

Objectives for LHC compatible BGC instrument (v3)

G. Schneider

Content

- **Framework of the project**
- **Performance objectives for v3**
- **Vacuum considerations**
- **Dimensions**
- **Planning**
- **Interfaces and Installation considerations**
- **Infrastructure**
- **Summary**

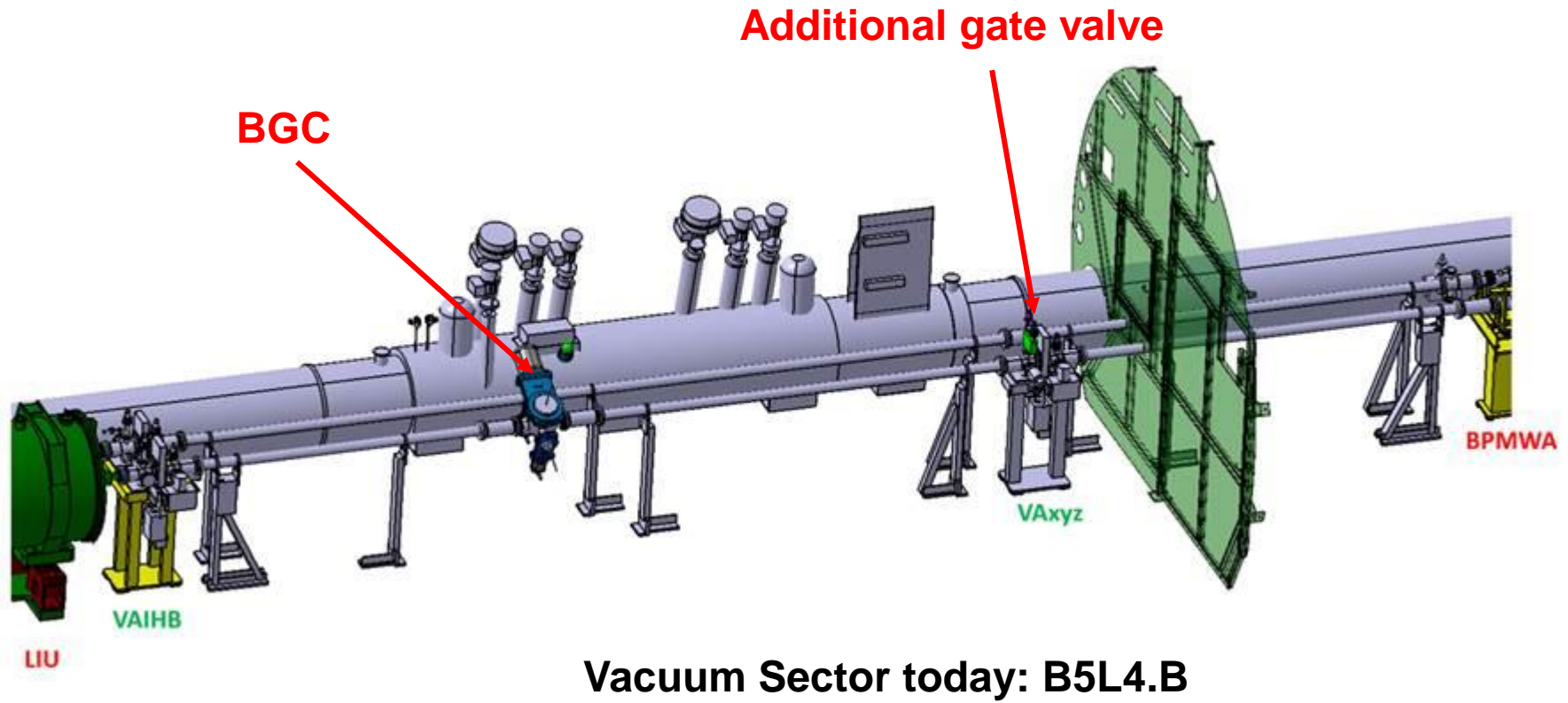
Framework of the project

- The CERN internal PLAN reservation made in 2015 as Activity 10834
- Engineering Change Request (ECR) for the installation of BGC demonstrator instrument is about to be send out for check
 - Staged approach, further ECRs will follow until the installation
 - Location of Hollow Electron Lens (HEL) vacuum sector, what is today B5L4.B, will be split
 - Cable requests for BGC are made
- Our collaboration includes the design and production of a second gas-jet monitor (v3) by Cockcroft/Liverpool for installation in the LHC, with the following milestones:
 - “*Design report for a final gas-jet for the LHC*” : Report, June 2018
 - “*Full prototype adapted for testing in the LHC*” : Hardware, June 2019

Performance objectives for v3

- **Fully operational optical system, adopted for both proton and electron beam**
- **Gas curtain traversing LHC beam in a defined way**
 - **Quantity and Density**
 - **Position**
 - **Shape**
- **LHC Beam compatible (Vacuum, Impedance, Aperture, Alignment, Safety ...)**
- **Useful integration time**

Vacuum Sectorisation to be made in LS2



Vacuum Sector today: B5L4.B

Courtesy: Pablo Santos Diaz

Vacuum Considerations

Amount of gas injected, based on Cockcroft design:

Pressure in Nozzle chamber: 1×10^{-3} mbar, using 100 l/s pump

→ gas flow of 1×10^{-1} mbar.l/s

Use for 1 year run assuming 200 days continuous:

1×10^{-1} mbar.l/s x 3600 s x 24 h x 200 d = 1728 bar/l

Consider 50 l gas bottle at 200 bars → 10000 bar/l → will last 5 years

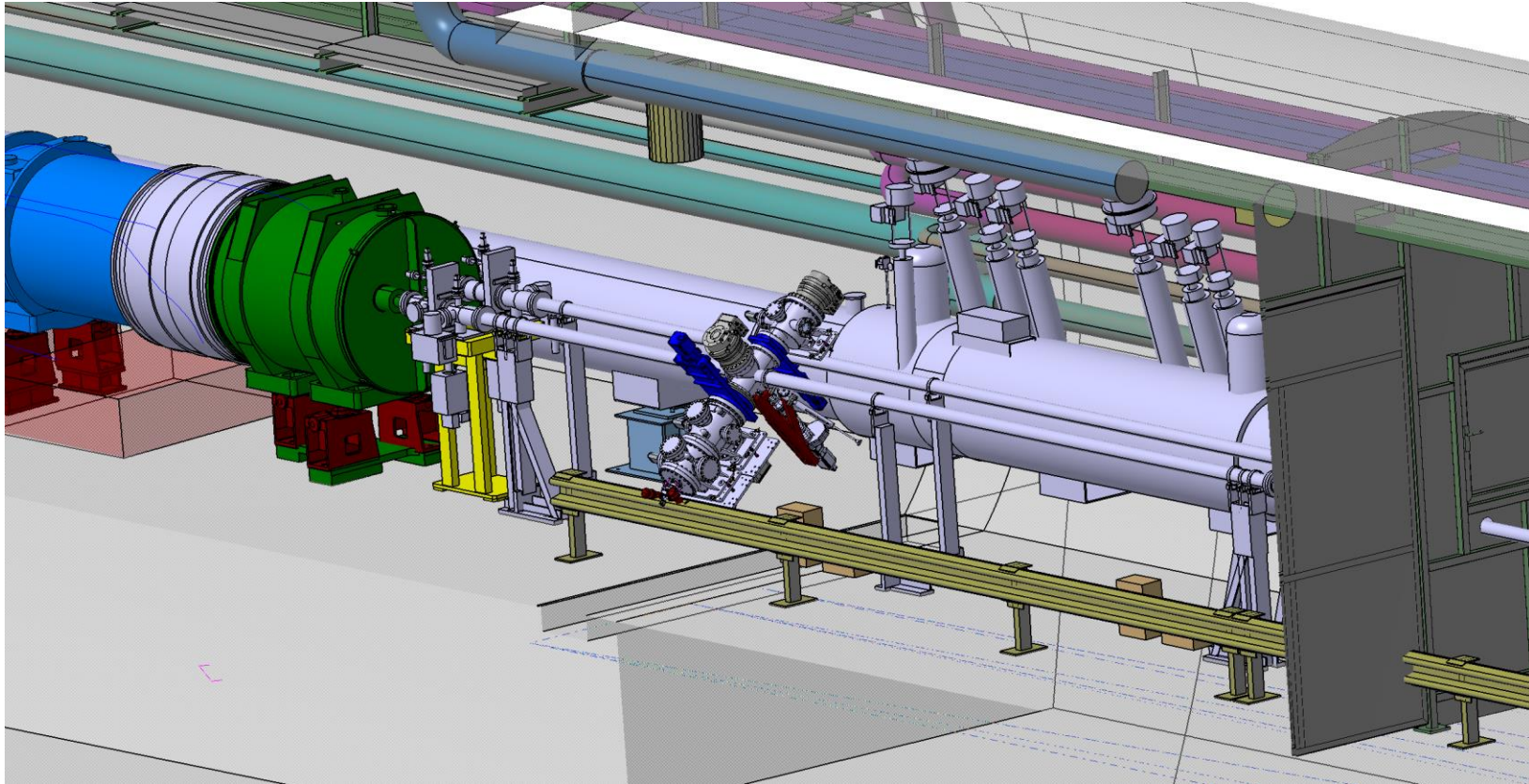
→ Will need positive replacement pump on Nozzle chamber → Turbo Pump

Pressure between skimmer 1-2 → 10^{-5} mbar using 100 l/s pump → 10^{-3} mbar.l/s

Pressure between skimmer 2-3 → 10^{-6} mbar using 100 l/s pump → 10^{-4} mbar.l/s

Pressure interaction chamber → 10^{-8} mbar using 100 l/s pump → 10^{-6} mbar.l/s

BGC dimensions must be optimised from laboratory set-up to machine instrument



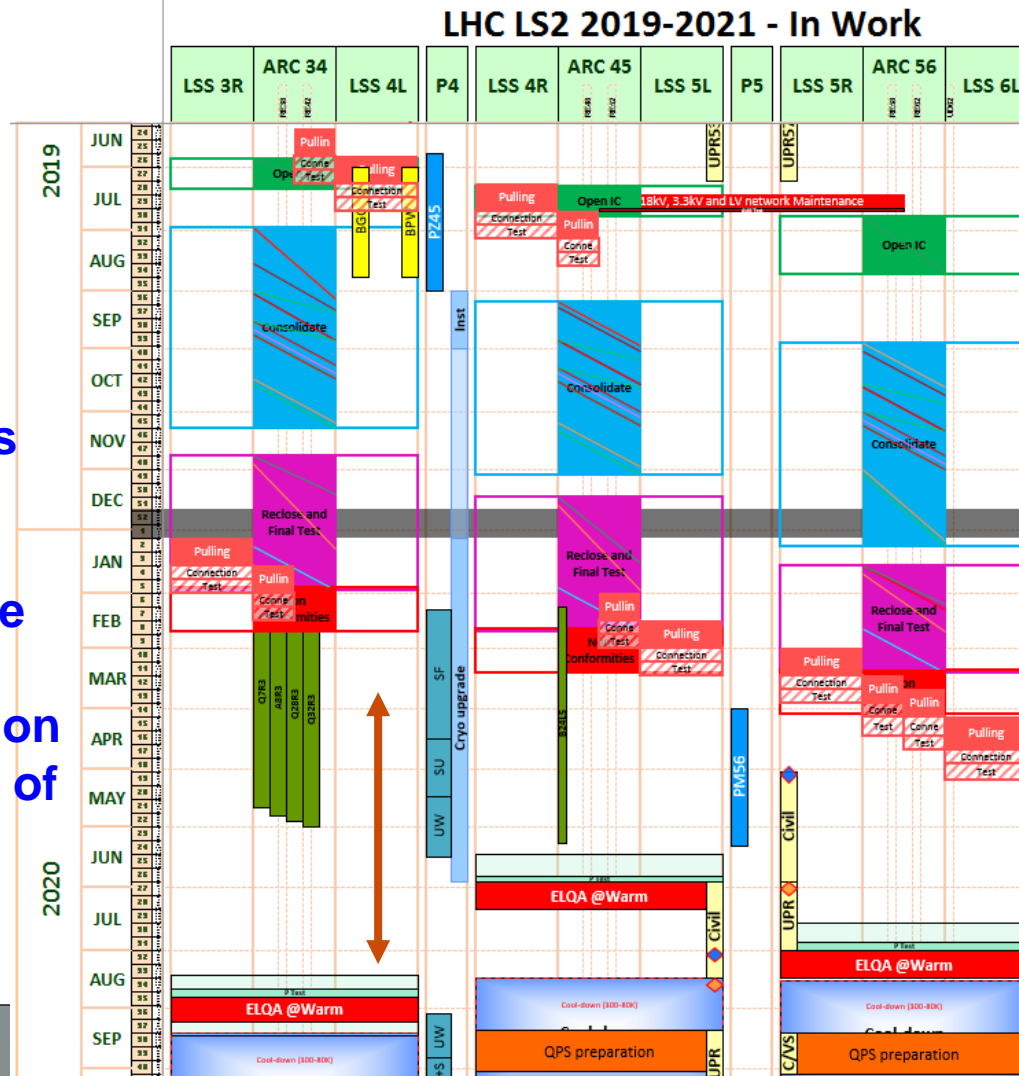
Performance/Space optimisation

- **Optimisation on high pressure side (Nozzle side)**
 - **Optimisation on the skimmer side → where to place which skimmer?**
 - **Optimisation on the pumping side → where to place the pumps and which type of pump?**
- The aim is to make the instrument more compact while reducing the integration time**

Planning: Machine installation 1

Milestone Dates

- **2018 October : Agreed design**
 - Blackening and coatings
 - Impedance
 - Gas type
 - Pumps
 - Optics
 - Skimmer dimensions an locations
 - Mechanical design of chambers
- **Safety considerations for machine and personnel:**
 - 10 bar gas, operation of pumps on beam vacuum system, injection of gas

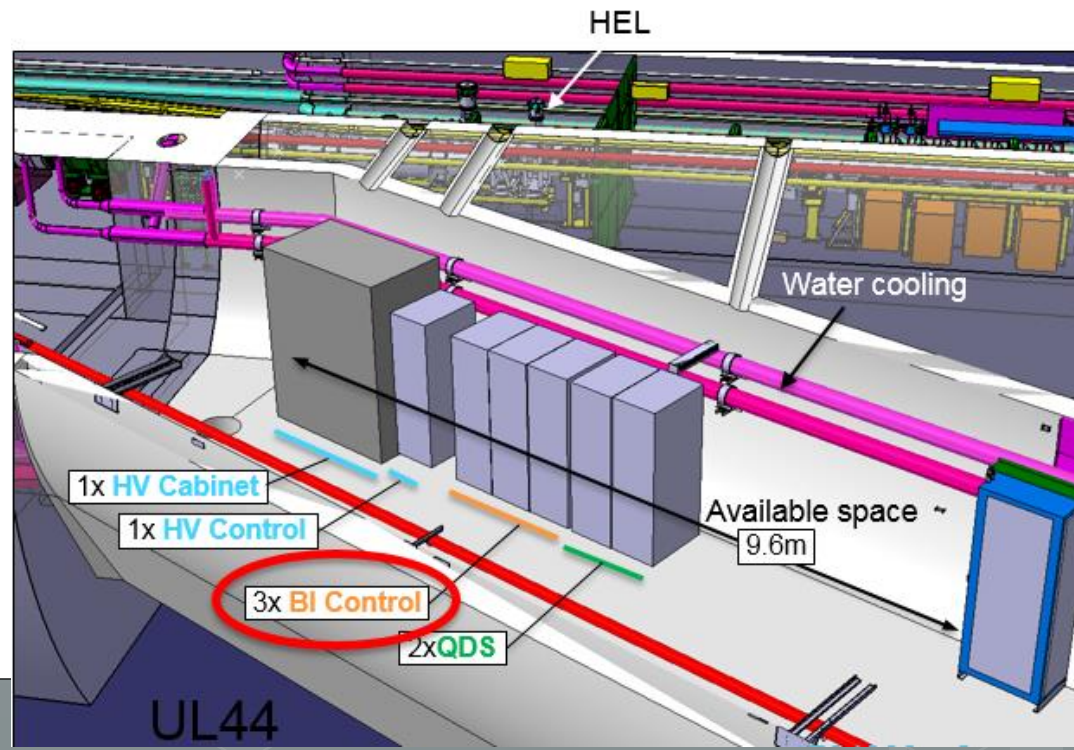


Interfaces and Installation Considerations

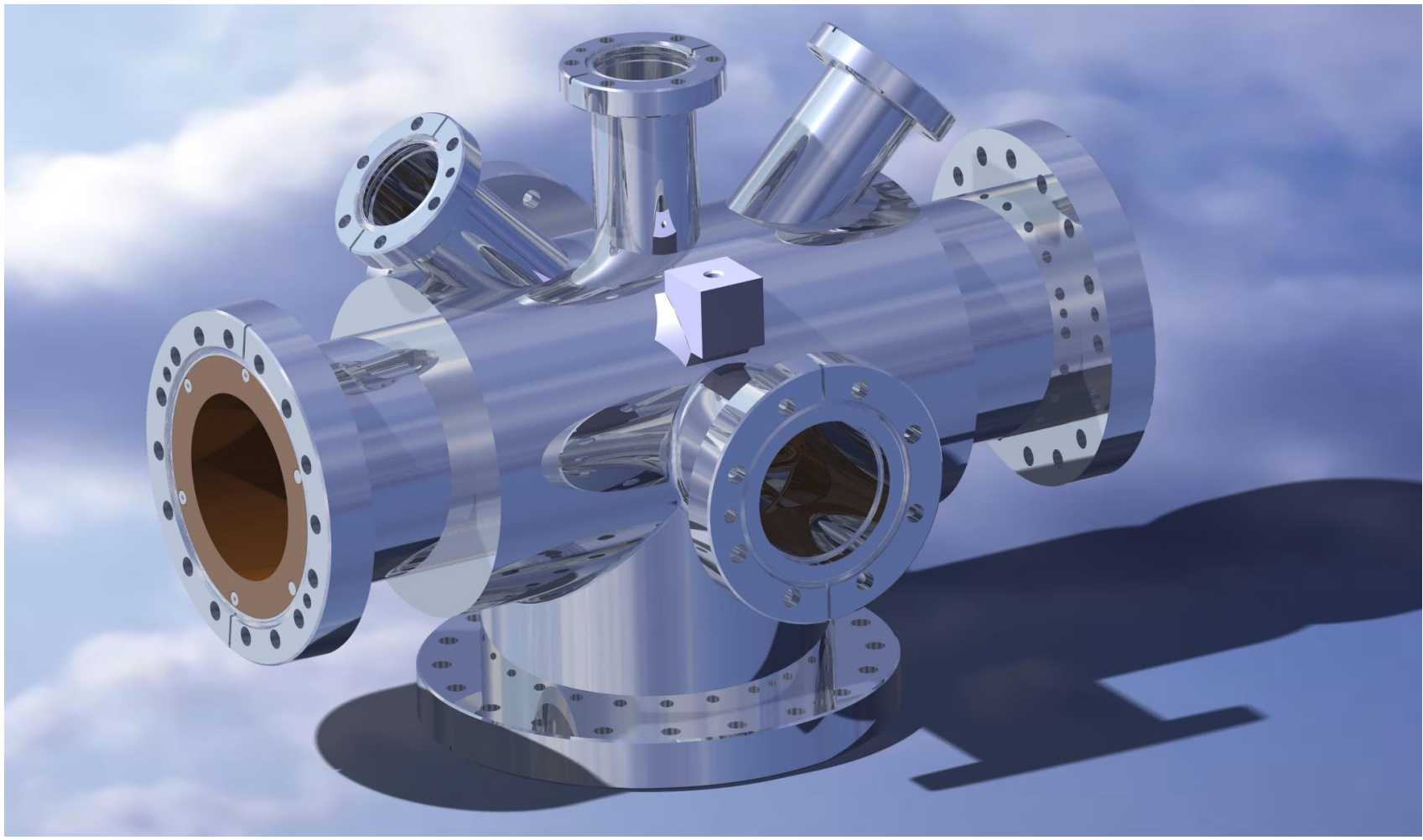
- **Impedance:** To be presented and accepted by the impedance working group
- **Geometers:** Assure that alignment of the interaction chamber is possible
- **Vacuum:** Agree on injection and pumping
- **Blackening of the chamber:** Agree on vacuum acceptable blackening with good light absorption.
- **Safety:**
 - Assure no hazard to persons
 - Assure for a save LHC operation

Infrastructure

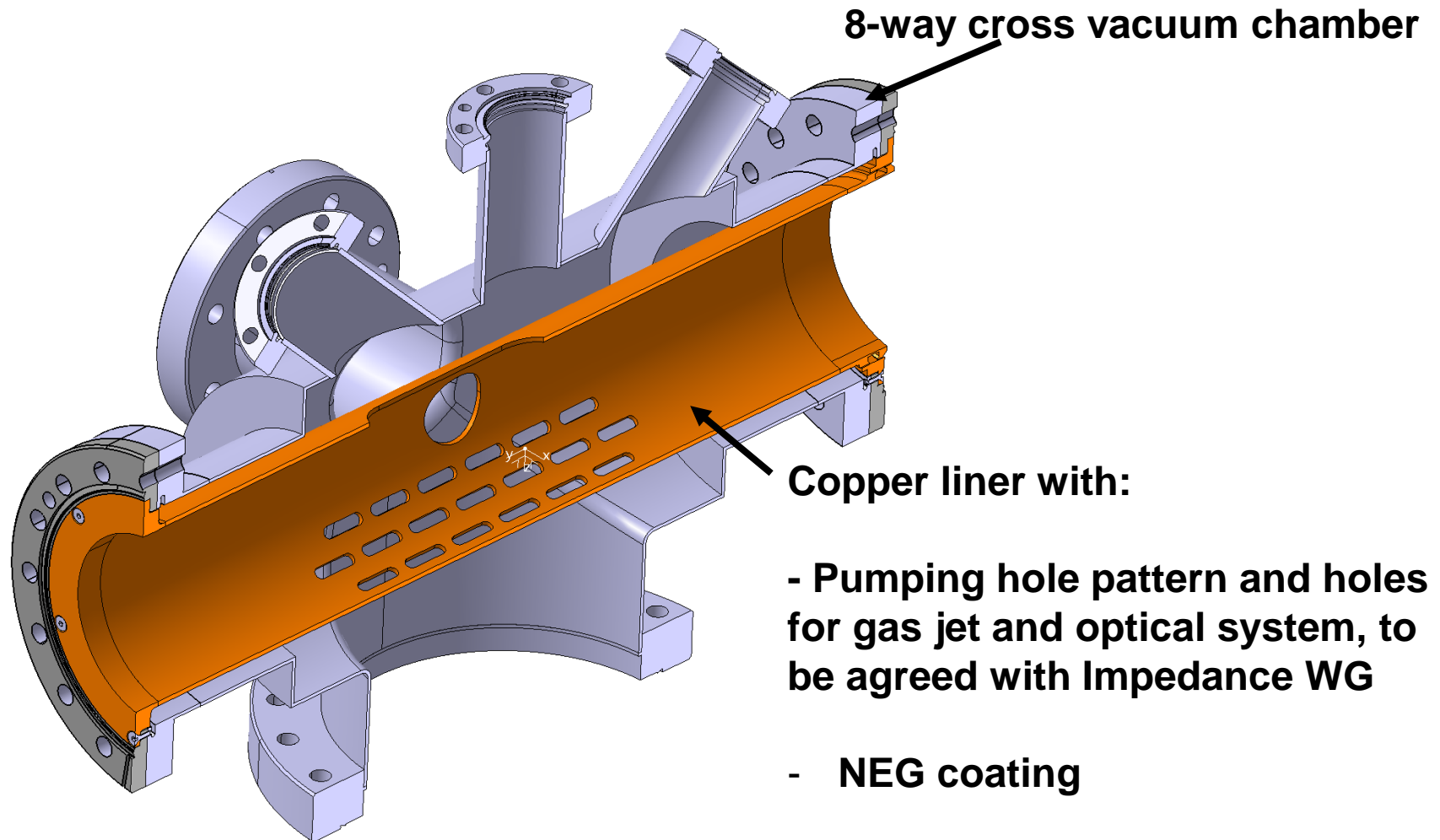
- Installation of 10 bar gas line from a gas bottle?
- Is a gas purification system needed?
- Operation of the vacuum system from the racks in UL44
- Installation of supports
- Pull cables
- Installation of Rack in UL44



BGC Vacuum Chamber



BGC Vacuum Chamber

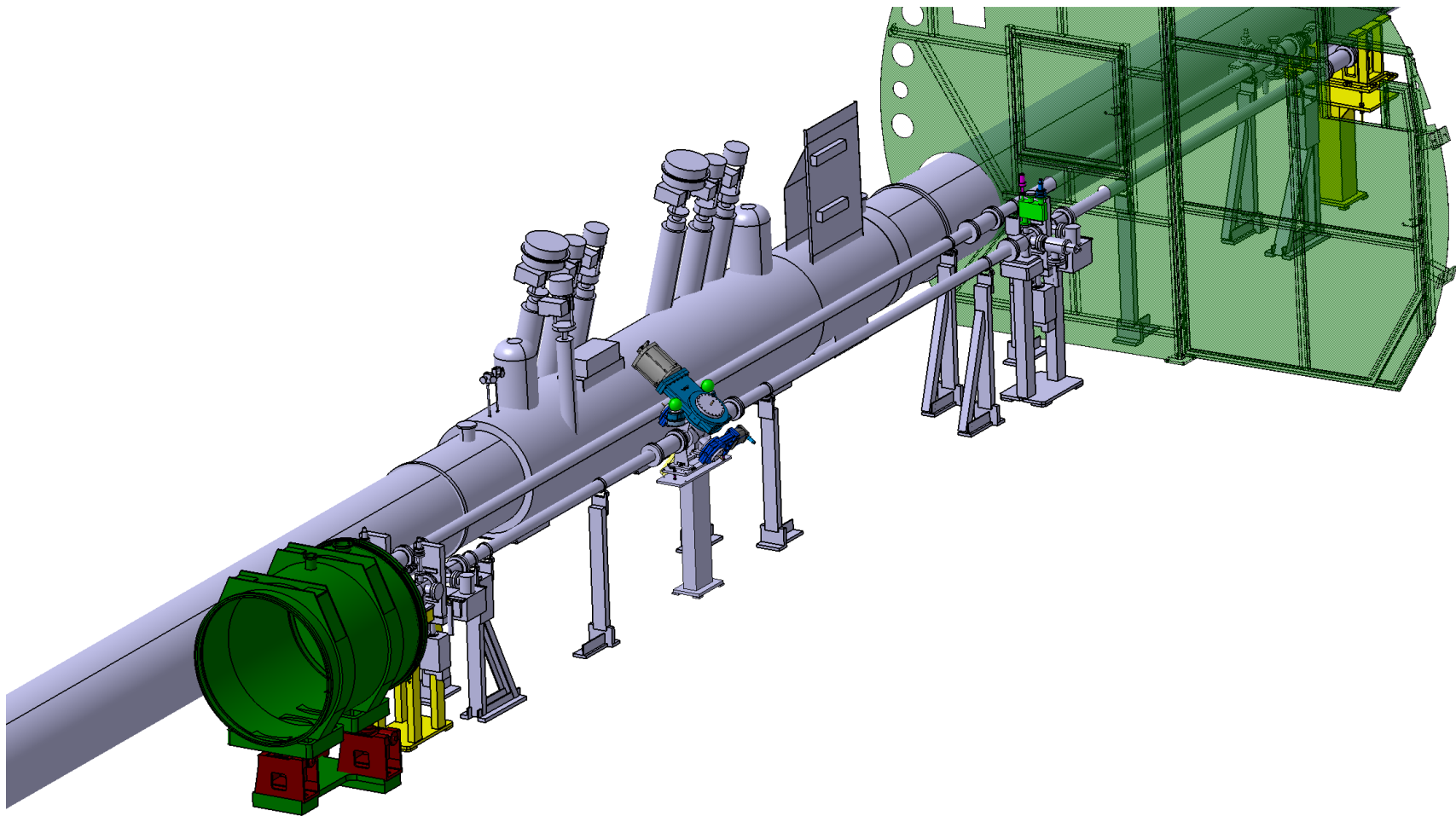


Summary

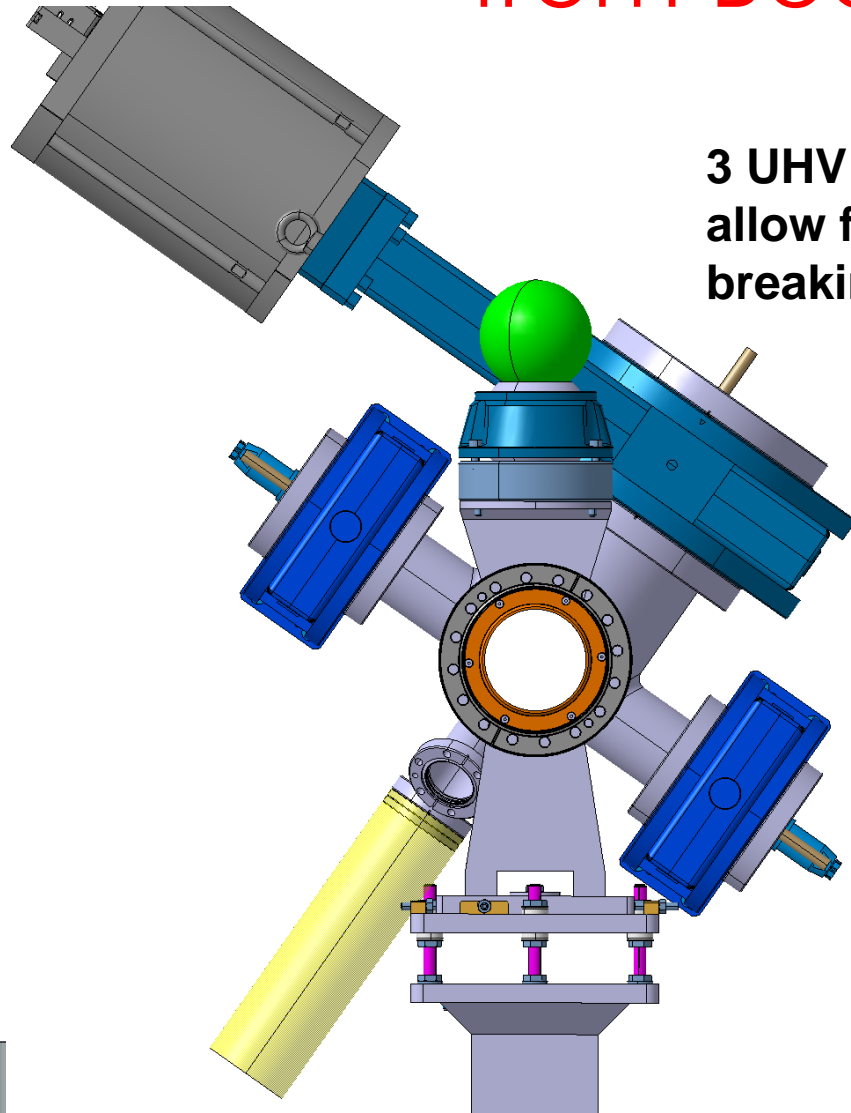
- Preparations for installation of a BGC demonstrator instrument during LS2 have started
- Many issues on the technical side to be addressed in a short timeframe
→ Further good collaboration essential for success
- Production review foreseen in October 2018.
- All parts should be available October 2019
- Assembled operational system in laboratory environment January 2020
- Installed in Point 4 LHC: March 2020

Thank you

BGC Demonstrator installed



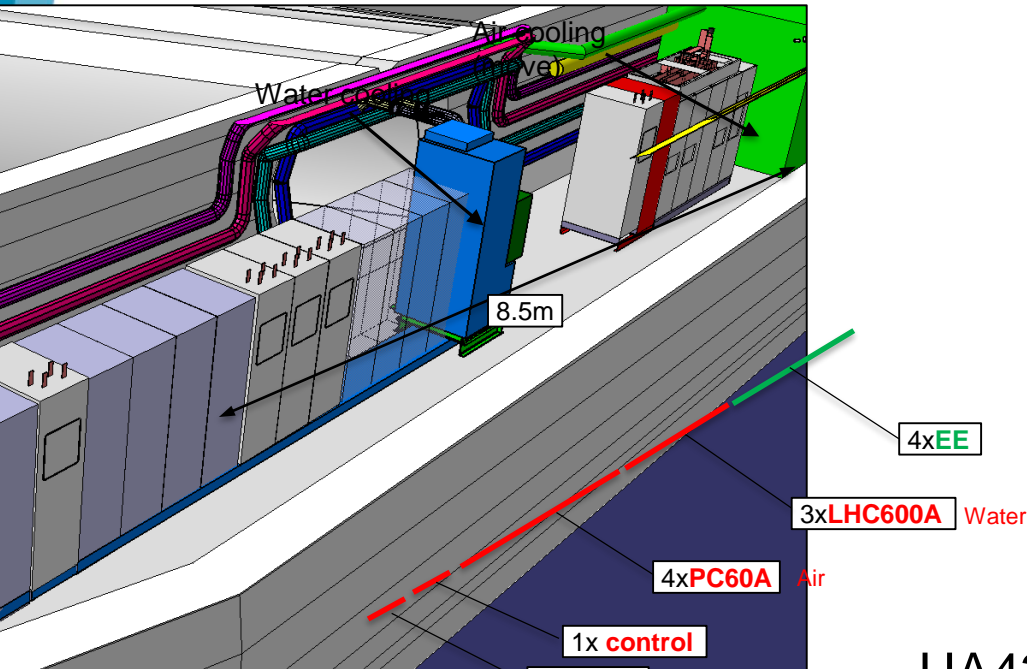
BGC Demonstrator installed, view from Beam 1.



3 UHV all metal gate valve with pinch-off will allow for extensions to the BGC without breaking the beam vacuum.

Racks- Location

Option 1: UA43 & UL44 (P4L) / UA47 & UL46 (P4R)



Will use 2 of 3 Racks for BGC control

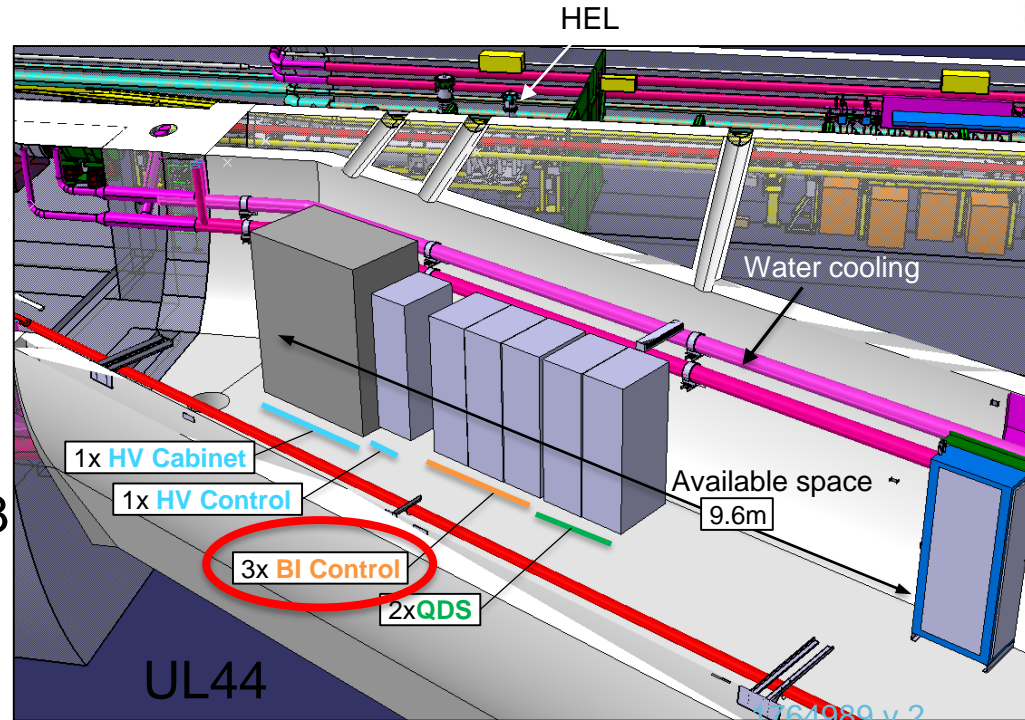
It could be the other way around

19/10/2017

Constraints:

- EE racks (if needed): to be placed together with PCs
- Cooling system required
- HV cabinet and Control rack: to be placed together

UA43

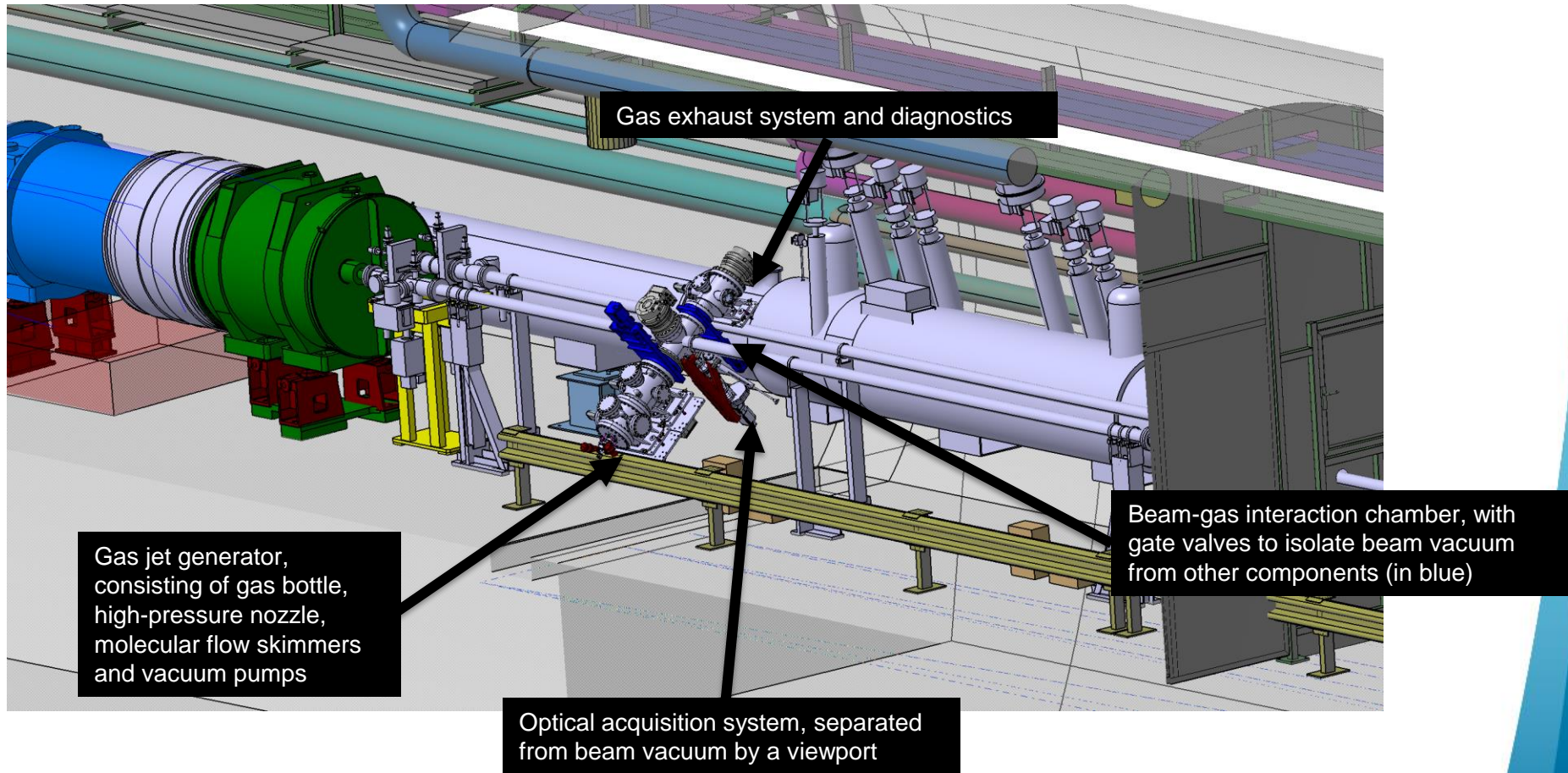


UL44

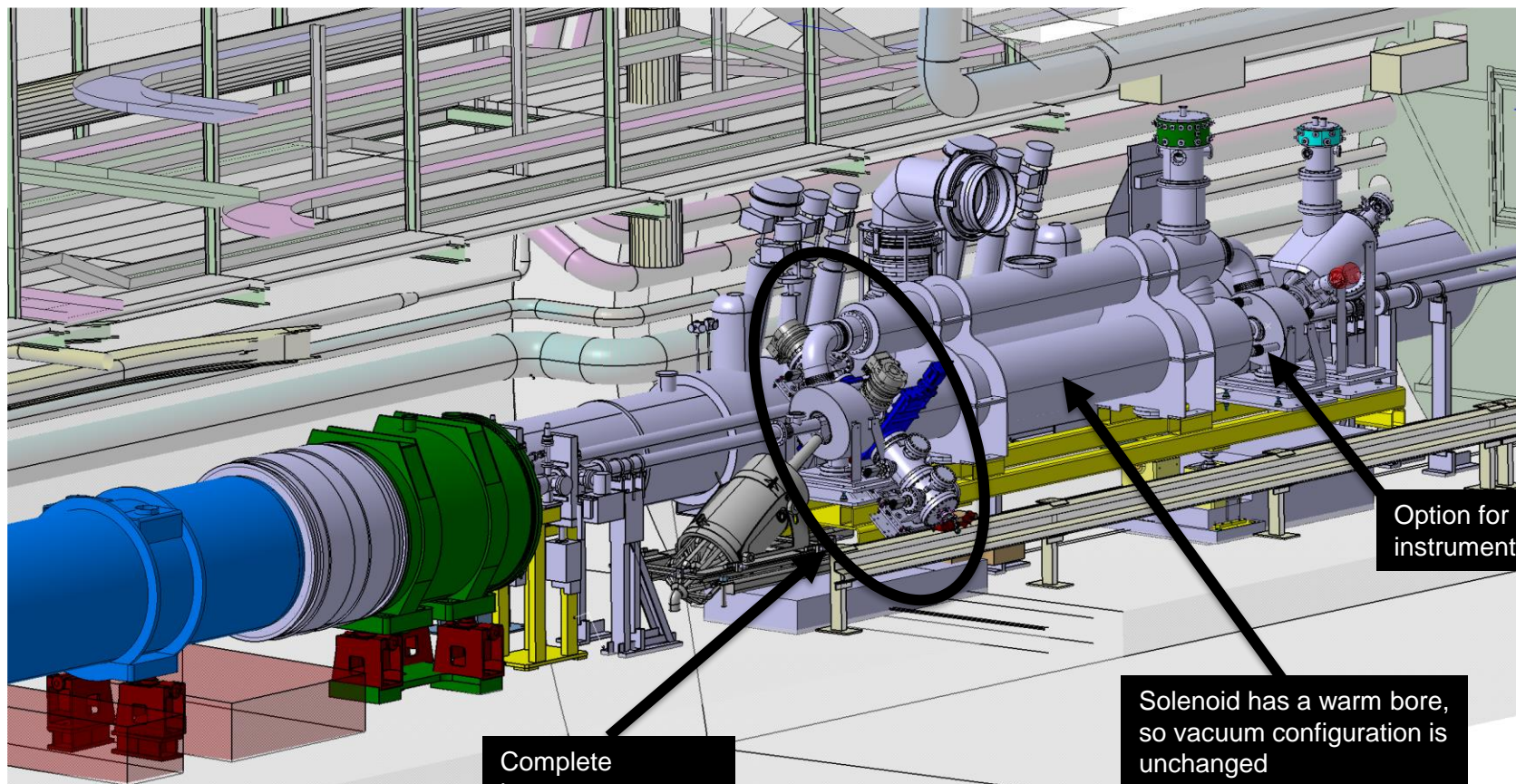
1764989 v.2

Beam-Gas Curtain: Instrument Components

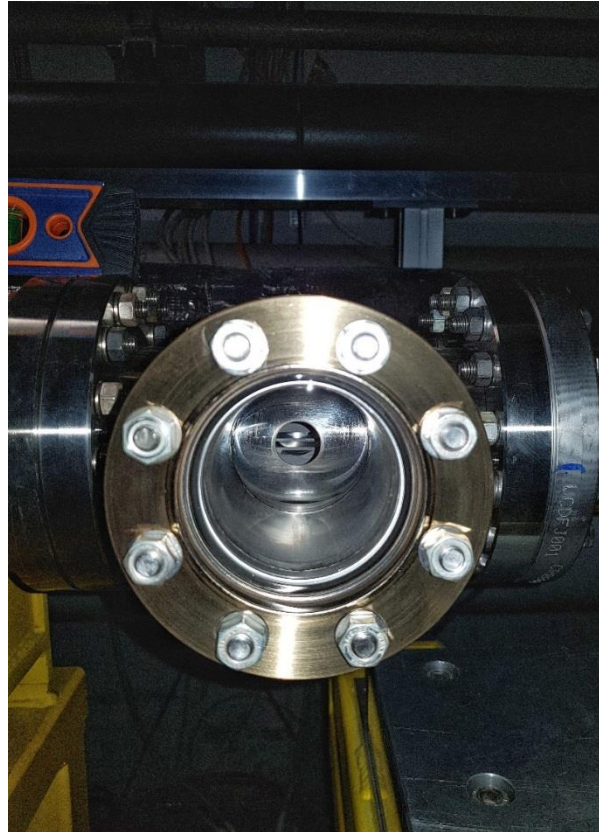
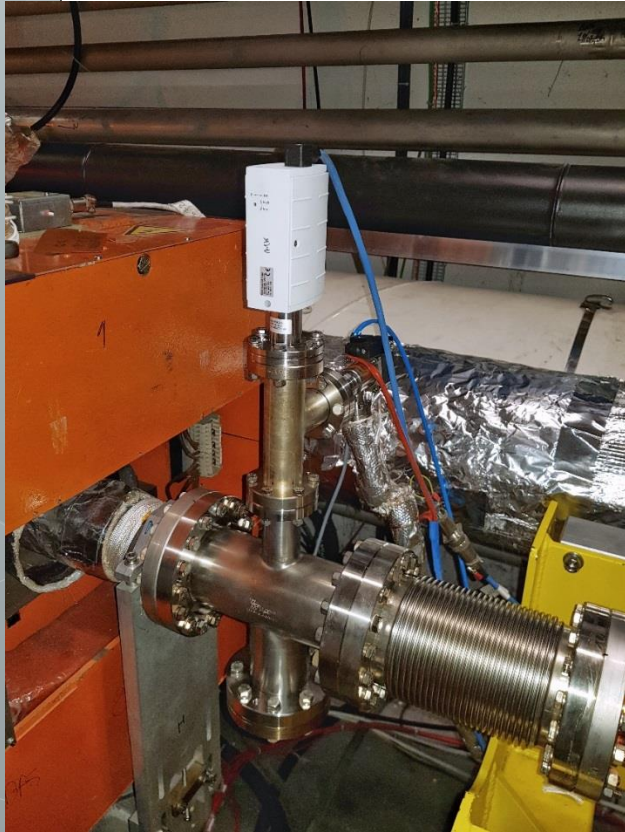
Note: This shows an integration of a laboratory prototype (v2), NOT an instrument designed for the LHC



BGC (laboratory, version 2) integrated in LSS4 with a candidate e-lens solenoid



Fluorescence Monitor Installation



Slide from T.Dodington shown in BGC project meeting of 20/12/17
<https://indico.cern.ch/event/686987/>
[see also presentation from S.Mazzoni in same meeting]