Conceptual Layout and Integration in High Luminosity Insertions

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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
Vacuum Performances

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

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<th>H₂_eq / m³</th>
<th>mbar</th>
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<tbody>
<tr>
<td>&lt;LSS₁ or ₅&gt;</td>
<td>~ 5 × 10⁻¹²</td>
<td>10⁻¹⁰</td>
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<tr>
<td>&lt;ATLAS&gt;</td>
<td>~ 10⁻¹¹</td>
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<tr>
<td>&lt;CMS&gt;</td>
<td>~ 5 × 10⁻¹²</td>
<td>10⁻¹⁰</td>
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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.
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

TAS remote tooling
Inside FIN (fin iron nose)

RF bridge repair 18-1-2012
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

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

To be redesigned for HL-LHC to allow remote tooling
• 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 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 assembly and interfaces to be redesigned to fit the available space

This version must allow 5\textsuperscript{th} 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 $Q_4^{\text{LHC}}$ cold warm transition for $Q_5^{\text{HL-LHC}}$
Crab cavities between D2-Q4

- Q4 and Q5 sectorised
- Collimation sectorised
- Module sectorised

Collimation must be in the same sector as the 2\textsuperscript{nd} 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
- 2\textsuperscript{nd} 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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