HERA/LHC Workshop, CERN, Jan 18th 2005

The integration of 420 m detectors into the LHC

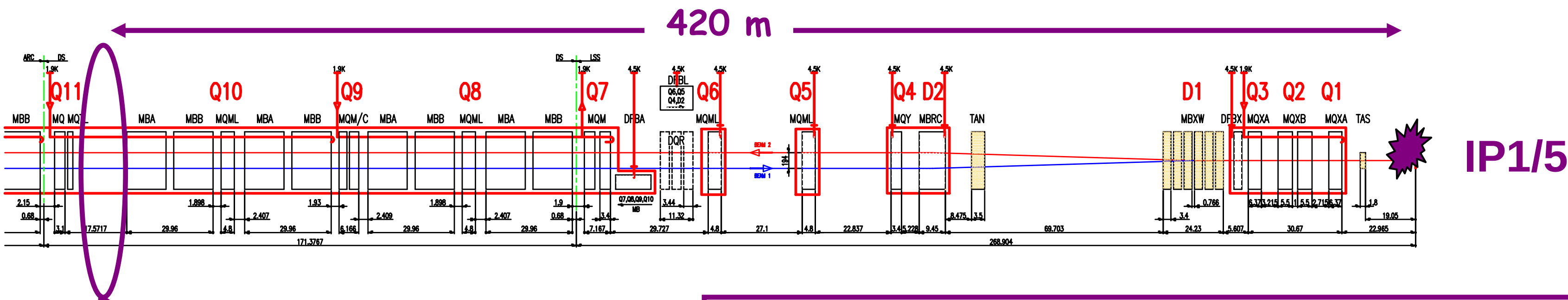
D. Macina (TS/LEA)

Many thanks to S. Marque (AT/CRI)
for the discussion summarized in this talk

OUTLINE

- Machine Layout in the IR1/IR5
- LHC cryodipole
- The interconnection cryostat
- Possible changes
- Conclusions

INSERTION LAYOUT



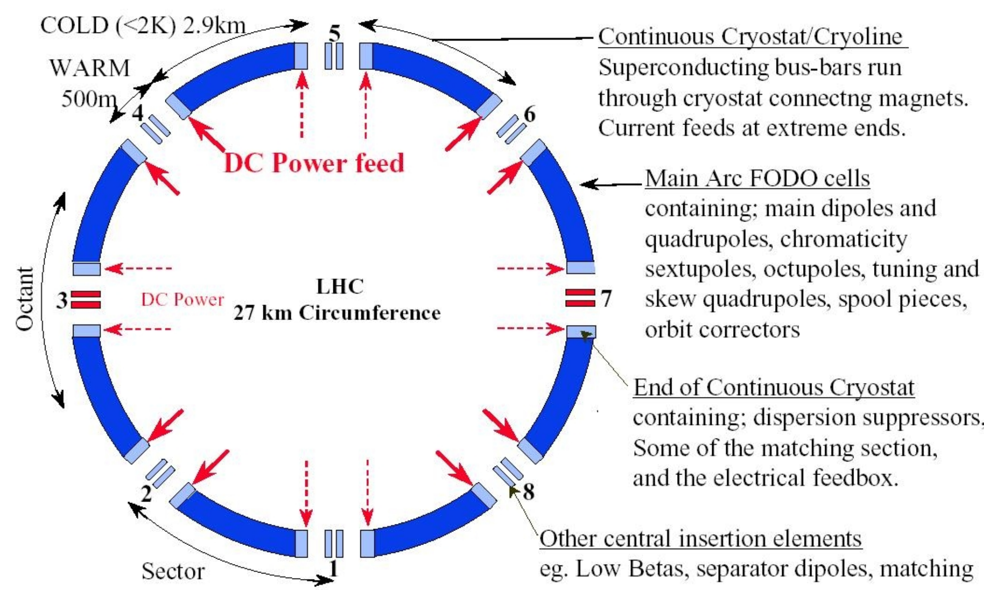
CONNECTION CRYOSTAT

Consists of 15 m long drift space

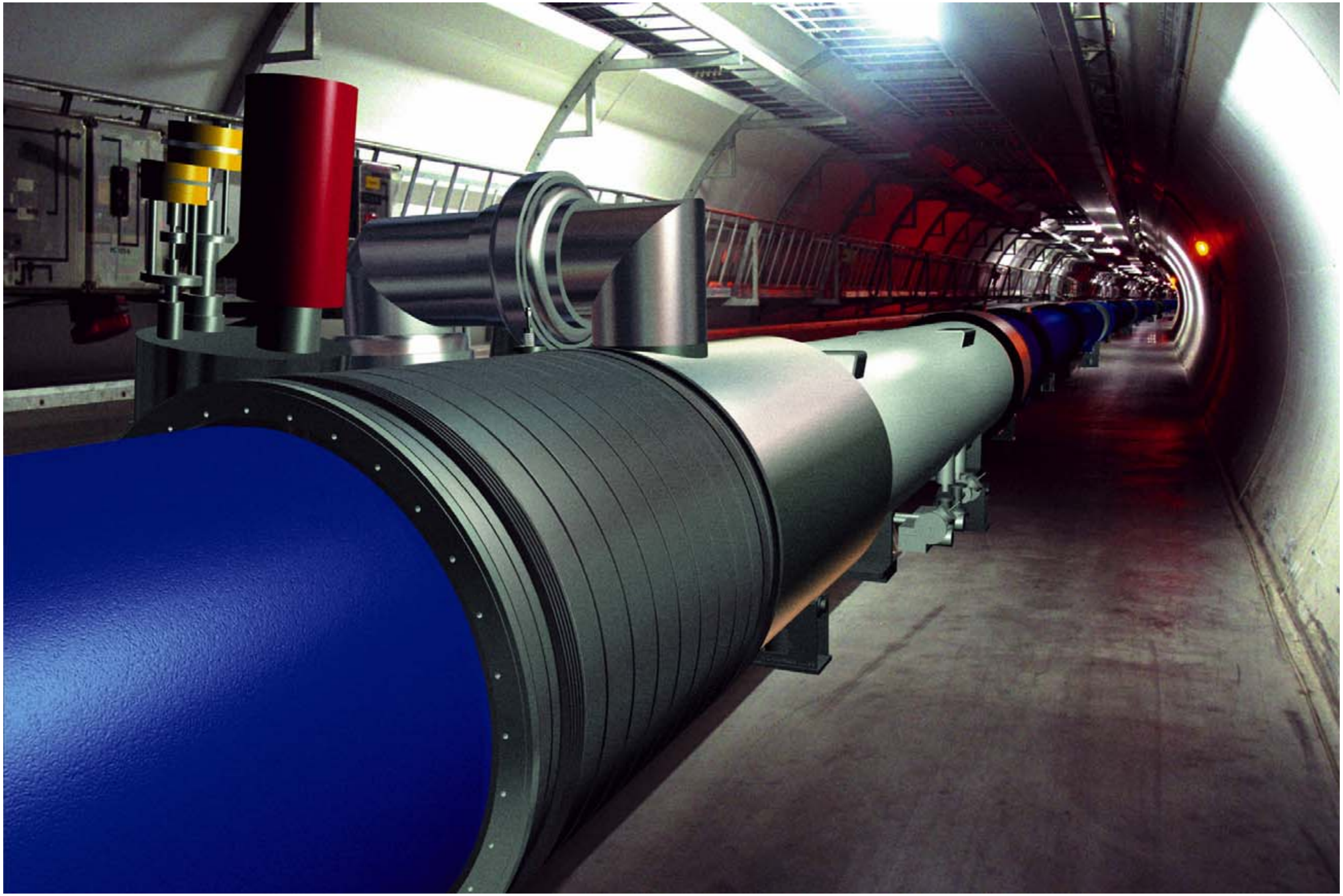
Provides a continuity of beam and insulation vacuum, electrical powering, cryogenic circuits, thermal and radiation shielding

Provides connection between the arcs and DS zones

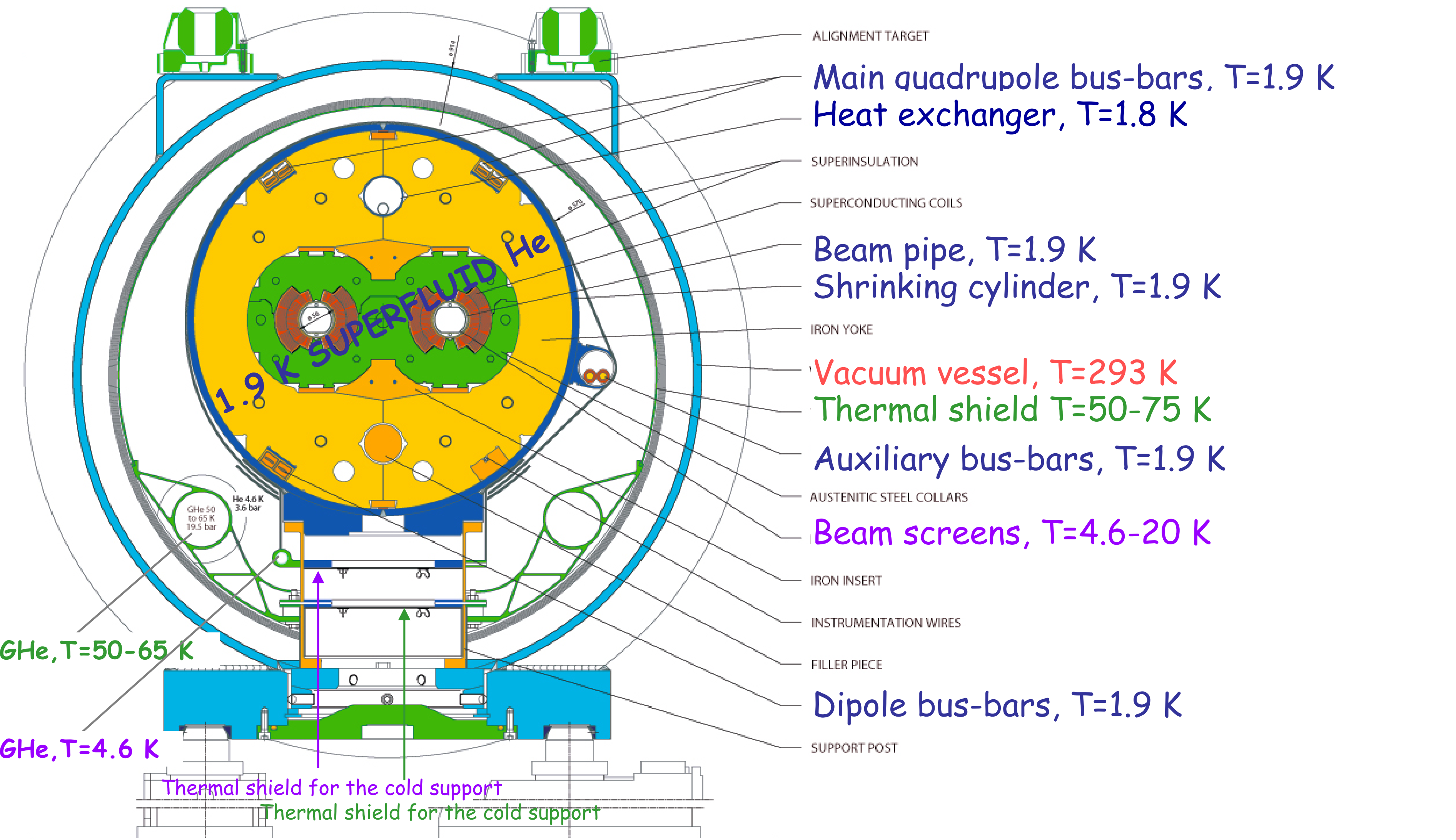
Powering of the 8 arc continuous cryostats 26 Busbars, 42 wires



LHC ARC



LHC dipole cross-section



The connection cryostat is exactly the same apart from the cold mass

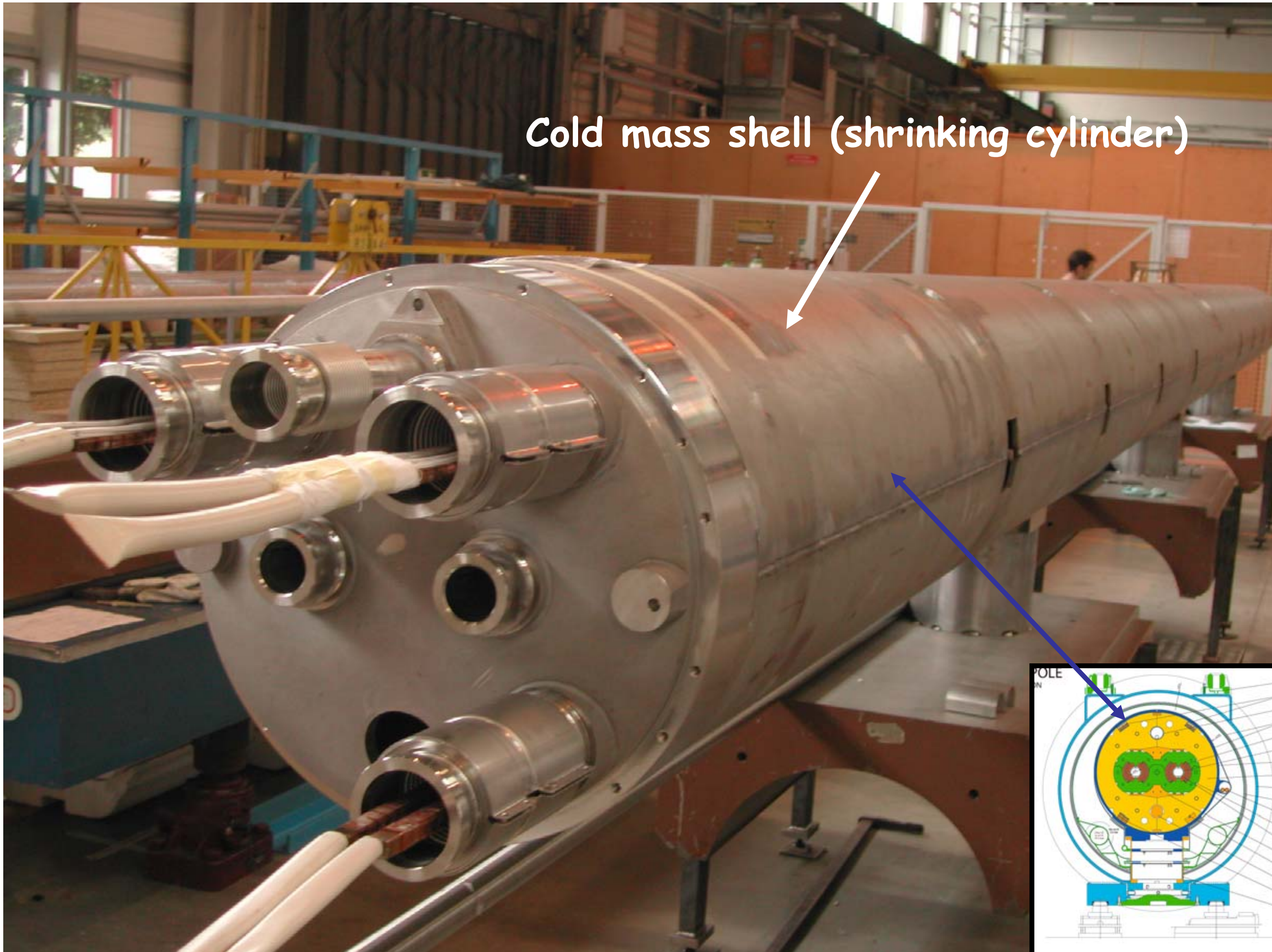
Connection cryostat

- All components located outside the "cold mass" are the same as for a cryodipole:
- jacks
- vacuum vessel (P<10^{-4} Pa, max 10^{-2} Pa)
- alignment devices
- cold mass supports
- thermal shield

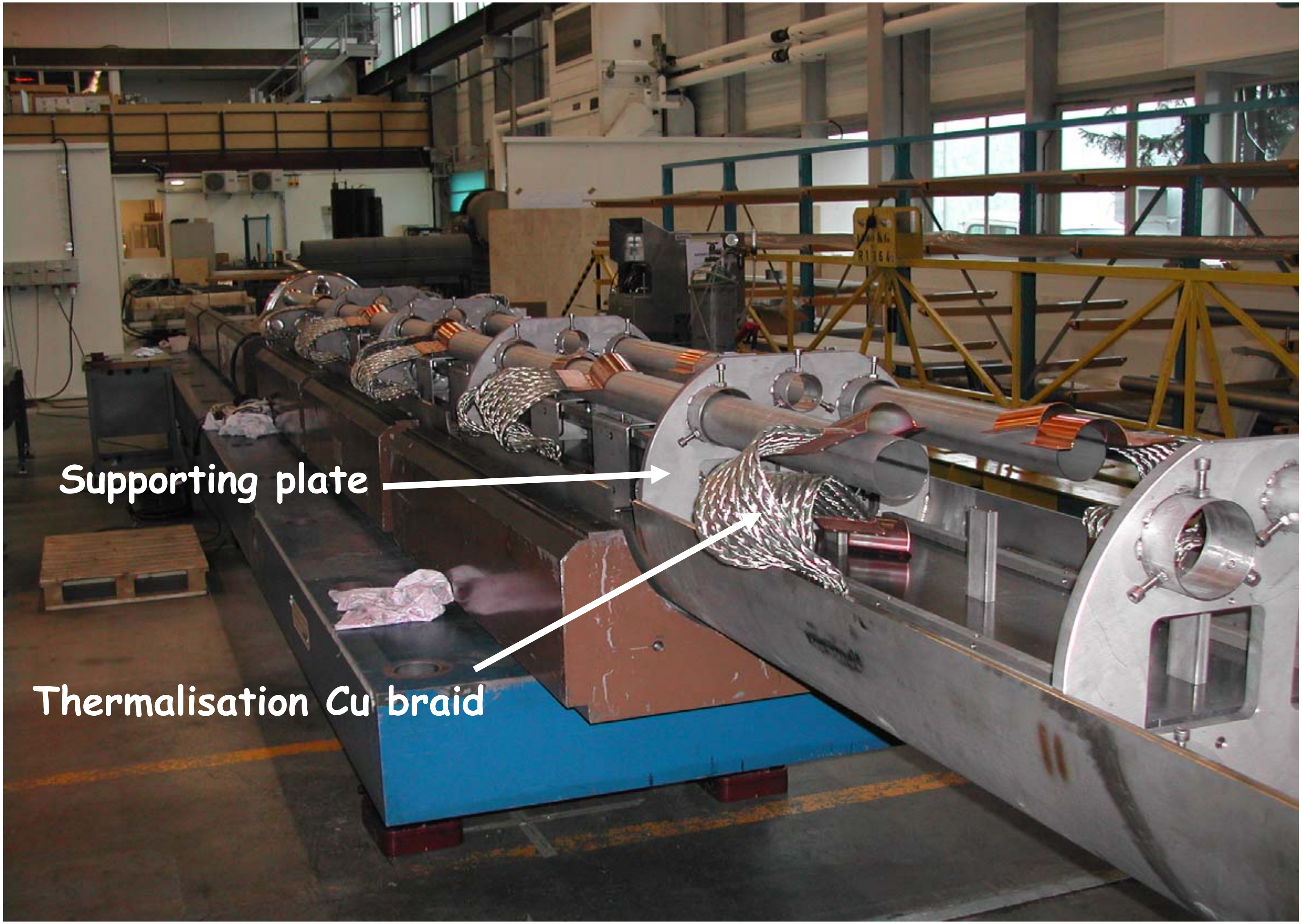
(reduces the heat from T=293->1.9 K. It is made of MLI blankets wrapped around Al shells)

- thermalisation of cold support posts

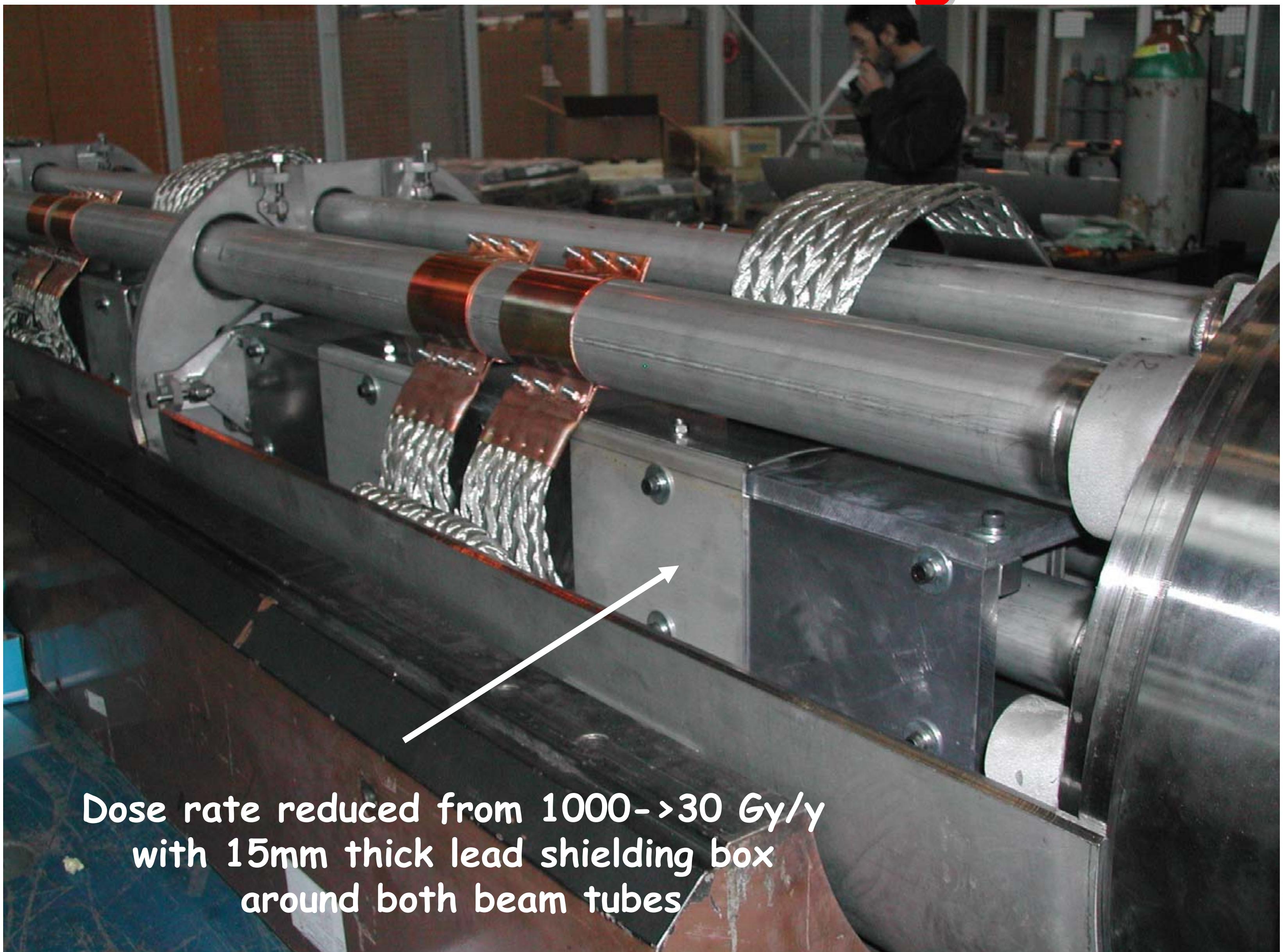
The connection cryostat "cold mass"



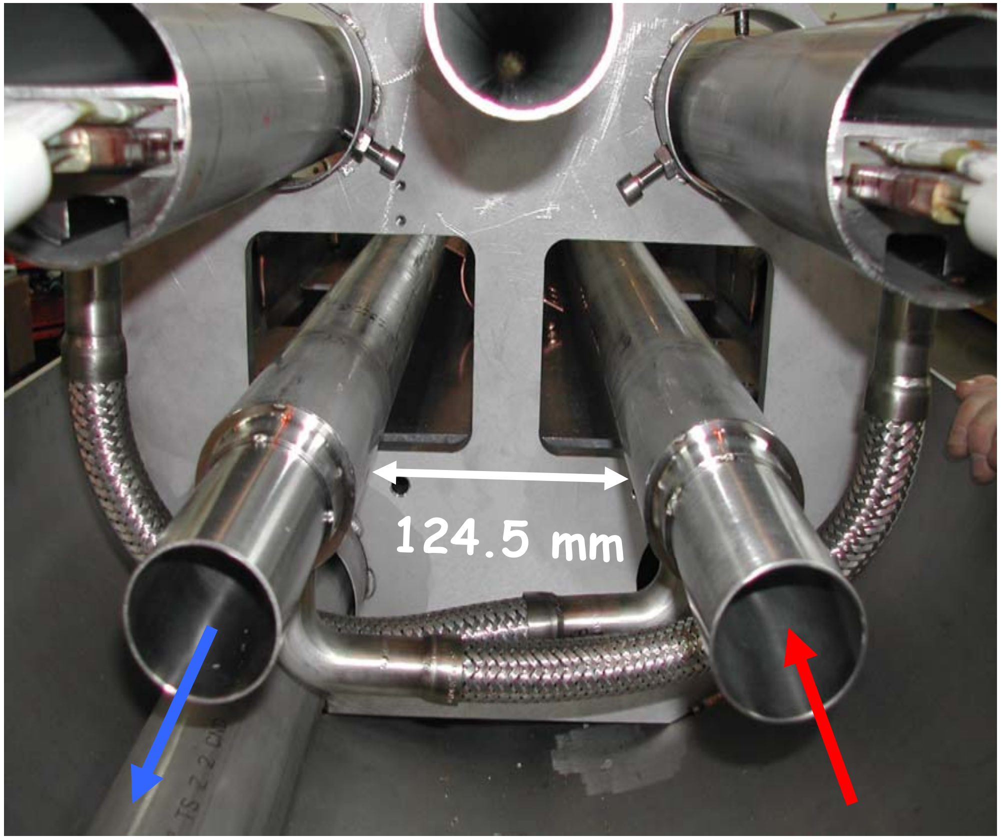
Connection cryostat "cold mass"



Radiation shielding box

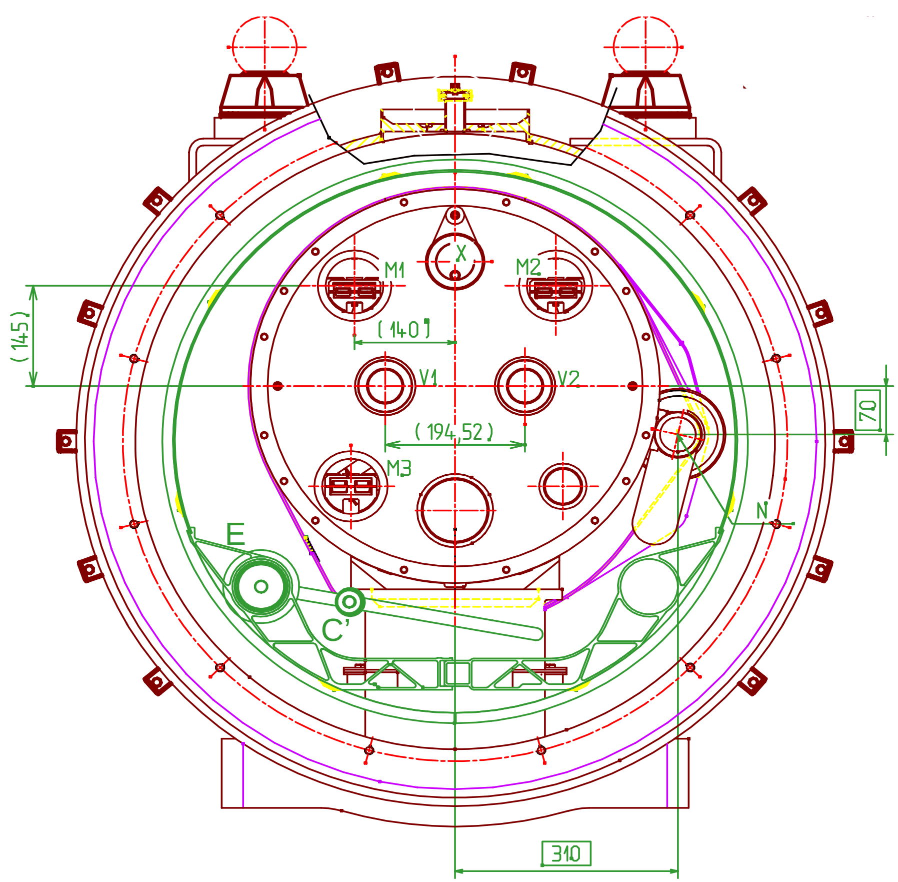


“COLD MASS”



- T (vacuum pipes) < 3.3 K to allow sufficient H_2 cryopumping => vacuum pipes immersed in a bath of superfluid He
- Minimal distance between bus-bars and beam pipes to avoid B magnetic field on the beam

Lines to be kept for continuity



Line	T(K)	$Ø_i$ – $Ø_e$(mm)
M1,M2,M3 Bus-bars	1.9	80-84
N Auxiliary bus-bars	1.9	50-53
X Heat exchanger	1.8	54-58
E Thermal shield	50-65	79-86
C' Supports posts and beam screens	4.6	15-17.2
V1,V2 He jackets	1.9	50-53 66-70

Proposal 1

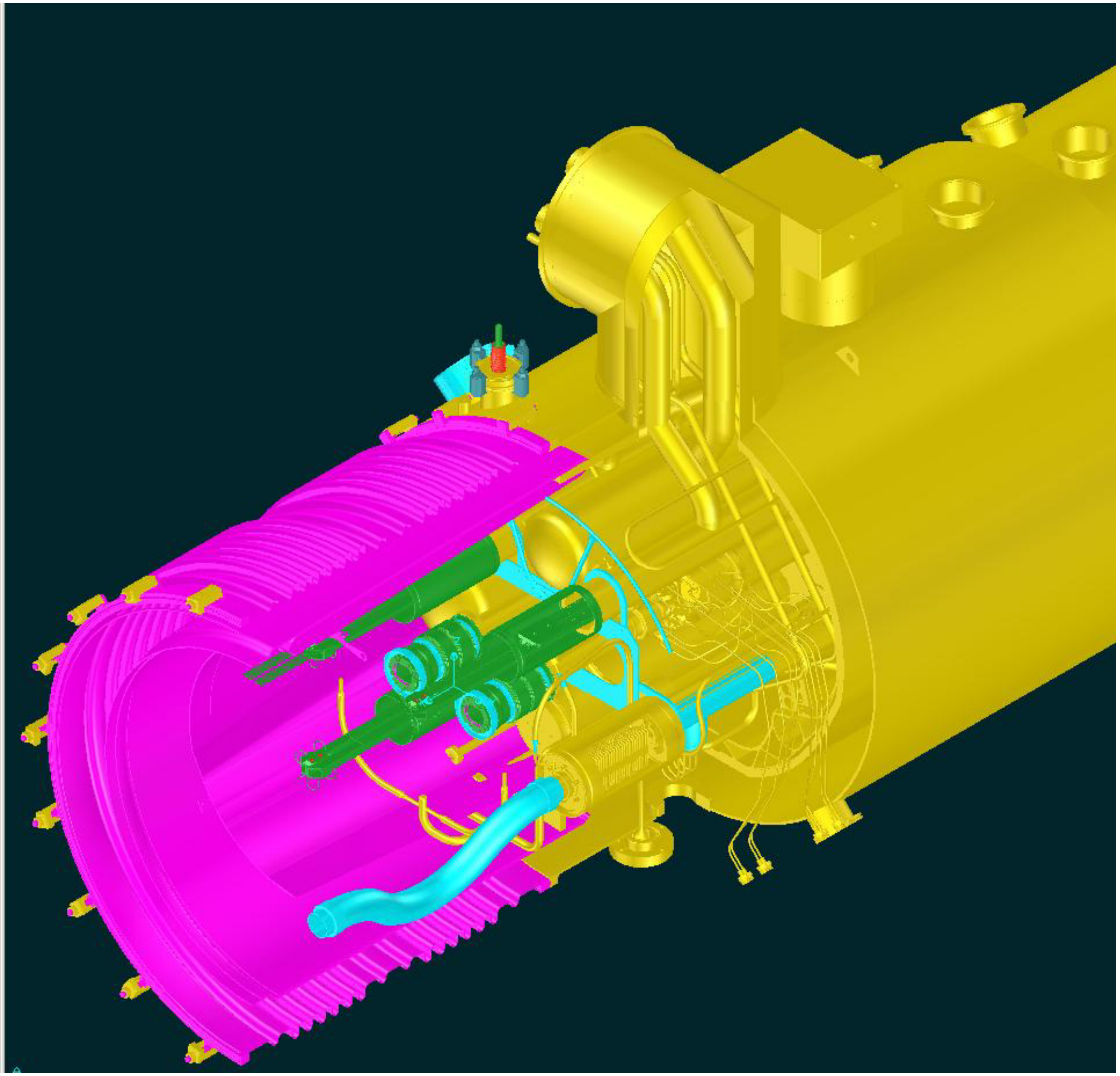
(continuity must be kept)

- **The connection cryostat is kept but is <u>modified over few meters</u> to place and access detectors** :
  - Vacuum vessel kept (an access port can be foreseen to access the detectors after the installation)
  - Thermal shield is modified to facilitate access
  - The shrinking cylinder is eliminated
  - The radiation shield is eliminated
  - The M1,M2,M3,N,E,C' can be rerouted and grouped together
  - The X line can be moved along the horizontal plane but has to be kept parallel to the tunnel floor
  - Both the He jackets and beam screens have to be kept to maintain a good dynamic vacuum pressure (in particular if "non conditioned" vacuum pipes). However they can be eliminated over a length of few tens of cm at the detectors location

Proposal 1 con't

- Advantages
  - The connection cryostat "continuity concept" is kept and the modifications are minimized
- Disadvantages
  - The access to the detector is very difficult:
    - One sector , ~ 200 m long, has to be warm up to 293 K
    - The two adjacent sectors have to be warm up to an intermediate temperature
    - The whole procedure takes at least one week (the same is valid for cool down)
    - One could imagine a "sas device" (technically <u>very</u> challenging) that together with a remote handling of the detector, could avoid the warm up of the whole sector
  - The additional heat load due to the detectors has to be carefully studied. The cryostat has been designed to cope with the assumed ultimate static and dynamic heat loads of 8.2 W dissipated at 1.9 K (both beams)
- Machine safety and vacuum issues to be discussed

It may look like a magnet interconnection…



Proposal 2
(continuity must be kept)

We make a cold-warm transition (as in the LSS)

- The connection cryostat is eliminated
- 4 cold warm transitions are made between the last dipole cold mass after Q10 and Q11
- Two standard warm beam pipes between the cryostats (Cu beam pipes and NEG coating)
- New "mini cryostat design" to keep the continuity of the cryogenic and electrical lines

Proposal 2 con't

- Advantages:
  - Accessibility to the detectors similar to the one foreseen for the Roman Pots at LSS1 and LSS5
  - Detector heat load less problematic
- Disadvantages:
  - The design of the new cryostat has to start from scratch and is very challenging:
    - The location and supports of the mini cryostat have to fit the tight space constraints in the tunnel
    - The overall rigidity of the new structure has to be carefully analyzed (differential pressure of 20 bar during a quench, interconnection forces..)
    - Given the number of lines which have to be kept "continuous", their sections, the cryogenics constraints (heat loads, thermal shielding etc) it is not clear how much space is left for the detectors
  - This proposal requires more study than the previous one since the continuous cryostat is eliminated
- Machine safety and vacuum issues to be discussed

Conclusions

- The integration of experimental detectors in the cold region of the LHC (420 m from IP) looks conceptually feasible
- The complexity of the new design strongly depends on the detector requirements
- In addition to the cryostat design and detectors requirements, machine safety and vacuum issues should be taken into account