



**High
Luminosity
LHC**

Wrap-Up and Perspectives for Vacuum (WP12)

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**Technical Meeting on Vacuum for HL-LHC
CERN – 5th March 2014**



The HiLumi LHC Design Study is included in the High Luminosity LHC project and is partly funded by the European Commission within the Framework Programme 7 Capacities Specific Programme, Grant Agreement 284404.



Outline

- Beam screens for IT 1-5
- Conceptual Specifications
- Parallel projects to IT
- Radiation Impacts
- Pressure profiles for Experimental areas
- Conclusions

Definition

- For simplicity I assume HL-LHC project means:
 - Studies & production for LS2
 - LS2
 - Studies & production for LS3
 - LS3

Beam Screens for IT1 -5

- Assume **no new beam screen** for IT2 & 8 and for LSS1&5 matching section unless SAM operates at 1.9 K (removal of cryosorber) and interest to do a-C coating to reduce background: to be clarified
- **Prototypes** with W shielding
- Validation of **a-C coating** on the BS
- Feasibility study of alternative/complementary solutions

BS prototype with W shielding in IT1-5

- Several small samples types studied by Q1-2015:
 - Electrical and (thermal) conductivity measurements
 - Brazing tests, thermal expansion coefficient measurements
- Procurement of prototype long CB tubes to study achievable tolerances by Q3-2015
- **1.2 m long prototype** expected by end Q3-2015:
 - Asses metrology and tolerances
 - Insertion tests into CB
 - Definition / validation of supporting device
 - Definition of insertion procedure
- Produce a-C samples onto colaminated Cu : 2014-2015
 - Define coating procedure
 - Definition of production procedure
 - Qualify SEY and other vacuum parameters
- Production of ~ 10 m long BS by 2016
 - Metrology and define tolerances
 - Finalise supporting device and insertion tooling
 - Installation in a string magnet



Resource: a doctoral student was selected in January and will start by Summer

a-C coating beam screen

- Vacuum characterization to be continued and completed:
 - **SEY** at cryogenic temperature:
 - Different T,
 - Electron energy, dose
 - Electron reflectivity
 - Gas condensation
 - Electron and Photon **Stimulated Desorption**:
 - Room temperature
 - Cryogenic temperature
 - Photoelectron yields and photon reflectivity
- **Resources**:
 - CERN & support from external institutes : INFN, BINP
 - INFN to be continued and BINP to be initiated

COLDEX with a-C beam screen

- Status:
 - Beam screen installed, under vacuum
 - Control system (cryogenic & vacuum systems) and motor displacement to be refurbished
 - In SPS BA4 till end 2015 (according to CC schedule)
 - 2016 is wished to allow complete validation
- Resources:
 - A GET fellow, funded by HL-LHC project) is expected to be selected by Summer

COLDEX with a-C beam screen

- **Scientific objectives:**
 - Isotherms measurements in 40-60 K range
 - Studies with LHC type beams:
 - Pressure increase
 - Gas composition
 - Heat load
 - Electron flux
 - Studies of operational impact with:
 - Gas pre-condensation
 - Temperature oscillations / excursions

Alternative solution to a-C coating

- **Clearing electrodes:**
 - Conceptual idea: O. Brüning LHC PR158, Nov 1997
 - Implemented in Daφne and KEK B
 - Feasibility study initiated with ASTEC and INFN (Frascati):
 - Very good knowledge of vacuum systems and LHC specificities
 - Objectives under definition:
 - Impact on impedance
 - Integration into a long cryostat
 - Conceptual design
 - Ideally to be tested in COLDEX set-up (2016 ?)
 - Might be installed in LHC room temperature Vacuum Pilot Sectors by 2016 ?
 - Allocated budget and milestones **to be defined**

Conceptual Specifications

- 11 documents identified to be due for June

EDMS	Title	Objective
1361079	Draft Conceptual Specification HL Beam Screen	
1361087	Draft Conceptual Specification HL Bypass Cryostat	
1361088	Draft Conceptual Specification HL ATLAS Vacuum chamber	
1361089	Draft Conceptual Specification HL CMS Vacuum chamber	
1361090	Draft Conceptual Specification LHCb Vacuum chamber	
1361091	Draft Conceptual Specification ALICE Vacuum chamber	
1361092	Draft Conceptual Specification HL Vacuum around P5	
1361093	Draft Conceptual Specification HL Vacuum around P1	
1361094	Draft Conceptual Specification HL Vacuum around P4	
1361095	Draft Conceptual Specification HL Insulation Vacuum	
1361096	Draft Conceptual Specification P2&P8 Beam Screen	Needed ?

Parallel Projects to IT-1

- Crab cavity (**WP4**):
 - Layout must be defined
 - Insulation vacuum to be defined
- New RF cavity (**WP4 ?**):
 - Layout must be defined
 - Insulation vacuum to be defined
- RT collimator in bypass cryostat (**WP5-WP11**):
 - A bypass prototype exist, collimator integration to be completed
 - **Resource**: a GET fellow, funded by collimation project, to be continued till production/installation

Parallel Projects to IT - 2

- New collimators in IR7 + IR3 (WP5):
 - Design to be validated
- Hollow lenses (WP5):
 - Layout must be defined
 - Vacuum performances must be studied/validated
- New TDI (WP14):
 - Layout must be defined
 - Vacuum performances must be studied/validated
- Insulation vacuum for magnets cryostats & cold powering (WP3 & 6)

Parallel Projects to IT - 3

- Upgraded dilution kickers (WP14):
 - Vacuum performances to be consolidated
- Upgrade of MKI (WP14)
- New TAS and TAN in IR8 (WP8)
- New Q5 in IR5 (WP ?)
- New mask, new experiments ?
 - To be clarified when possible
- ALICE beam pipe upgrade for LS2 (LEB)
- LHCb velo upgrade for LS2 (LEB)

Radiation Impacts

- Use of Al instead of stainless steel/Cu:
 - Development of Al based material
 - Sealing techniques and bakeout:
 - Experience from LEP, KEK, Spring 8, Elettra, APS, ALS, Petra 3 ...
 - Use of “quick flange” concept
- New layout around TAS-Q1
 - Prefer “tube + bellow” without complex devices (BPM, Warm module’s RF bridge, gauge)
 - Compatibility of instrumentation with radiation hardness ?
 - Sector valve which can be actuated by a robot
- **Resource:** a **GET** fellow for LHC experiments expected to be selected by summer

Radiation Impacts

- IP 3 and IP7:
 - Consolidation of lumped scheme with NEG cartridge and of “quick flange” connecting concept
 - Review of maintenance, operational work and vacuum performances – review sectorisation ?
 - Study and implementation of robotic activities
 - Leak detection, venting, flange connection ...
 - **Resource** : a GET fellow, funded by collimation project, is expected by 2015

Pressure Profiles

- Expected gas density must be computed for the new IRs.
- Layout must be well known and almost frozen
- Profiles to be evaluated by 2017
- Validated by LHC experiments 2018
- 2019 : Launch components production

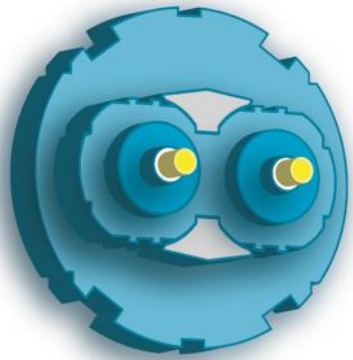
Conclusions

- HL-LHC for WP12 consist of :
 - New BS for IT1 and 5
 - Many parallel projects
- Conceptual specifications will be issued by June to define a roadmap till commissioning

Table 6: Example Equipment XXX Simplified Schedule

Phase	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Requirements definition	■	■								
Functional specification		■	■							
Engineering specification			■	■	■					
Acquisition Process				■	■	■				
Fabrification, Assembly & Verification					■	■	■	■		
Installation – Commissioning							■	■	■	

EDMS 1311290



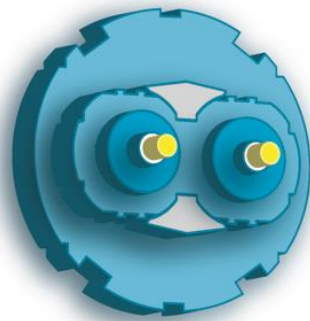
High Luminosity LHC

**Thank you for
your attention**



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