Conceptual Layout and Integration in High Luminosity Insertions

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6th HL-LHC Technical Committee
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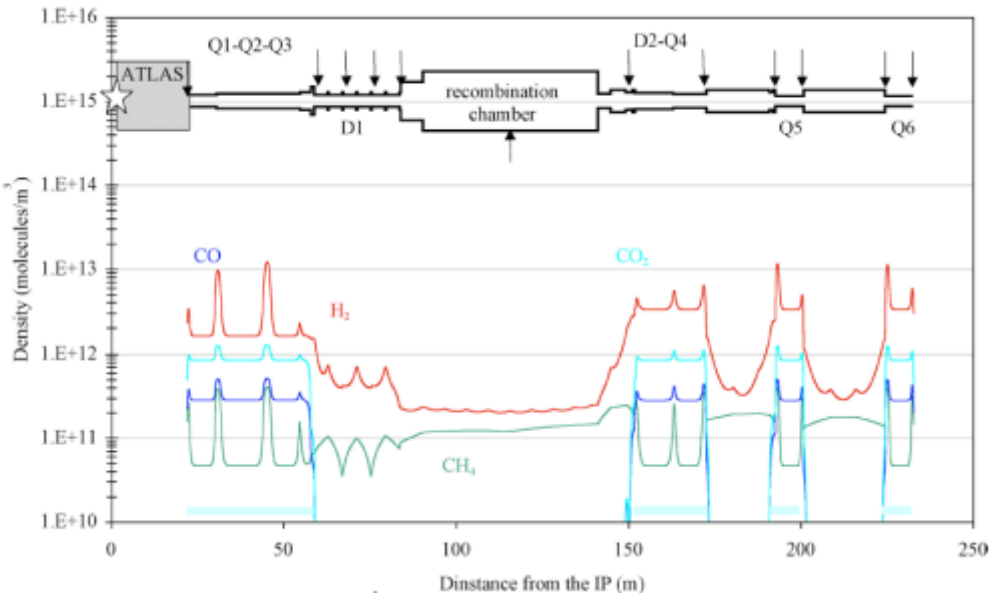
Outline

- Vacuum performances
- Layout generalities
- Key areas:
  - Experiments
  - TAS-Q1
  - IT
  - Q3-D1
  - LRBB
  - TAN-D2
  - D2, Q4, Q5, Q6
  - Crab cavities
  - Masks
- Conclusions

High Luminosity LHC

Vacuum Performances

- Layout must ensure vacuum performances
- Vacuum stability: beam current, ion desorption
- Low background to the experiments



	H2_eq / m3	mbar
<LSS$_{1 \text{ or } 5}$>	~ 5 10^{12}	10^{-10}
<ATLAS>	~ 10^{11}	10^{-11}
<CMS>	~ 5 10^{12}	10^{-10}

A. Rossi, CERN LHC PR 783, 2004.

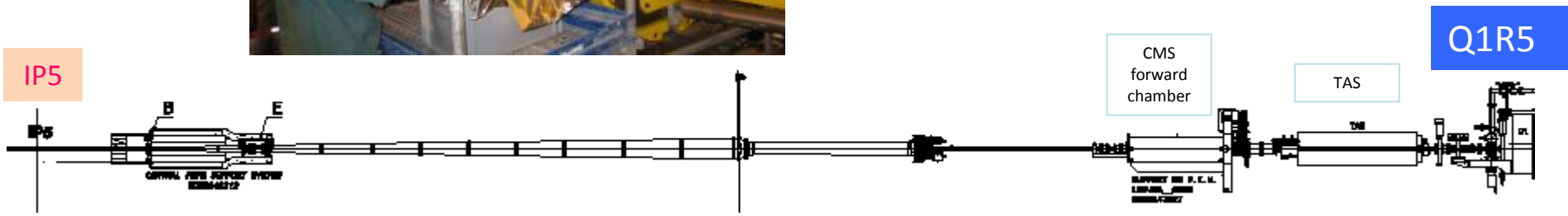
Layout Generalities

- Sectorisation at each cold to warm transition:
  - Lowest unbaked length at RT required
  - Decoupling RT and cryogenic systems
- Instrumented sector valve assembly
- Cryogenic system with perforated beam screen
- Room temperature system with NEG coating
  - Fully bakeable 200/250 deg, 50 deg/h
  - A roughing system every ~ 20 m
  - Instrumentation
  - Ion pumps every 28 m (to be review for HL-LHC)
  - Dedicated pumping for uncoated chambers
  - ID 80, 212 are standard aperture (100, 130)
- Integration studies must take into account mobile systems (bakeout, pumping groups) and installation/desinstallation of components.

High Luminosity LHC

Experiments

- Complex and dedicated vacuum chambers: Be, Al (ATLAS) and stainless steel (CMS).
- NEG coated
- Minimised thickness flanges with helicoflex gaskets
- Adapted/dedicated supporting system
- Dedicated remote tooling at TAS

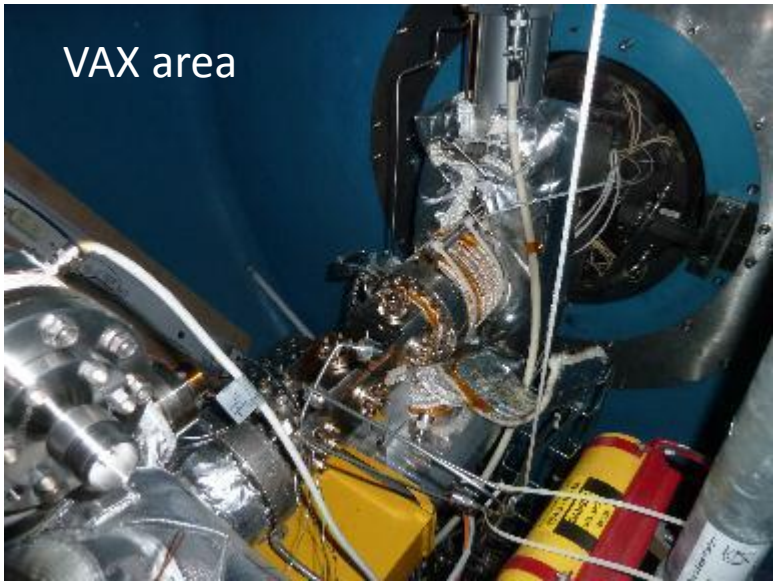


Experiments for HL-LHC

- For HL-LHC:
  - Be, Al material
  - NEG coated, no RF bridges
  - Issue with flange connection, robustness and radiation.
  - Impose “quick” flange concept
  - Review/redesign TAS remote tooling
  - Mechanical supporting system to be compatible with detector maintenance (no personnel intervention must be required)

TAS-Q1

- 2 sectors valves to decouple the experiments and allow pumping, Ne venting
- NEG coated



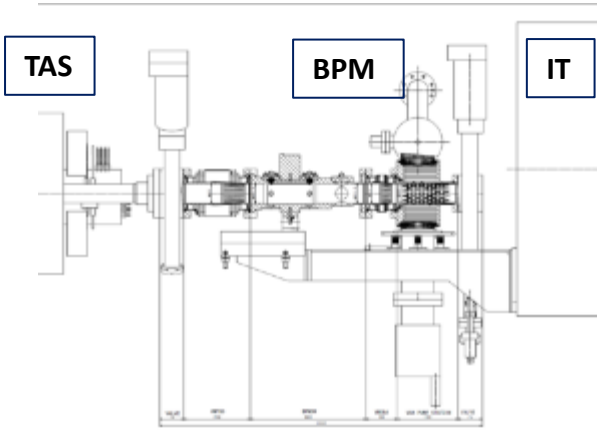


Figure 2 – Example of new VAX region layout (A1L1.X)

No room for personal to work !
(even to take a picture !)

→ To be redesigned for HL-LHC to allow remote tooling

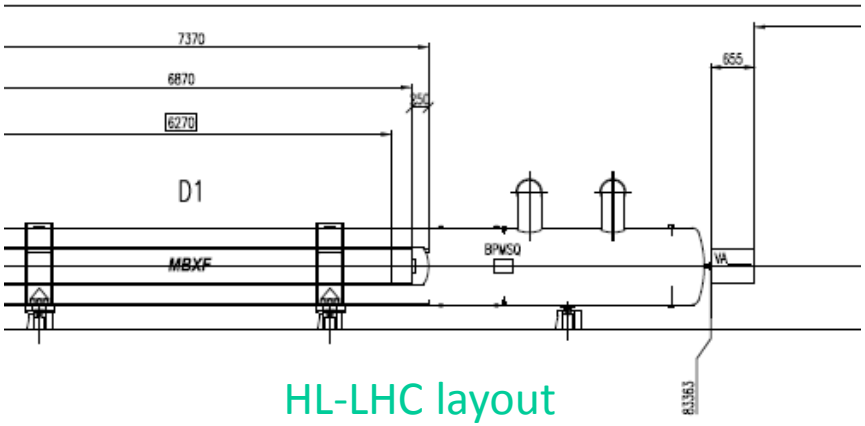
IT

- Perforated shielded beam screen
- a-C coated beam screen
- Active cooling (~ 40-60 K)
- Cold/warm transition
- Interconnects length to be compatible with vacuum stability

→ Under study, definition

Q3-D1

- Longest unbaked length in LHC : ~ 1.3 m !
- Weak area

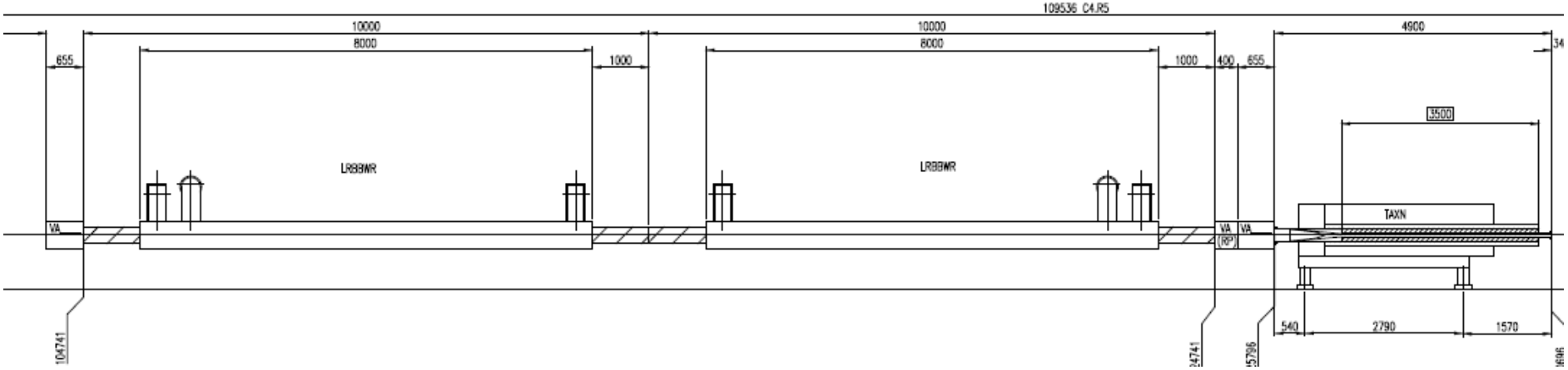


HL-LHC layout

→ HL-LHC has the sector valve assembly at D1

LRBB

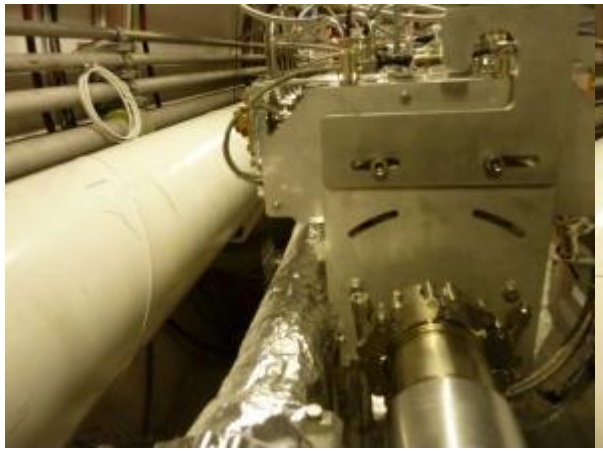
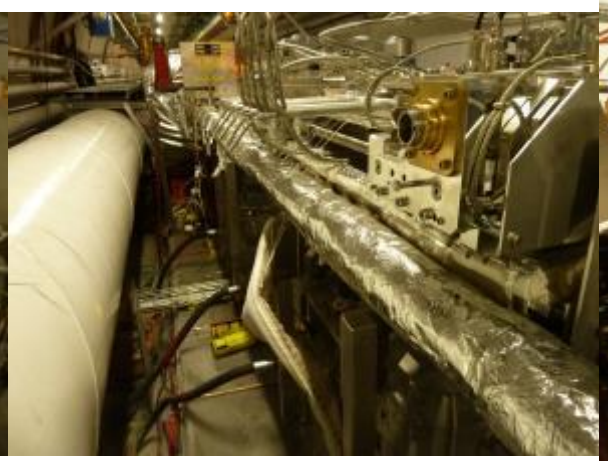
- Do not exist in LHC.
- Already sectorised
- Must be bakeable
- Material and layout to be studied and designed



→ Must be compatible with background to experiments

TAN-D2

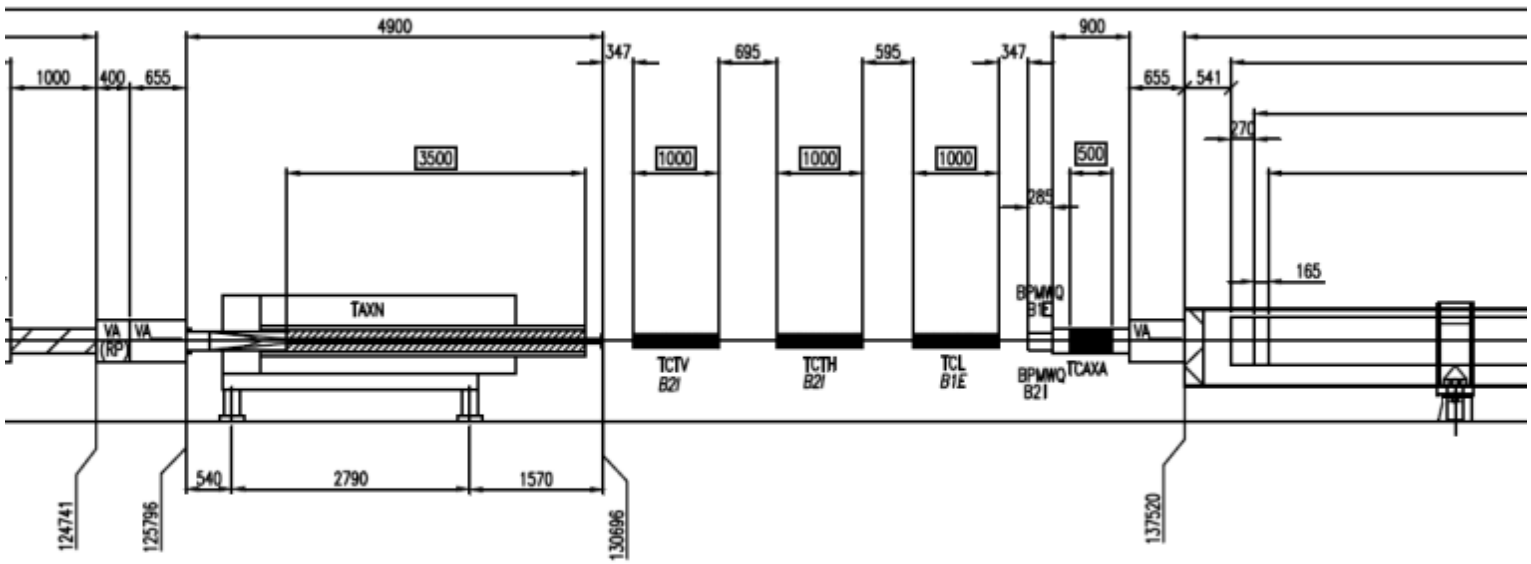
- Short distance between TAN-D2 to accommodate all components (7.43 m)
- Integration of all components (collimators, BPM, vacuum system) not properly done during LHC construction


→ Redesign of collimator's envelope taking into account mobile equipment : bake out + pumping groups

TAN-D2 for HL-LHC

- Current layout with added mask (TCA)



For collimators only active length.

Mechanical assmembly and interfaces to be redesigned to fit the available space

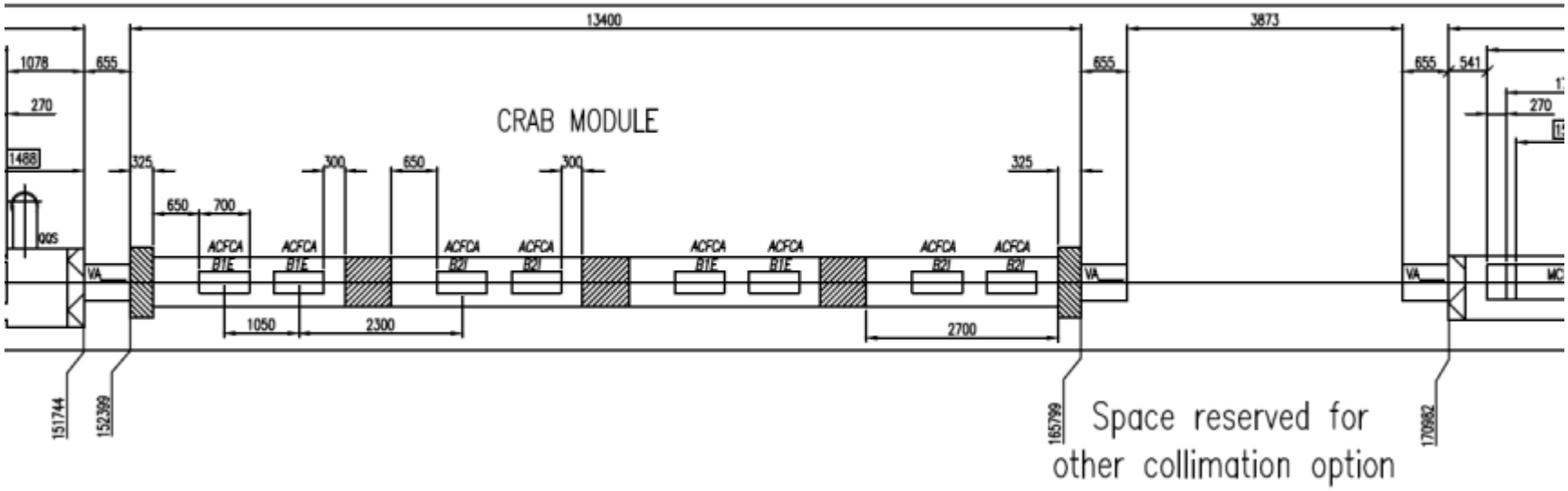
→ This version must allow 5th axis and remote tooling

D2,Q4, Q5,Q6 for HL-LHC

- Re-use sector valve assembly
- a-C coated beam screen (5 – 20 K ?)
- 1. 9 K cold mass
- R-use $Q4_{LHC}$ cold warm transition for $Q5_{HL\text{-}LHC}$

Crab cavities between D2-Q4

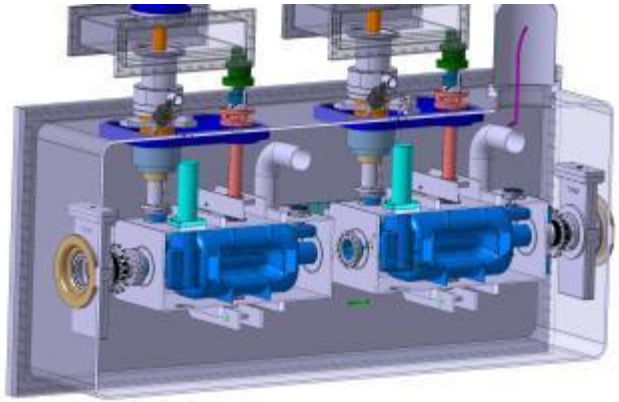
- Q4 and Q5 sectorised
- Collimation sectorised
- Module sectorised

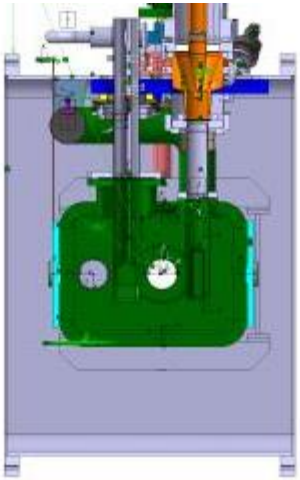


Collimation must be in the same sector as the 2nd beam to use it as a cryotrap protecting the cavities

Crab cavities between D2-Q4

- Vacuum valves inside insulation vacuum: not inserted into sector valve chain
- Interconnects: one sector valve + instrumentation + cavity roughing
- 2nd non accelerated beam at cryogenic temp (2.0 K) => need beam screen / shadowing





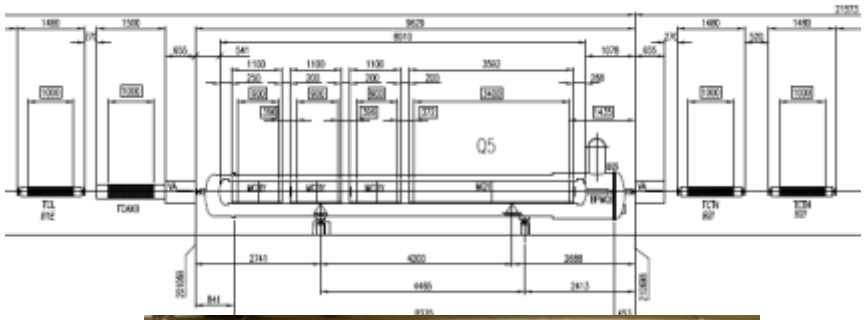
Examples of HL-LHC crab cavities

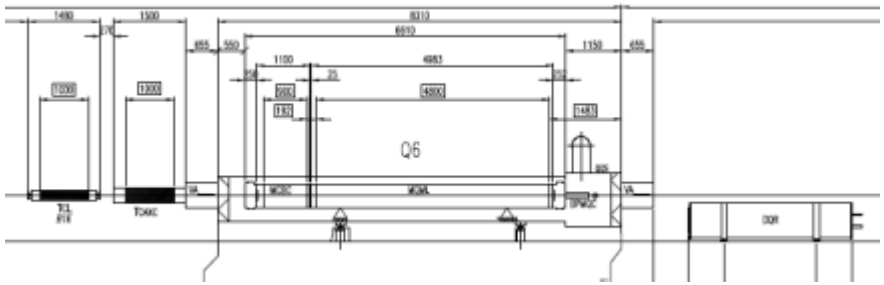
Layout study and design

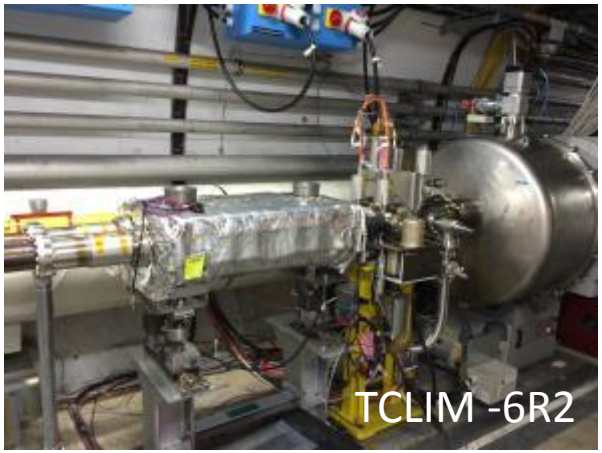
→ Impact of electron cloud and synchrotron radiation on crab modules ?

Other Masks and Collimators

- Room temperature
- Bakeable to 250 deg, 50 deg/h
- Room is available







Re-use of standard equipments

Conclusions

- Conceptual layout well advanced
- Objective to:
  - Have vacuum performances compatible with HL-LHC (1.12 A per beam, 2.2 10^{11} ppb, 2748 b)
    - 2.24 A in the IP instead of 1.16 A for LHC !
    - Above vacuum stability design margin !
  - Review/redesign and develop along the LSS the remote tooling
  - Re-use vacuum equipments from LHC

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Thank you for your attention

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