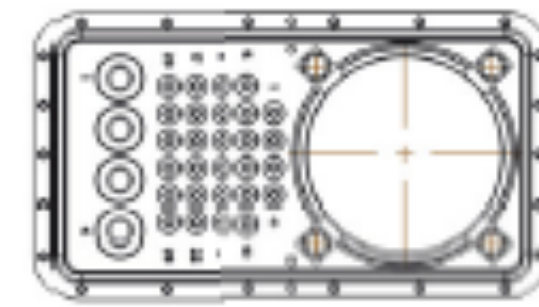
Oxford cryostat

“Small” or “Oxford” cryostat:

- by Oxford Instruments
- 36 cm diameter x 40-50 cm height
- one PT425-RM by Cryomech
- $>10 \mu\text{W}$ @ 20 mK
- base $T \leq 10 \text{ mK}$
- < 10 days to base T
- suitable for 3-6 months runs
- expected delivery: Nov 2024 - Mar 2025
- expected commissioning: mid 2025
- (2025->...) opened to scientific community

Specials:

- $\geq 220 \text{ kg}$ mass at base T
- secondary insert
- 12 T magnet
- sample loader



PR: INSERT BLL
(WIRING ORDERED SEPARATELY)



Istituto Nazionale di Fisica Nucleare
Laboratori Nazionali del Gran Sasso

Thanks

