
CERN

LS2 BGC Installation & Integration

Giannis Papazoglou

BGC collaboration meeting, March 2020, CERN, Geneva, CH

Contents

- Terminology
  - Phase1 / Phase2 / HEL Test stand BGC / HEL BGC
- Installation Design and Status
  - Design review
  - Status review
- ECR Progress
- Blackenings
  - Liner
  - Chamber
  - Additional
- Phase 1 manufacturing updates
- Steps towards Phase 2
  - Gas injection Design
  - Gas injection line
  - Gas Dump
- Nozzles
  - Design and manufacturing

Terminology

Phase 1 Installation (V3 BGC):

- Bare minimum installation
- Everything we need to keep the vacuum and allow the machine to operate.
- Basically a vacuum chamber with 3 valves that allow insert of gas injection system and dump side
- Similar to BGI used to measure the light with a distributed gas in the chamber

Phase 2 Installation (V3 BGC):

- Complete LHC Demonstrator BGC
- Addition of gas injection, gas dump, pumps and imaging system to the phase 1 installation
- Complete Gas Curtain generation – used to evaluate the instrument with protons

HEL test stand BGC (V3 BGC):

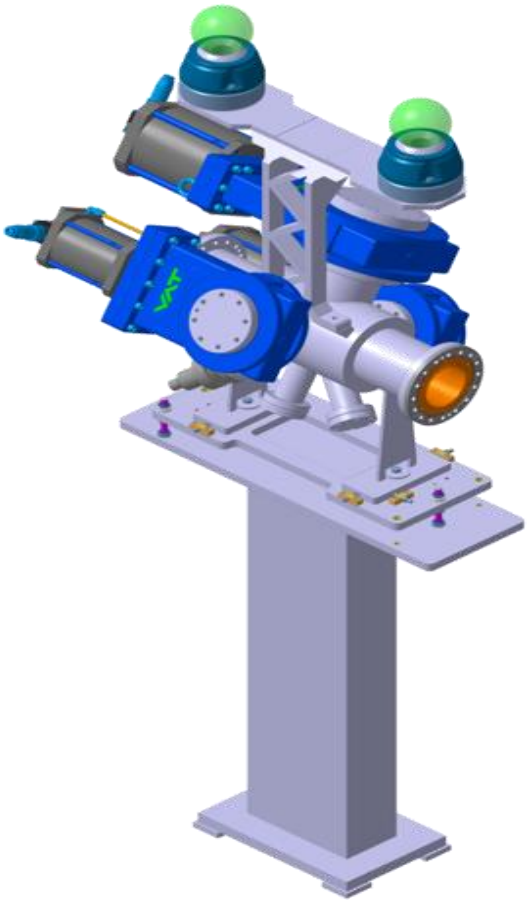
- Instrument functionally similar to phase 2 but integrated for the HEL test stand
- Complete Gas Curtain generation – used to evaluate the instrument with e^-

HEL BGC (V3 BGC):

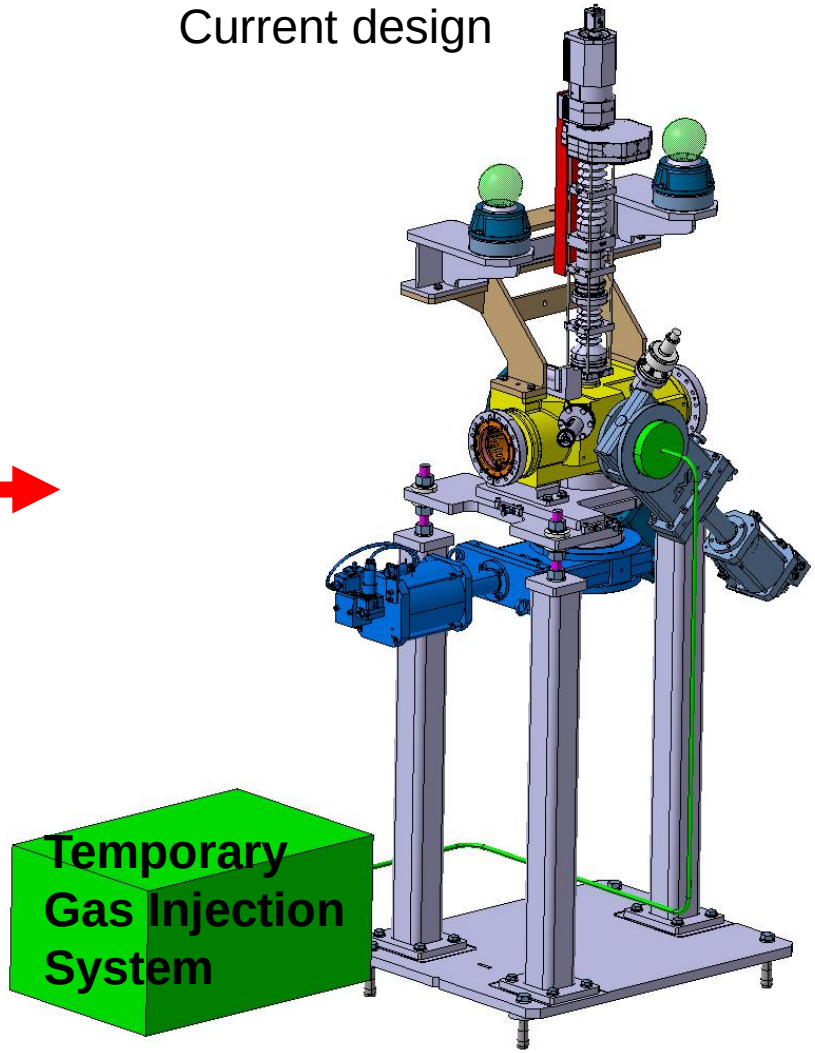
- Final instrument to be installed to the LHC during LS3

Installation design review – phase1

Previous design



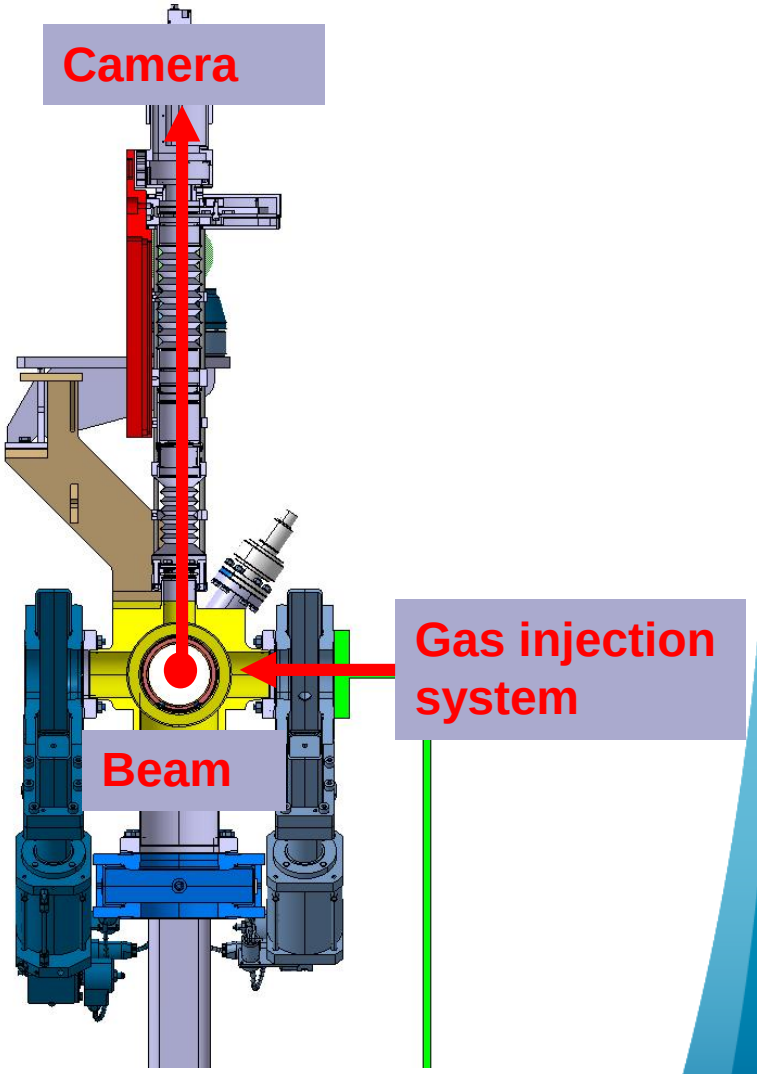
Current design



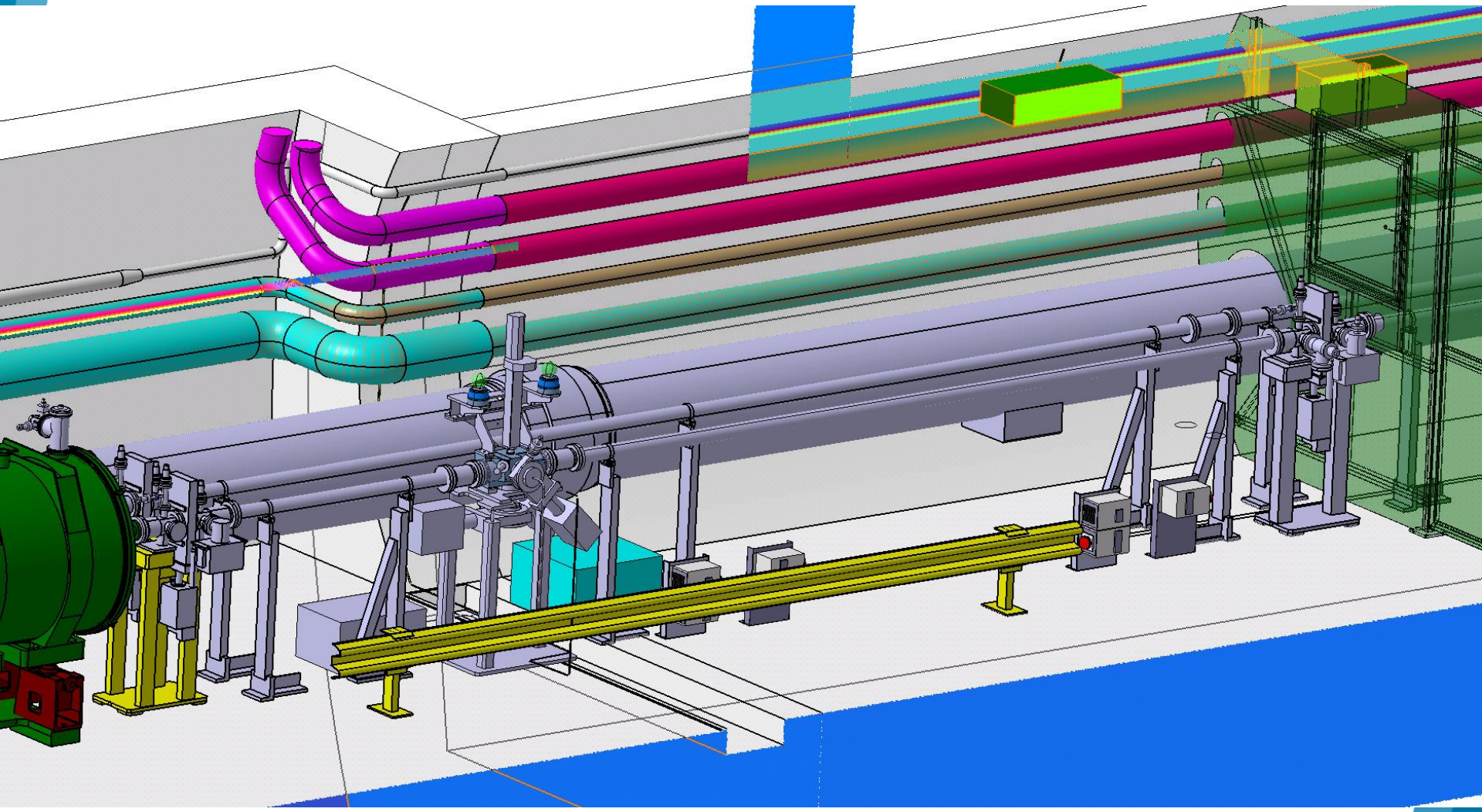
Horizontal Gas Jet

Orthogonal orientation in accordance with other Beam Instrumentation:

- Achieved by reducing the size of the final instrument
- Allows for cross calibration with other beam instruments
- Optical system support to be finalized – optical system ex-vacua

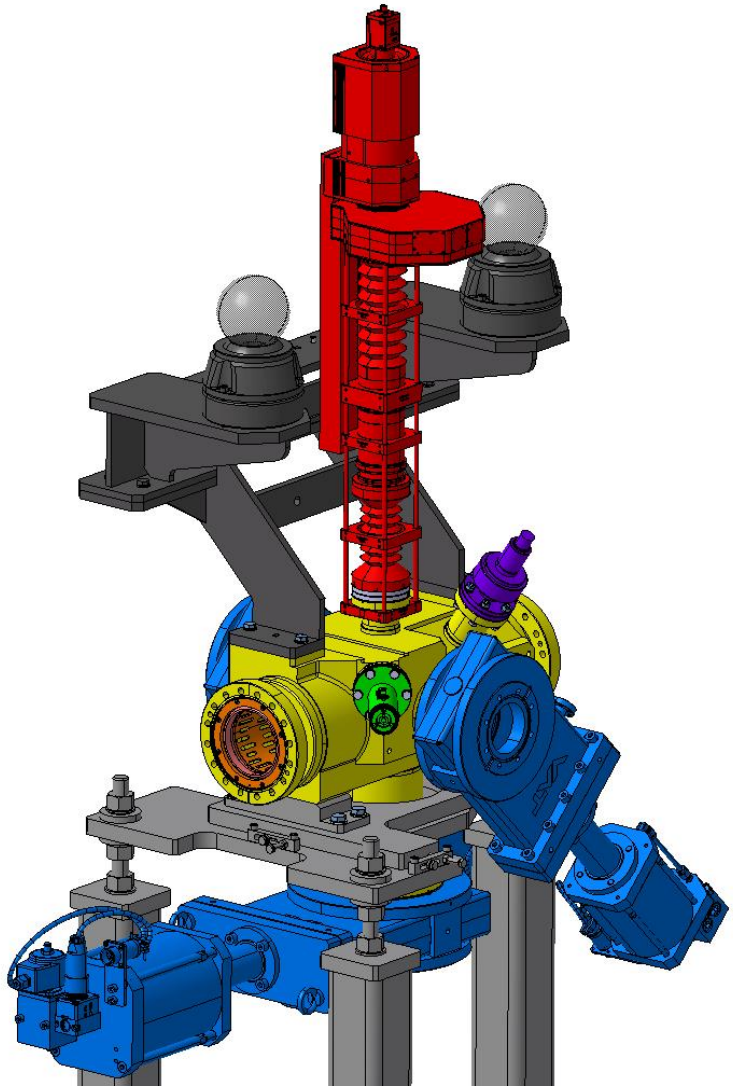


Tunnel Installation (Point 4)



Phase 1 Installation status review

Color	Part
	Support Structure
	Vacuum Chamber
	Copper Liner
	VAT valves
	LBD with camera target
	Penning
	Camera setup
	Geometer targets



ECR progress

- ECR circulation has been approved by the HL-TCC as of 27/2 – still need to wait for final approval
- ECR regards few changes in the BGC design:
  - Footprint of the machine – larger support structure
  - Orientation changed from 45 degrees to horizontal
  - Blackenings
  - Gas injection system moved from the BGI site to BGC
  - Moving of vacuum control racks and adding fiber optics racks

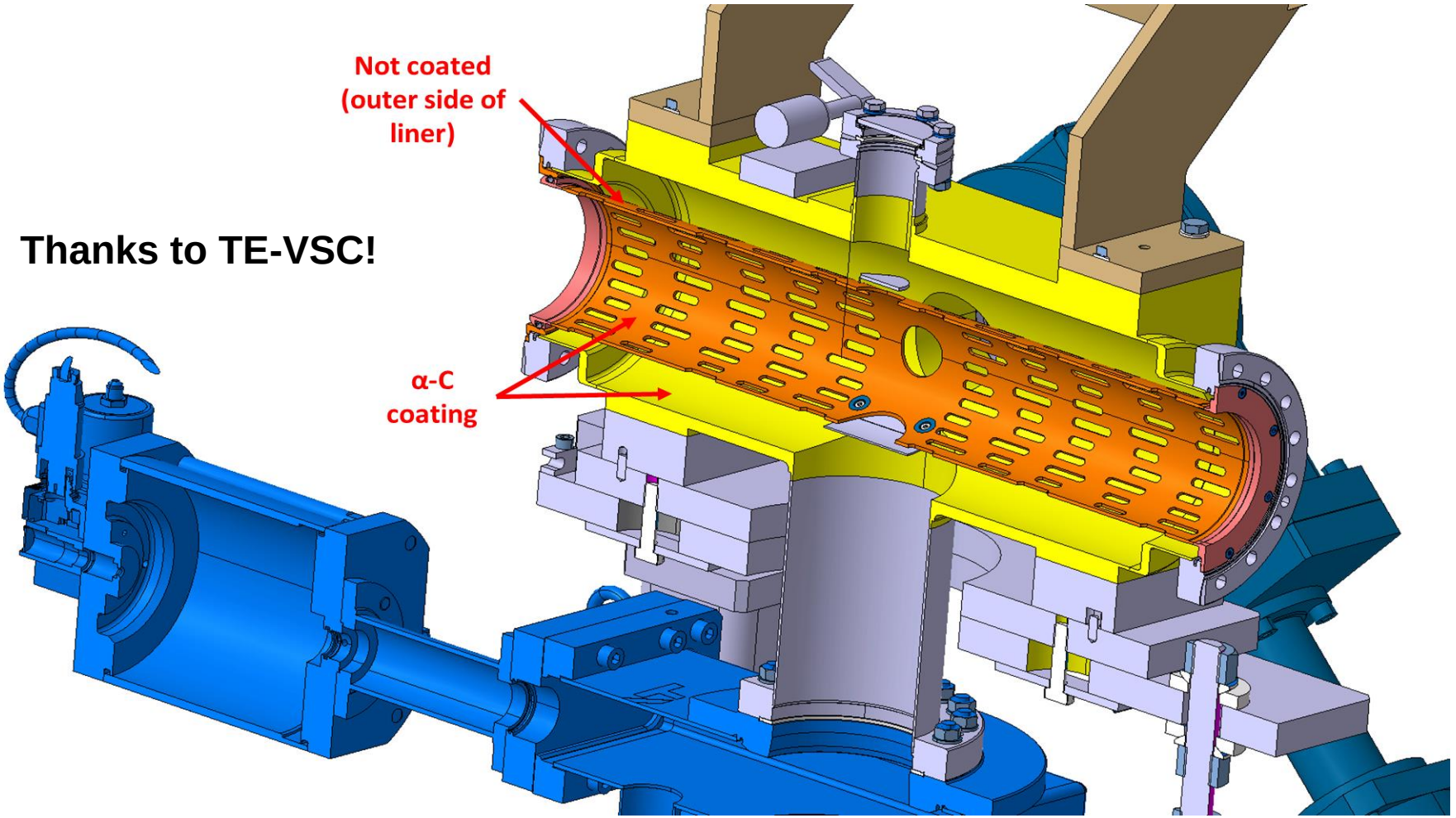
Blackenings

Different blackening used to Minimize the synchrotron radiation light reaching the sensor:

- α-C coating used in the copper liner and the vacuum chamber with reflection of 10-15%
- Multi-layer optimized coating used under the interaction point with reflection of < 0.2%

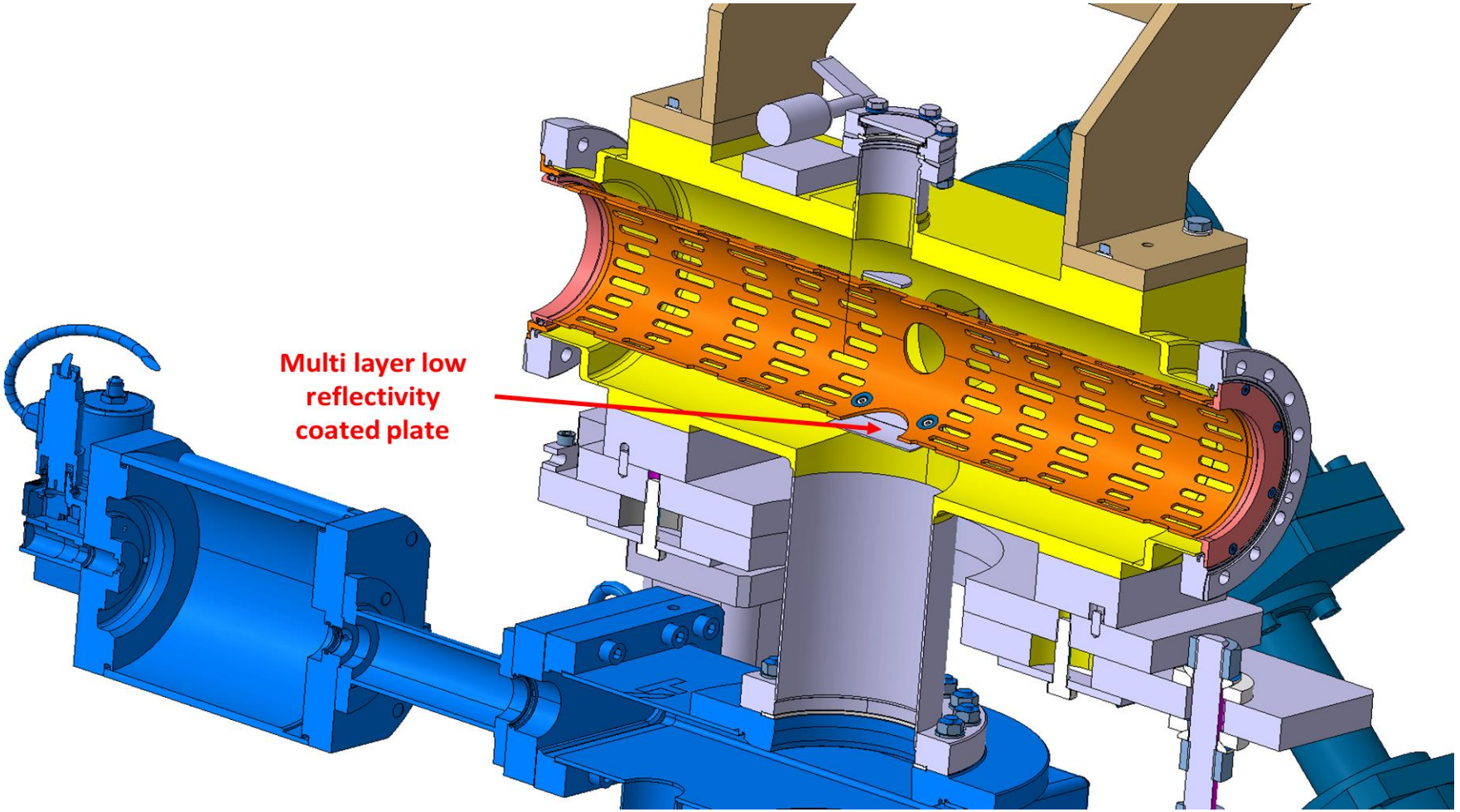
Oxidized copper blackening used for camera calibration target.

Amorphous carbon coating



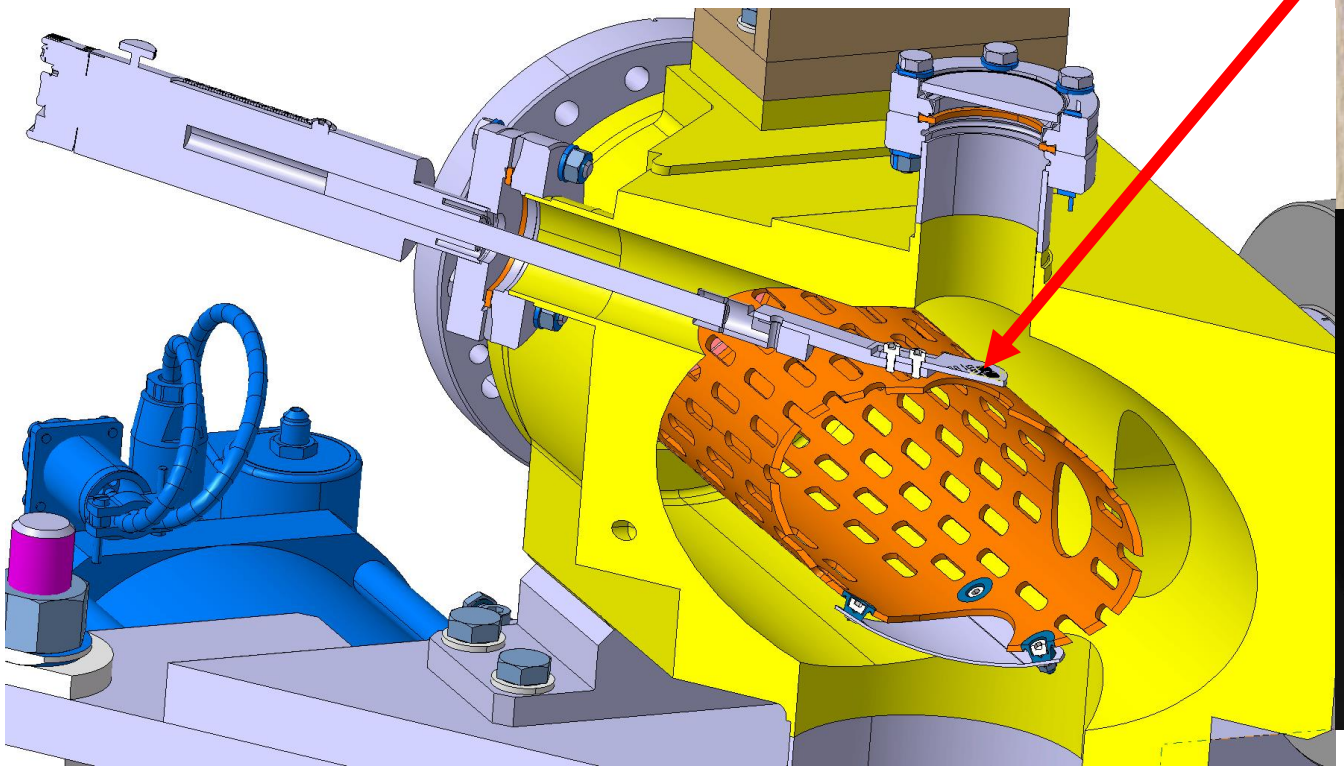
Thanks to TE-VSC!

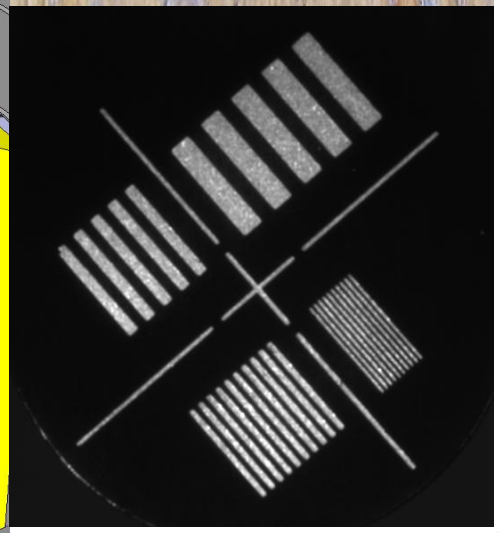
Multilayer coating



Oxidized copper

Thanks to EP-DT!

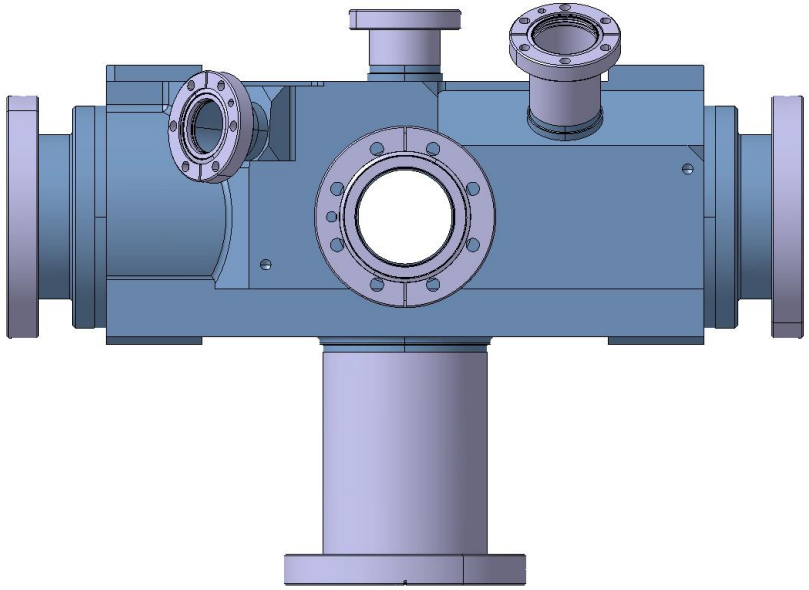


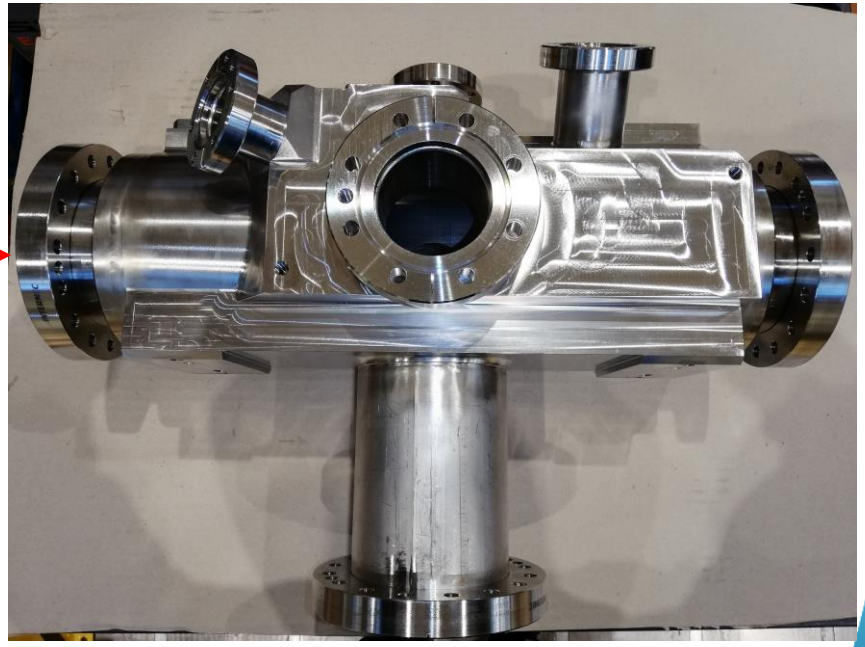


Manufacturing update

Vacuum Chamber

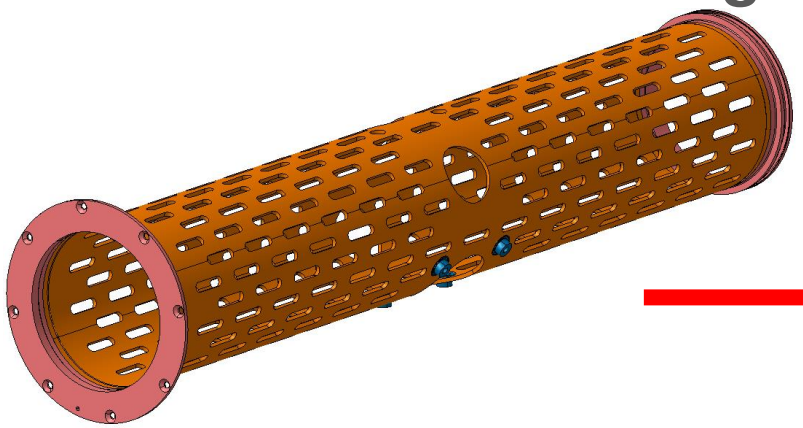
- Manufacturing is **done**
- Cleaned
- Vacuum testing (leak tightness) done: passed!
- For α-C coating to be done first week back!
- **Thanks to Main workshop for manufacturing!**

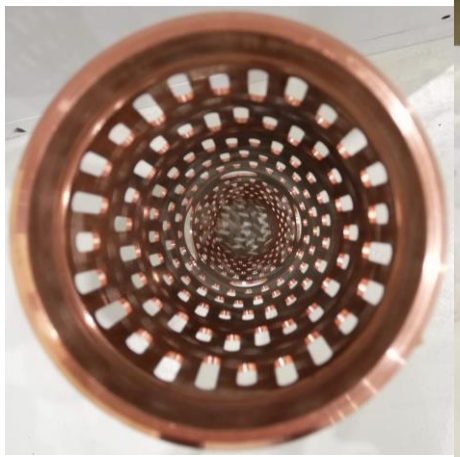




Copper liner

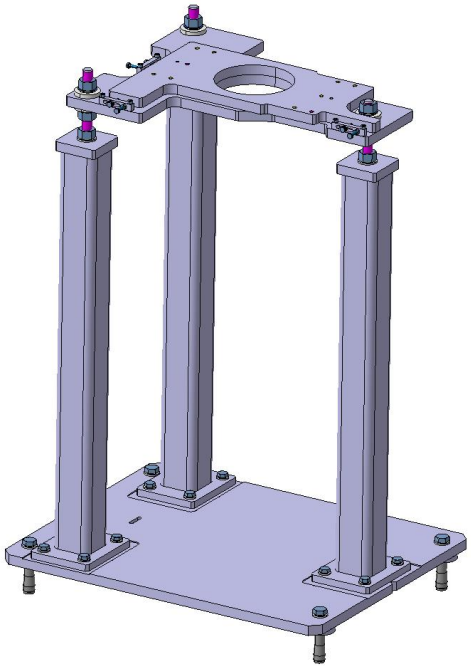
- **Ready!**
- Degreased and passivated.
- Blackening completed!
- Blackened plate received and tested.
- **Thanks to Main workshop for manufacturing!**





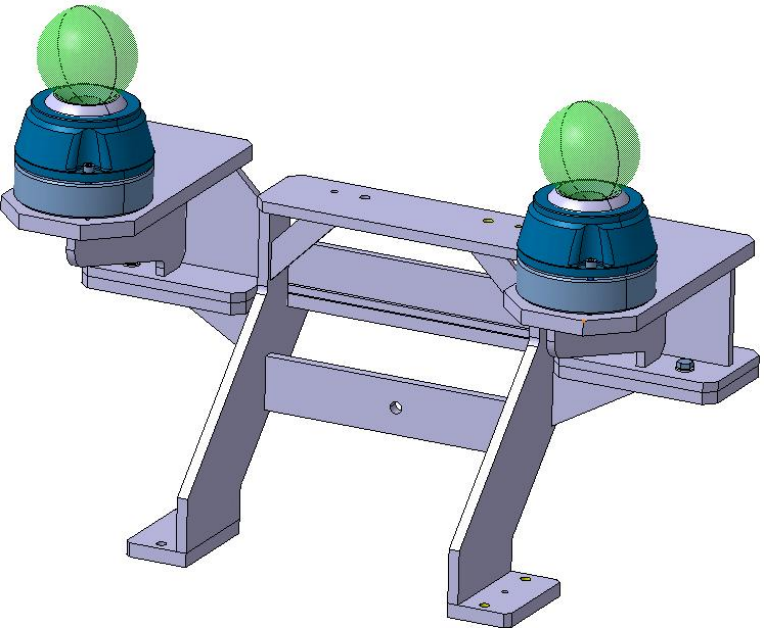
Support Structure

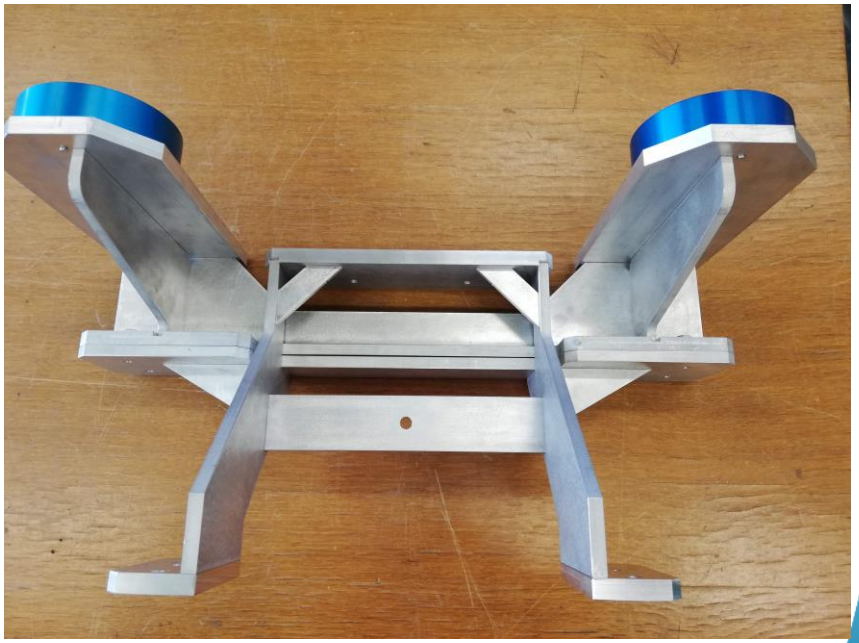
- Ready!
- Small modification needed for gas injection mounting
- **Thanks to ML workshop for manufacturing!**



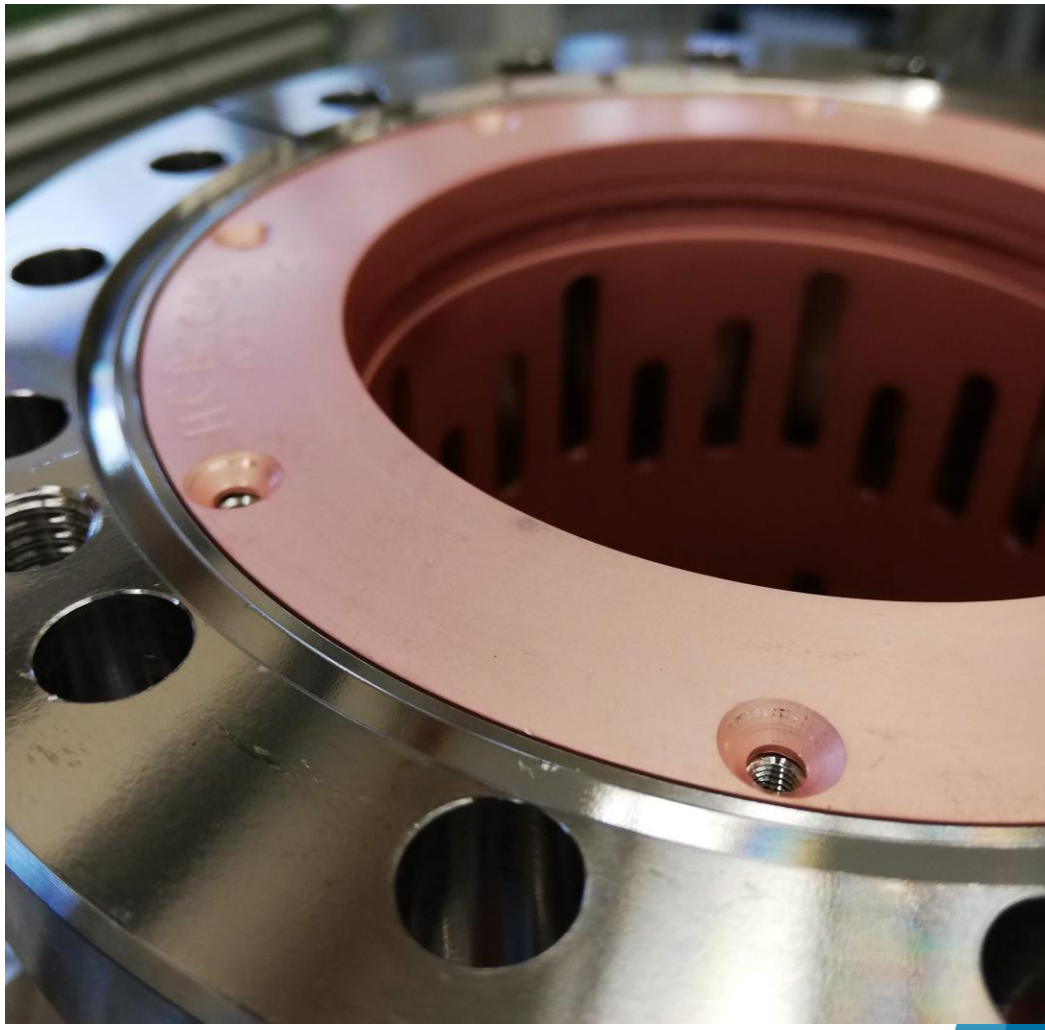
Target Support

- Ready!
- **Thanks to ML workshop for manufacturing!**



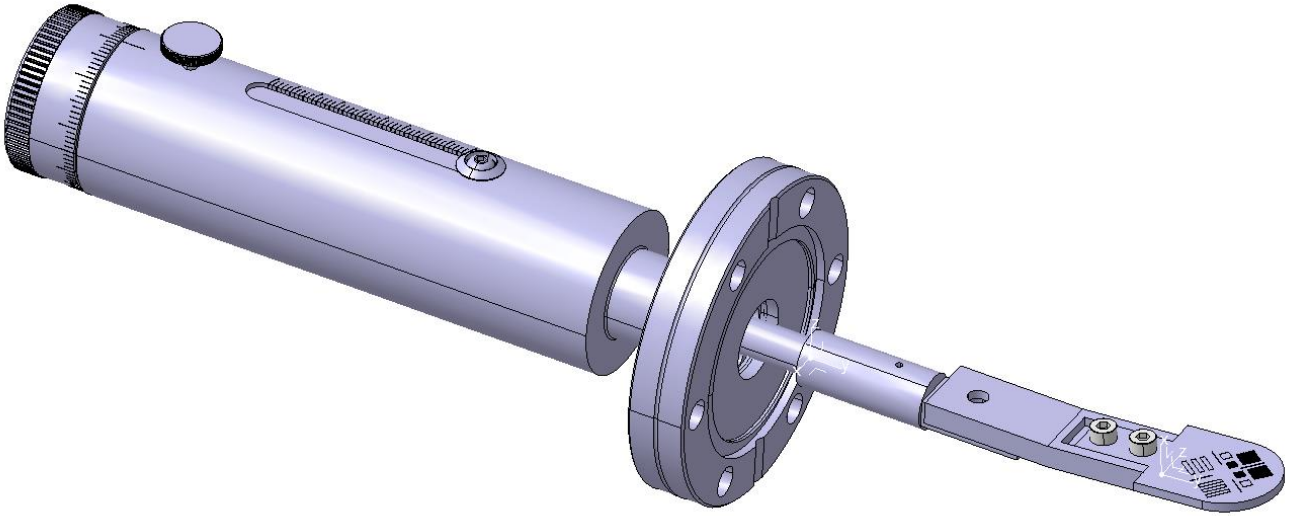


Test assembly



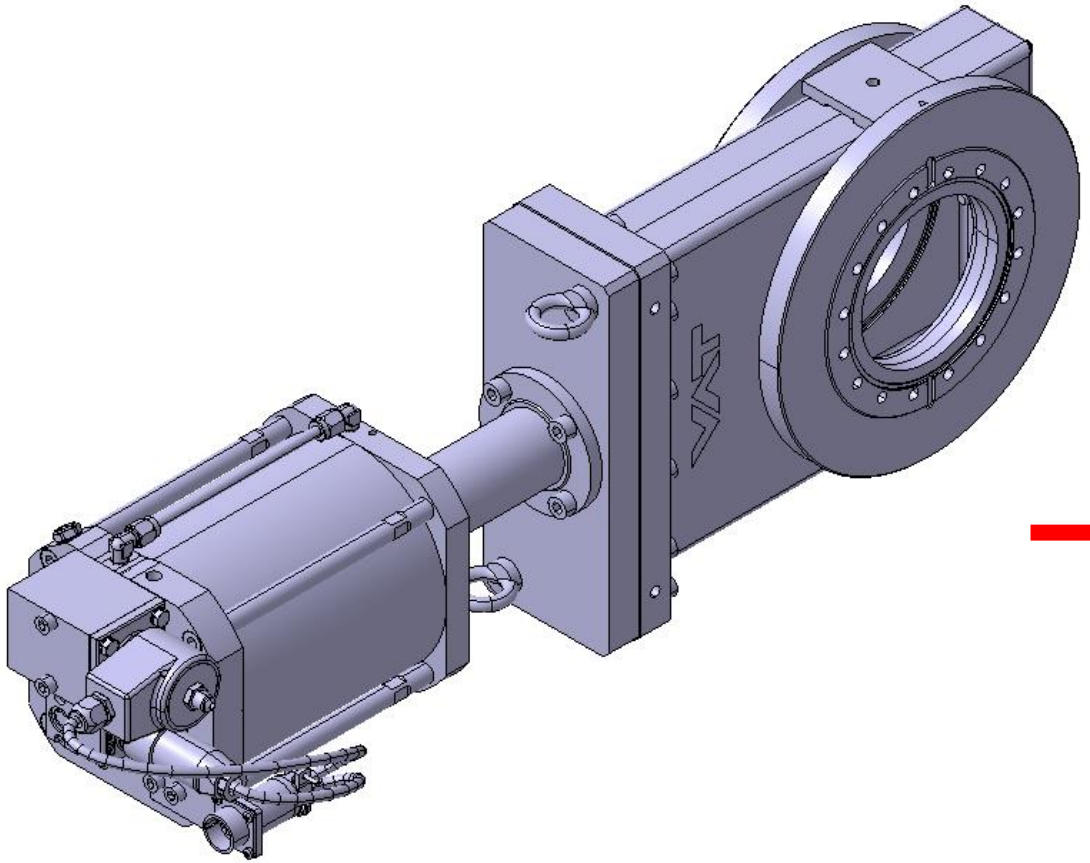
Linear Bellow Drive

- Back from UHV refurbishing
- Camera holder part welded
- Adaptor part cleaned
- Vacuum acceptance done → Passed



Valves

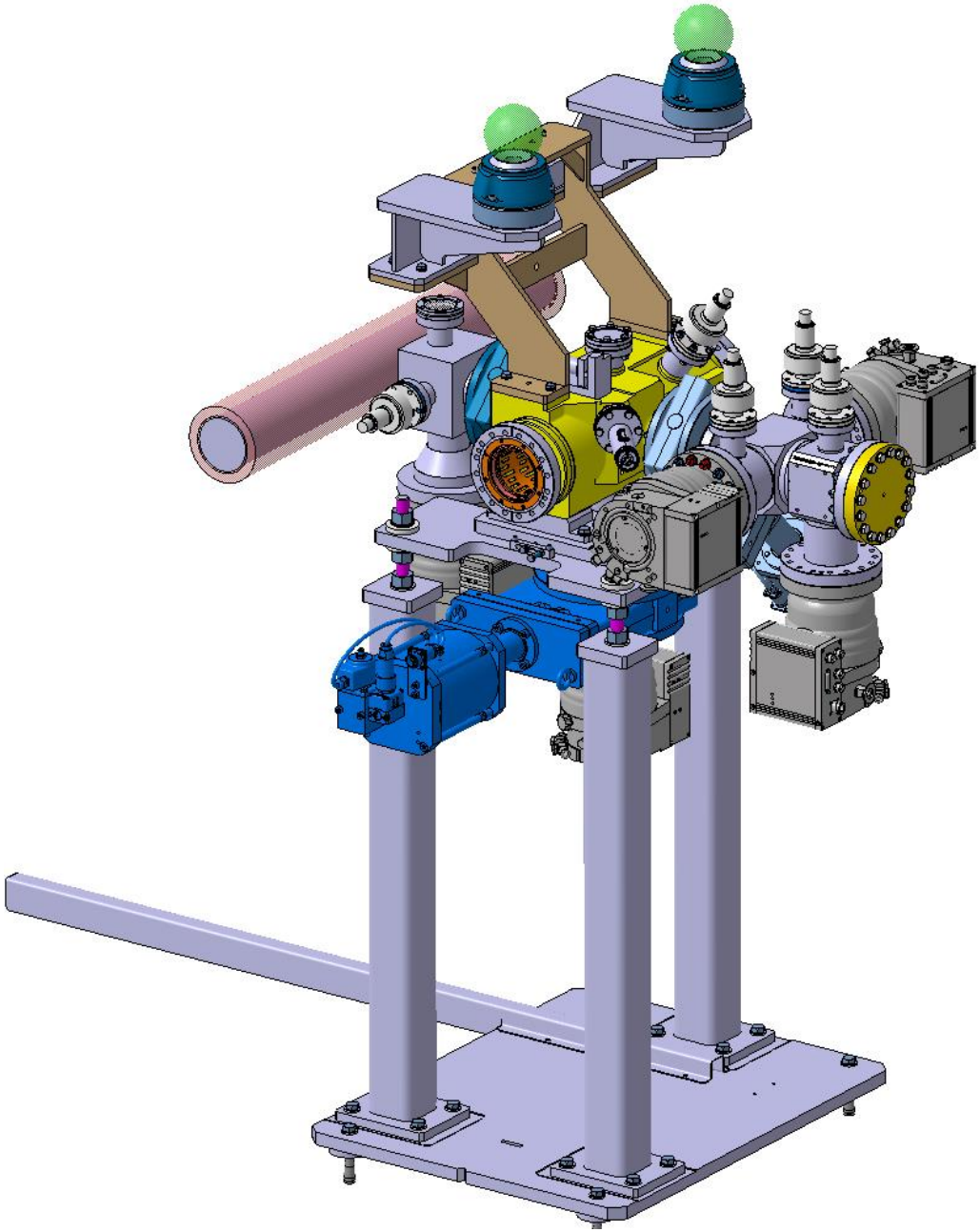
- Ready!



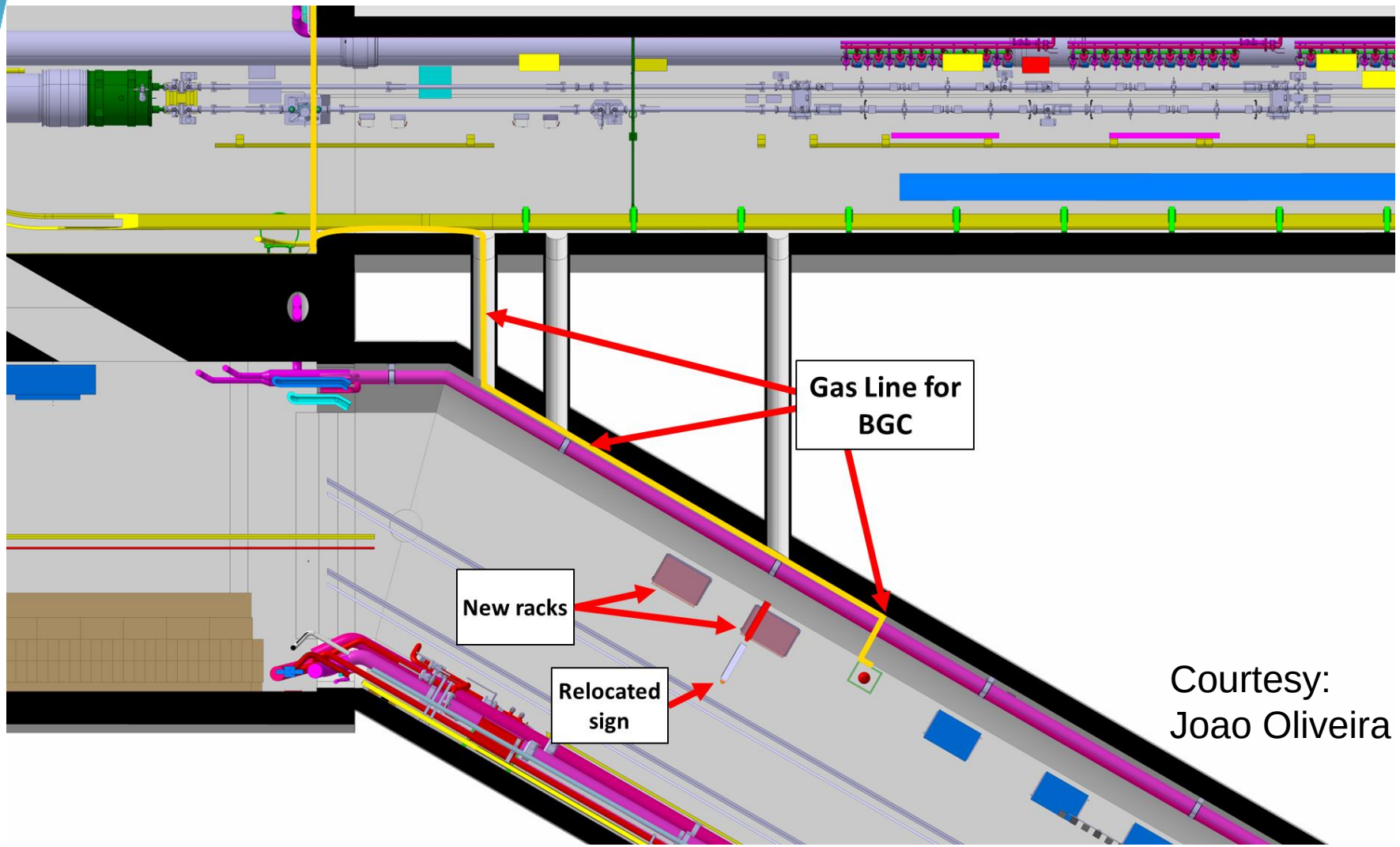
Bolts and nuts

- Delivered
- Cleaned
- Silver coated

Phase 2 Update



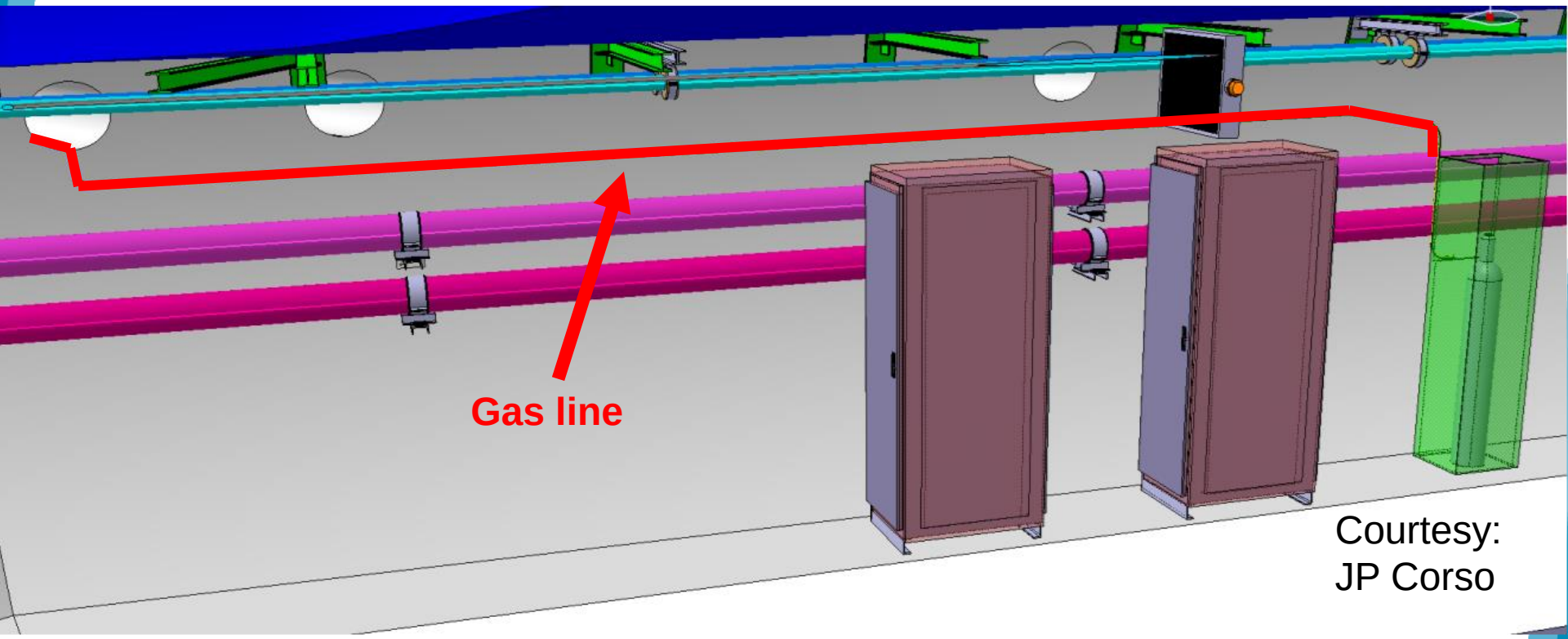
Phase 2: gas injection line



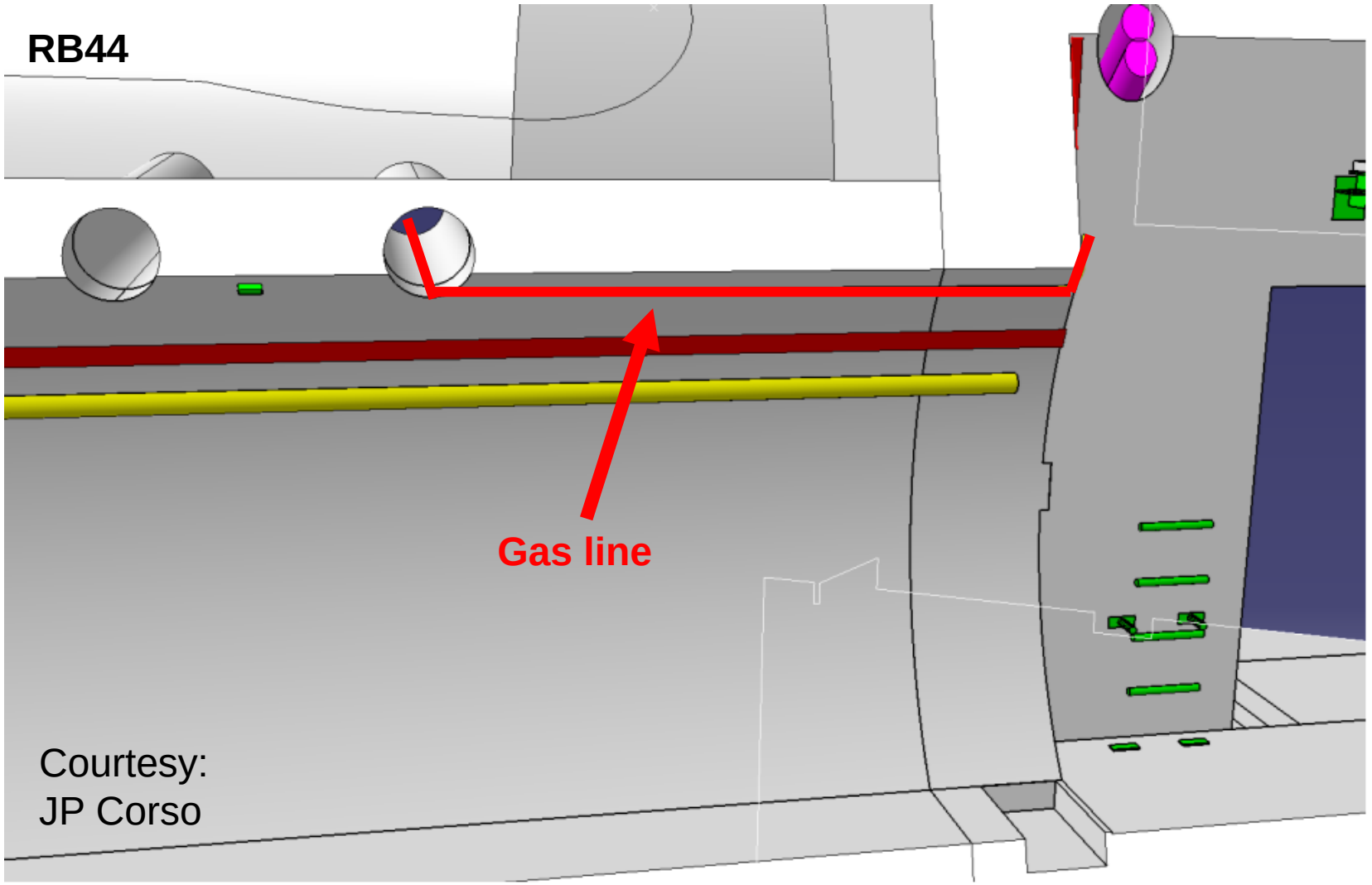
Courtesy:
Joao Oliveira

Phase 2: gas injection line

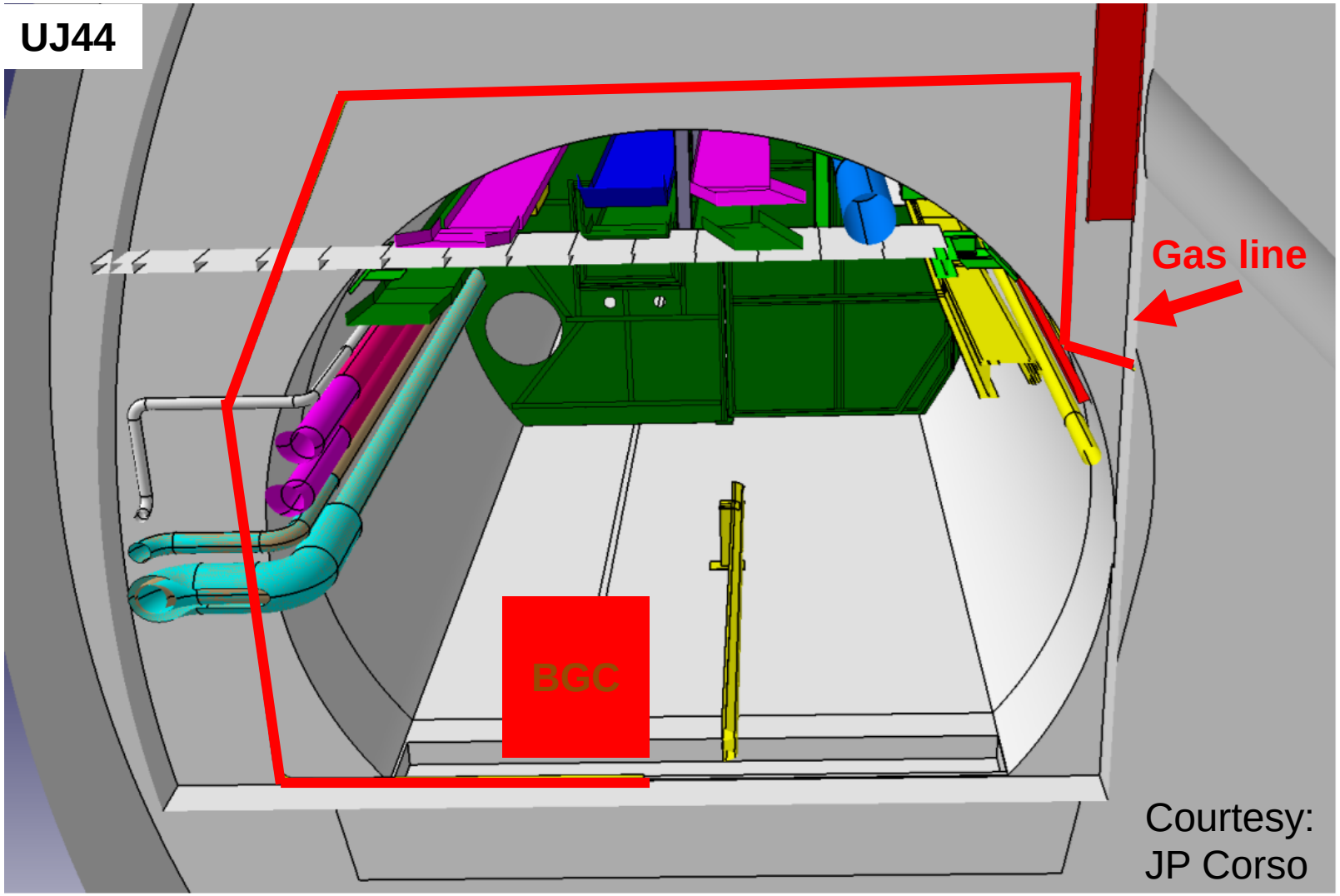
UI44



Phase 2: gas injection line

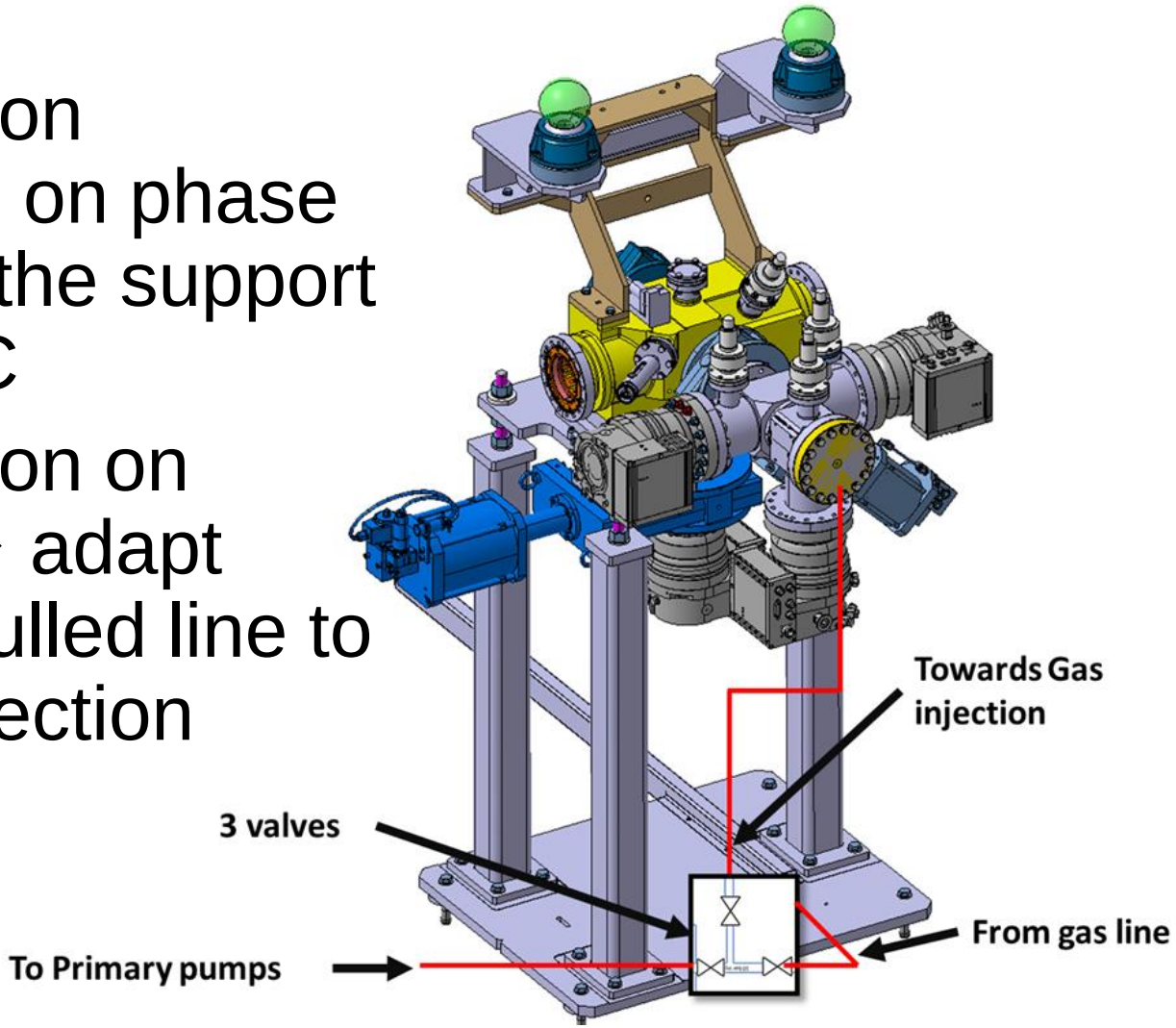


Phase 2: gas injection line



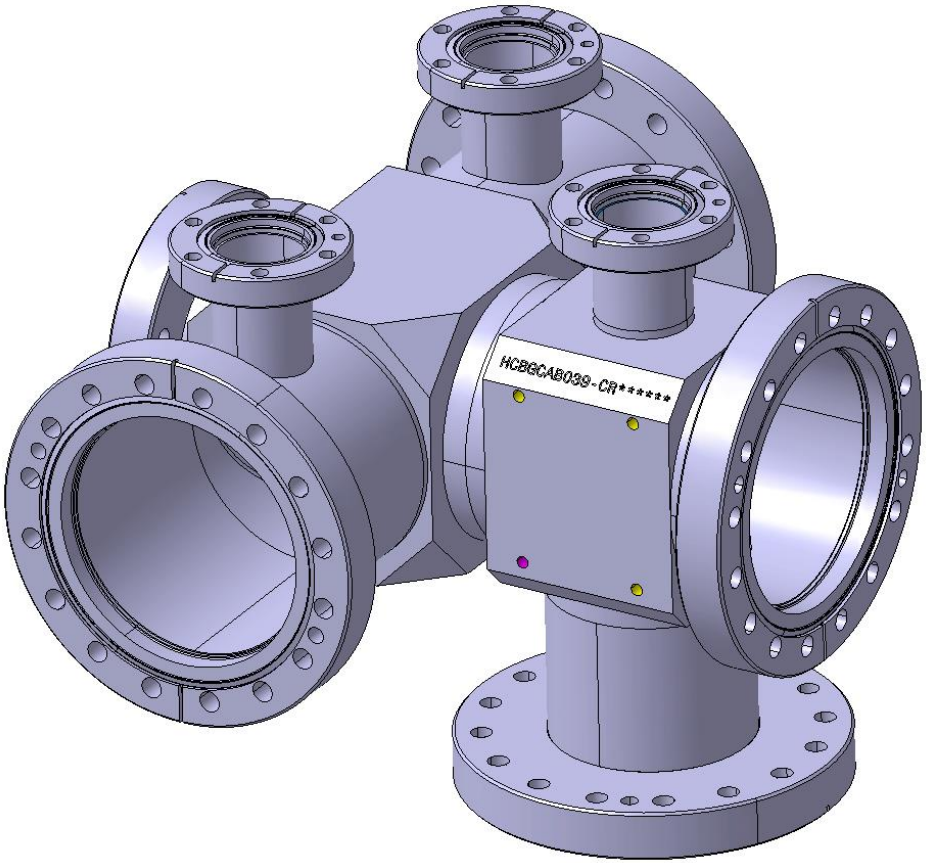
Gas injection

- Gas injection installation on phase 1 → up to the support of the BGC
- Gas injection on phase 2 → adapt from the pulled line to the gas injection system



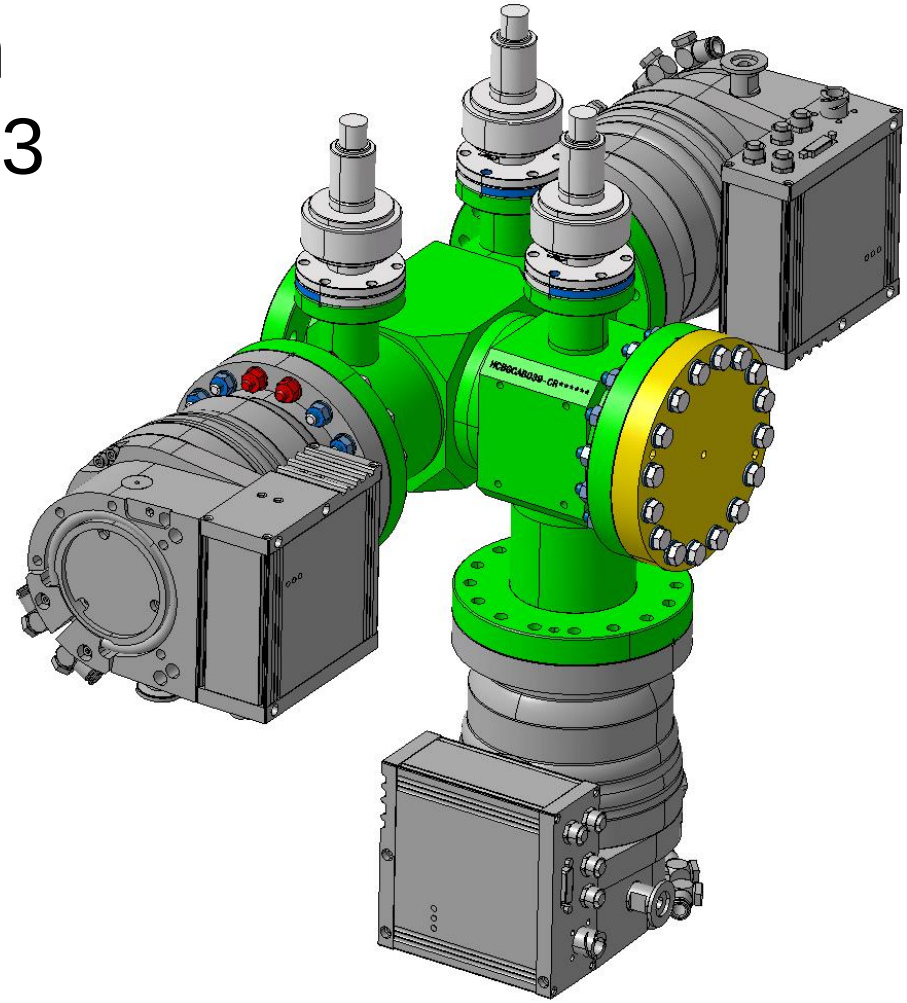
Gas injection system redesign

- Gas injection chamber designed in collaboration with **CERN's design office**
- Forwarded to CI for manufacturing



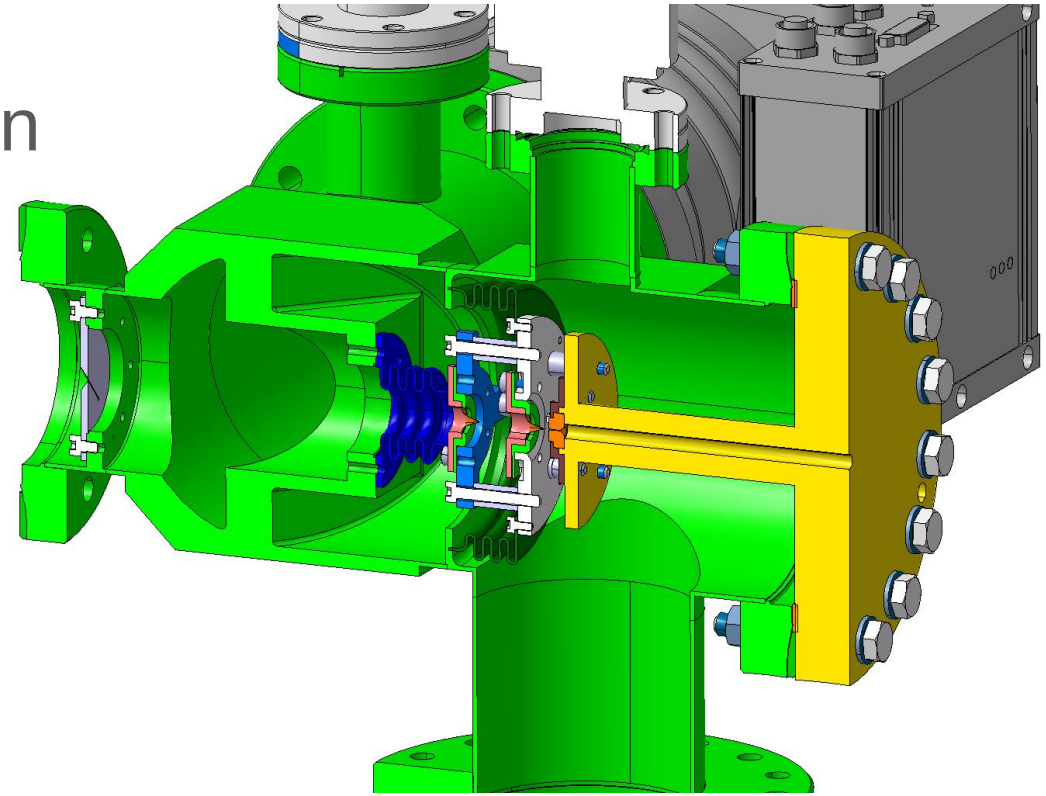
Gas injection system assembly

- On the gas injection chamber we mount 3 pumps, 3 pressure gauges and the gas injection system

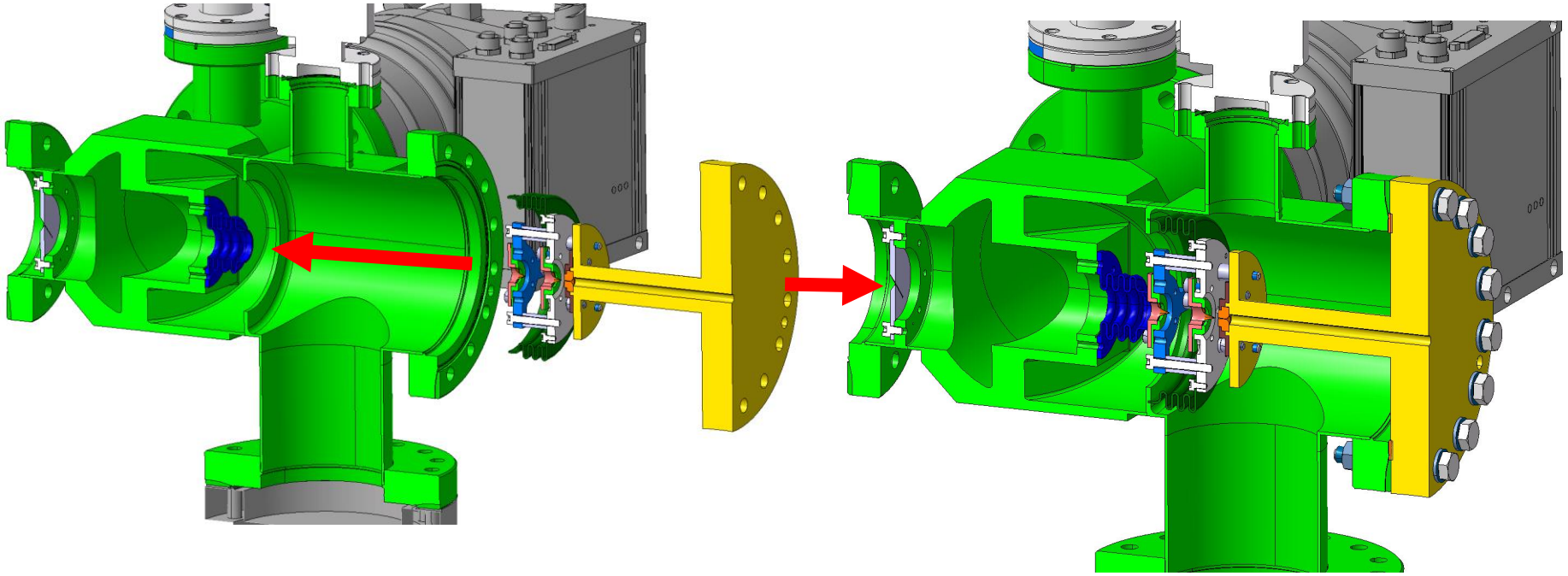


Gas injection system redesign

- New gas injection system redesigned to a further compact and easier to assembly in situ design

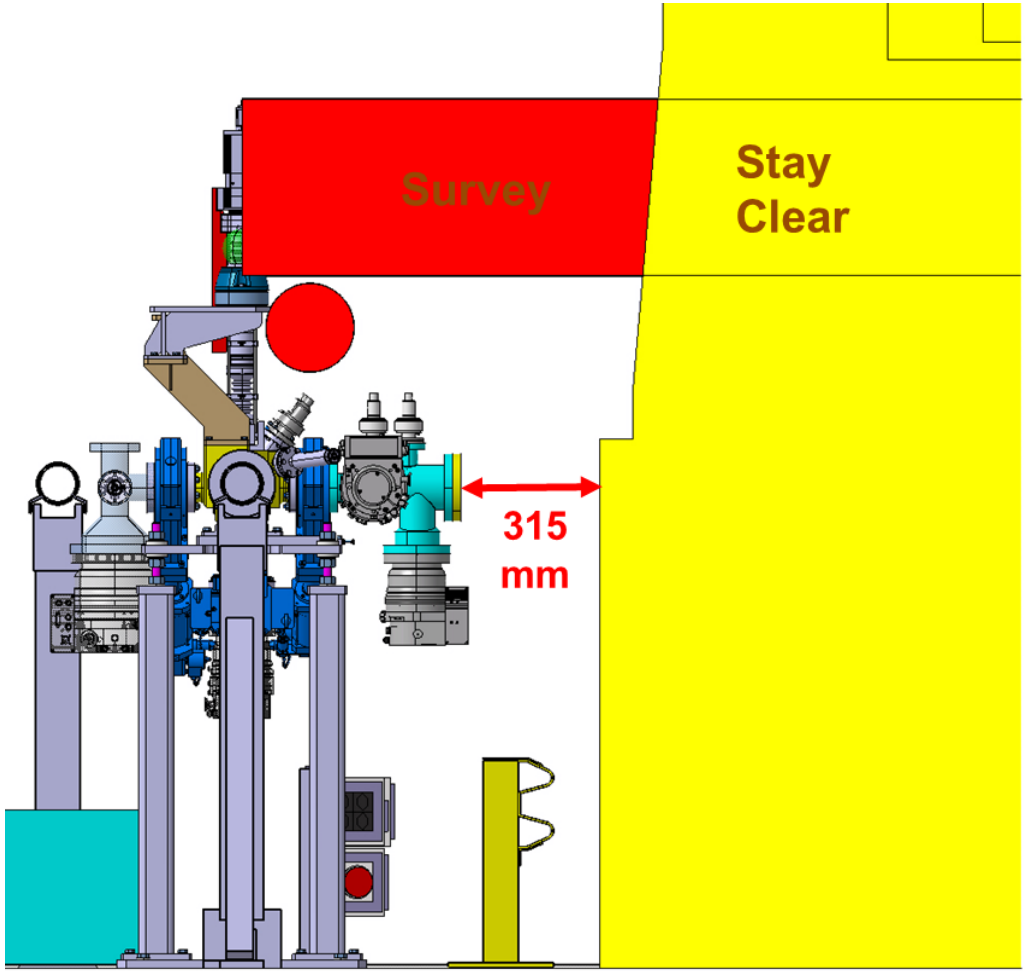


Gas injection system redesign



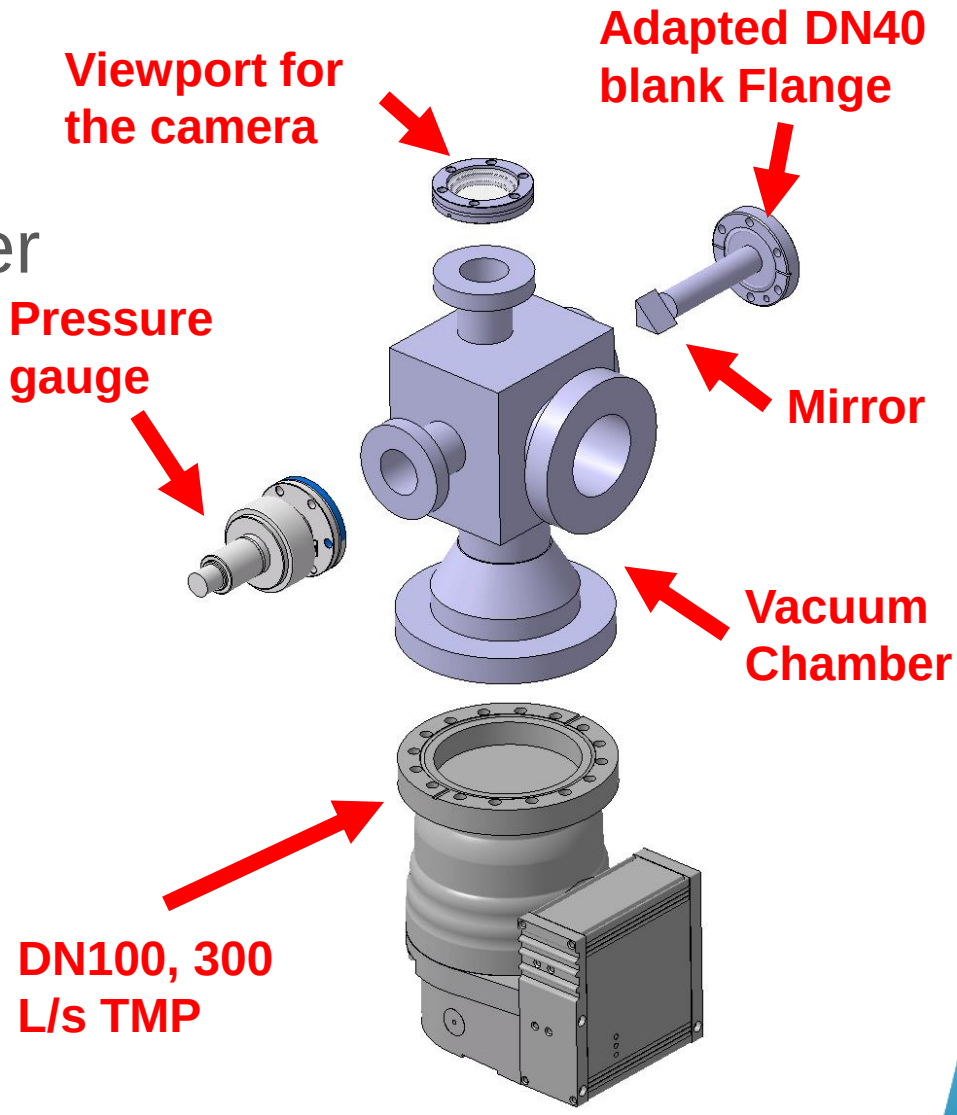
Gas injection system redesign

- New gas injection system redesigned to a further compact design.
  - Conforms with the LHC space constraints.

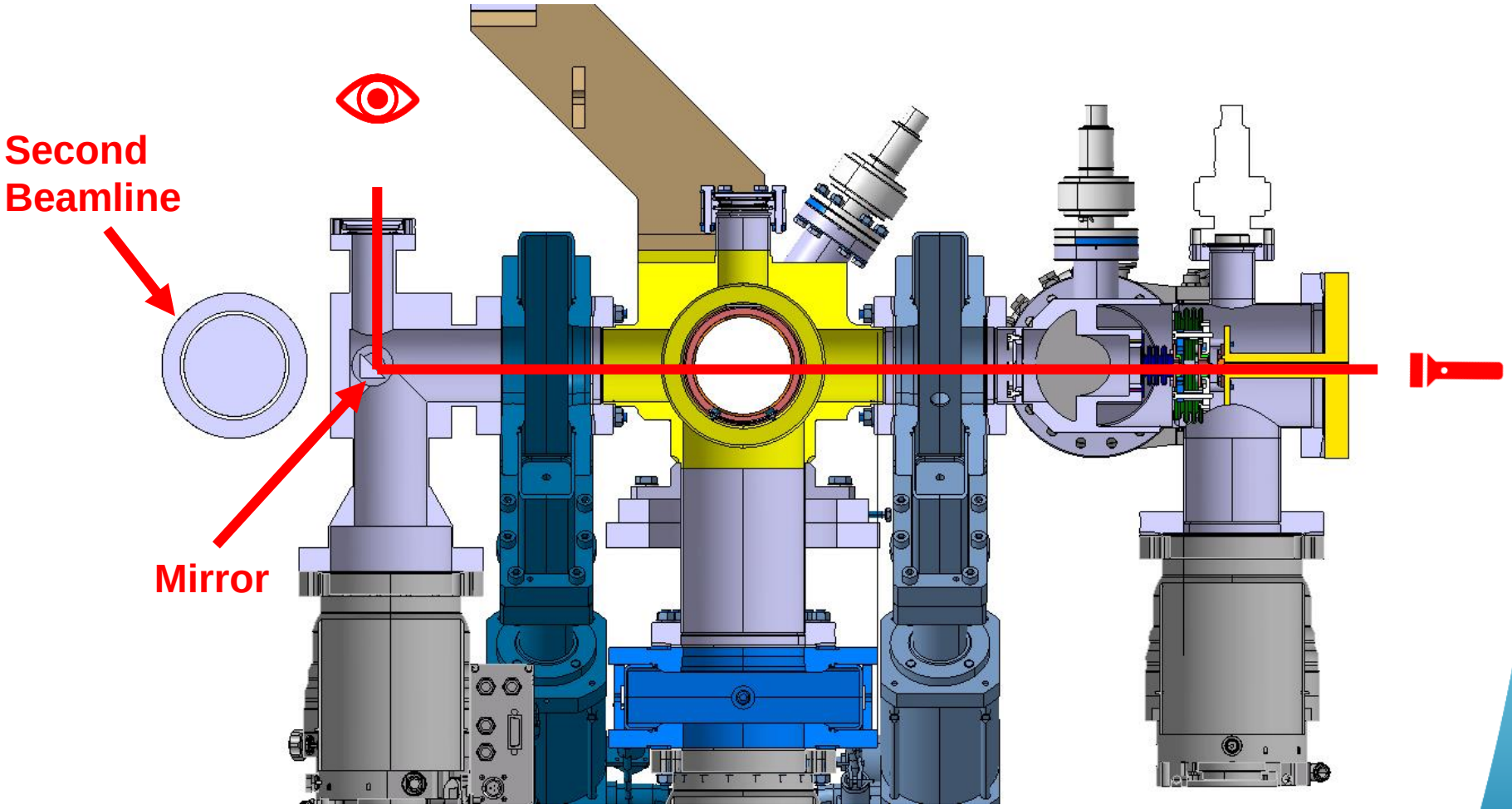


Gas dump side design

- Preliminary design of the gas dump chamber is done.
- Detailed design to be done with the Design office.

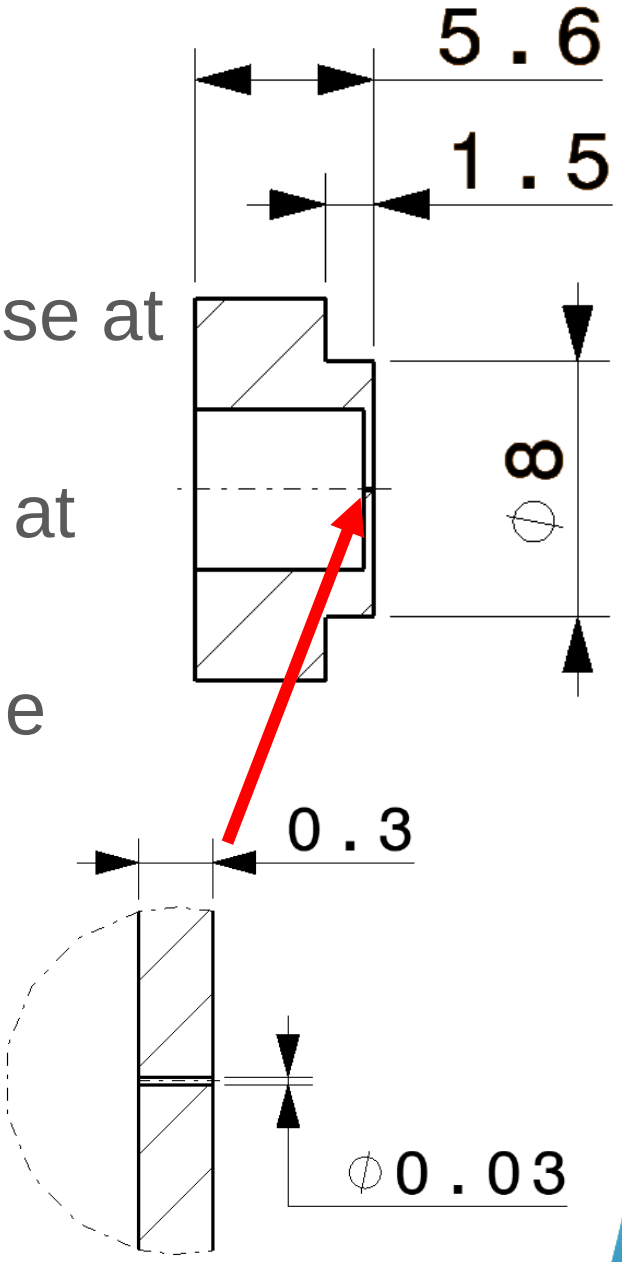


Gas injection alignment diagnostic system



Nozzles

- Blanks are manufactured in-house at **CERN – EN-MME**.
- Micro hole will be manufactured at RAL.
- Blanks ready and will arrange the details with RAL when possible.



Conclusions

LHC Installation:

- All parts on hand, only few final steps left before installation
  - Finish of tank blackening
  - Final assembly
  - Geometers calibration
  - Transportation testing
  - Vacuum acceptance

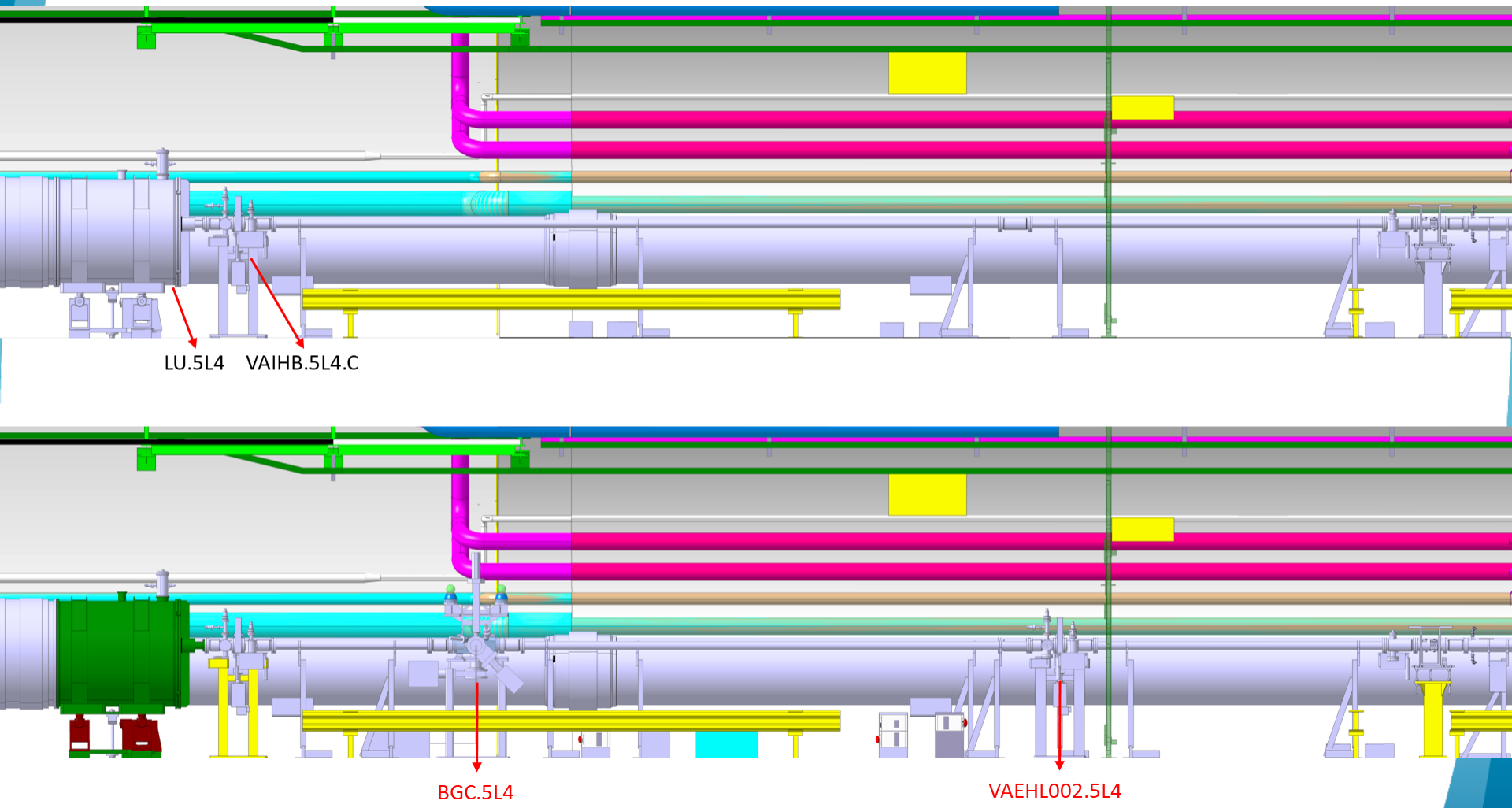
Phase 2 and further developments:

- Gas injection system design work well underway
  - Gas injection chamber finished
  - Gas injection system on works
  - Gas system alignment system on works
  - Gas dump to be done
- Gas line design and installation planning advanced
- Nozzles design and manufacturing is advancing
- HEL integration on work
  - Close communication with CI for the chamber design

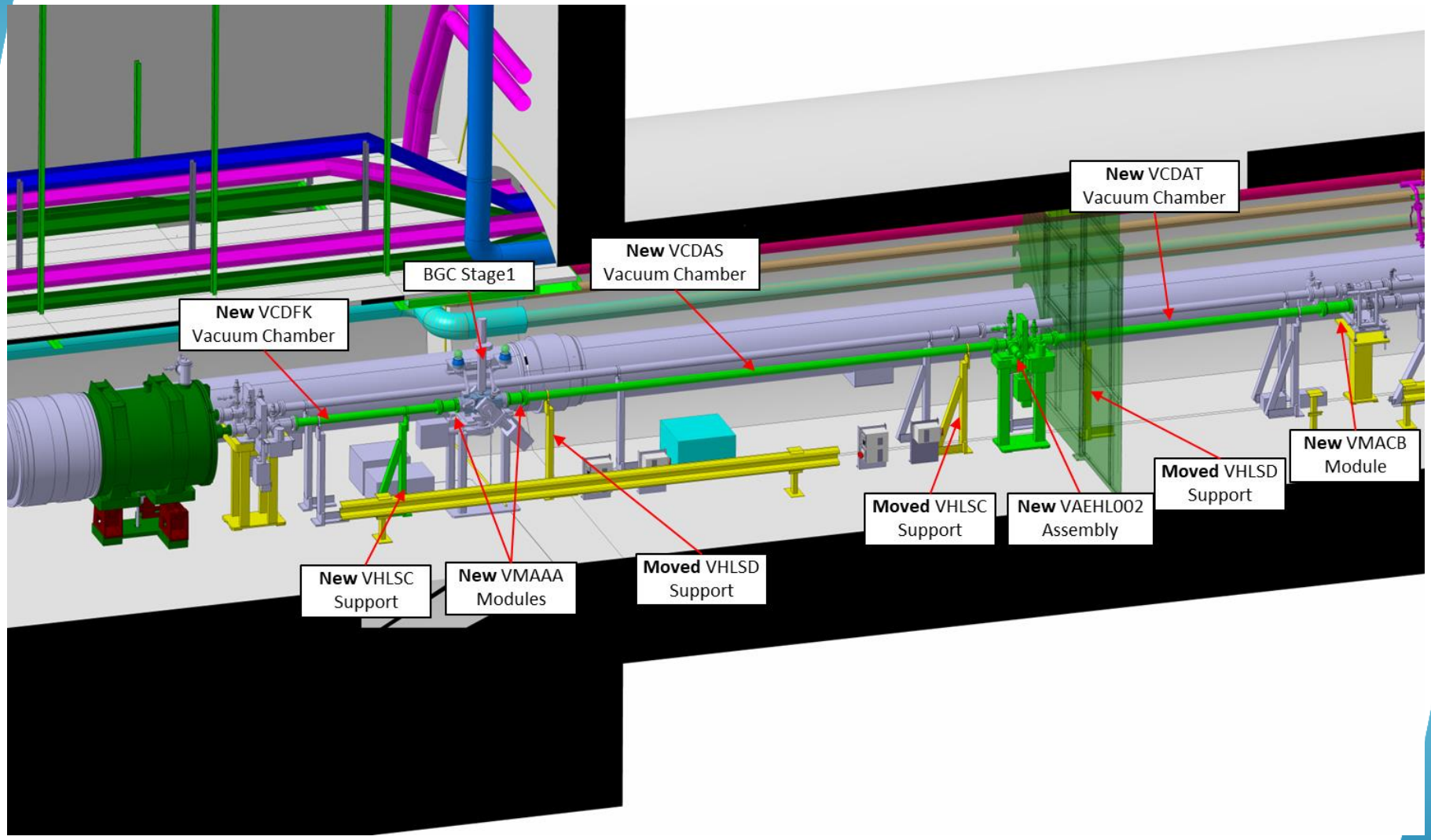
Thank you!
What questions do you have?

Backup slides

Tunnel Installation (Point 4)



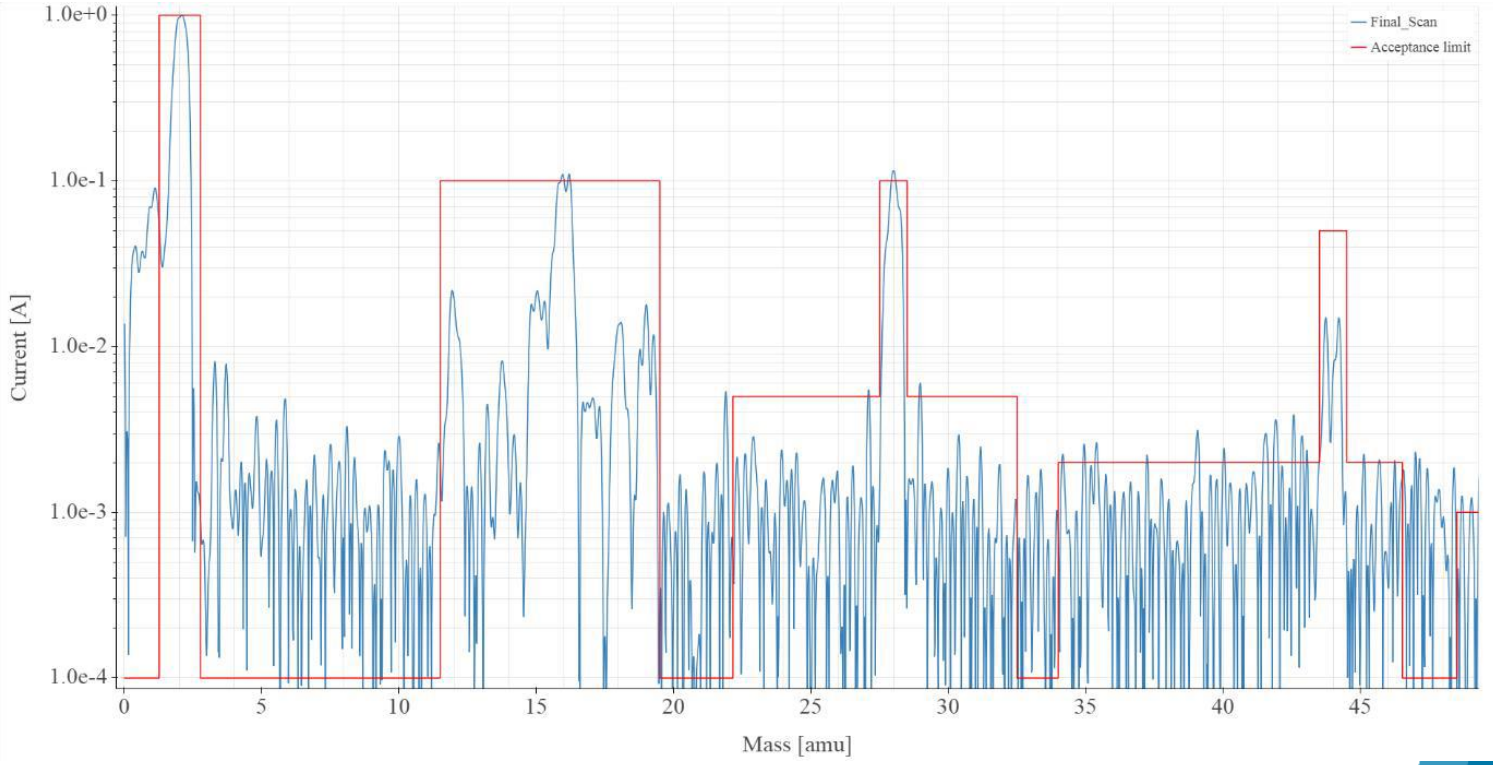
Tunnel Installation (Point 4)



Polyteknik coating vac. acceptance

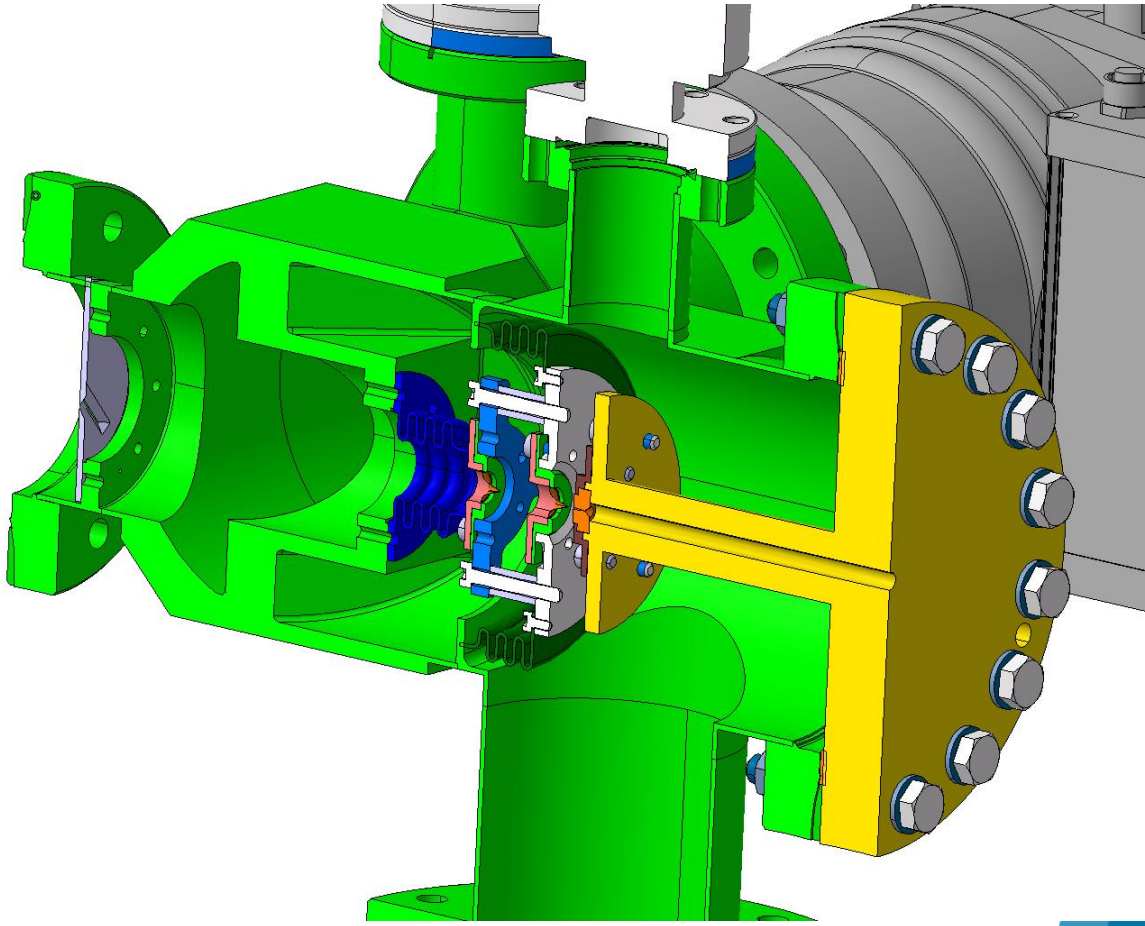
EDMS Document N°: 2134360

	P1 [mbar]	P2 [mbar]	S_{N_2} [l/s]	Q_{TOT} [mbar.l.s^{-1}]	Q_{TOT}* [mbar.l.s^{-1}.cm^{-2}]
3 Samples	$< 1 \cdot 10^{-11}$	$3.1 \cdot 10^{-11}$	9.6	$< 2 \cdot 10^{-10}$	$< 2.7 \cdot 10^{-12}$



Gas injection system redesign

Parts	Distance [mm]
Nozzle → Skimmer 1	1.87
Skimmer 1 → Skimmer 2	23.5
Skimmer 2 → Skimmer 3	151



Vacuum synoptics