



EDMS No. 2059472

International Review of the HL-LHC Collimation System

Mandate

The main objective is to review the collimation system of HL-LHC in view of the LHC Run1 and Run2 experience and the suitability for installation in the LHC. The review will examine the upgrades in the experimental and cleaning insertion regions as well as the new cleaning systems in the dispersion suppressor regions of P7 and P2.

Charges

The review panel is invited to answer the following questions:

- Is the collimation system in the present baseline addressing the design criteria required for the HL-LHC operation?
- Are the original design criteria of the collimation system validated by the LHC Run1 and Run2 experience and by the various tests carried out on each component? Is there room for modifications or simplification after the LHC Run1 and Run2 evaluation and what would be the resulting risk implications? What should be learnt in Run 3 as feedback to the LS3 plans?
- Review the observed hardware performance during the present prototype production: are there non-conformities and how relevant are they for the HL-LHC operation and could they limit the HL-LHC performance reach (or the LHC performance for the collimator installed in Run3)? Are the observed hardware characteristics compatible with the HL-LHC operation requirements?
- Review in particular the motivation for using coated MoGr as collimator material [robustness, likelihood of damage and impact of damage on the rest of the machine] also based on the LHC Run2 operation: Is the use of MoGr as collimator material well justified or could other materials with better conductivity or other combination of jaw bulk material with coating be used instead?
- Is the cleaning upgrade envisaged for the DS still justified and good enough for both proton and ion beams at their maximum intensities or are there alternative solutions?
- Is the IR cleaning envisaged for the HL-LHC well justified or are there alternative solutions?
- Is the choice of installing collimators in the dispersion suppressors of point 7 still adequate taking into account the results of proton and ion operation in Run 1 and 2 including crystal tests.

Format

One and a half day presentations and discussions, followed by an executive meeting of the committee and a close-out on the second day. Following the close-out by the review chair, the committee is asked to compile a short report with findings, comments and recommendations within one month. The report will be delivered to O. Brüning, HL-LHC Deputy Project Leader and L. Rossi, HL-LHC Project Leader.

Review Panel

Ralph Assmann (DESY), Wolfram Fischer (BNL), Mike Lamont (CERN), Mike Seidel (PSI, Chair), Alban Sublet (CERN), Walter Venturini (CERN).

Scientific secretary: Alessio Mereghetti | S. Redaelli: link person for the HL-LHC Collimation upgrade (WP5)

Date and Place: 11th – 12th February 2019 at CERN (Auditorium TE 30-7-018).



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Detailed agenda and syllabus

Executive Session (closed session)

Introductory Session

1. Welcome, introduction and mandate, O. Brüning

- Detailed introduction of upgrade plans
- Review of HL-LHC parameters
- Brightness frontier in Run III following LIU upgrade

2. Collimation upgrade plans, S. Redaelli

- Detailed introduction of upgrade plans
- Definition of timeline for the WP5 upgrade: LS2 and LS3 plans
- Recap. of the planned consolidation activities, impacts for the HL goals
- Introduce the new design features relevant for HL: BPM collimators, new jaw design
- Recap. status and plans for hollow e-lenses and crystals
- Recap. of the last technical review for HL-LHC at Chamonix 2018 for collimation

Session 1: Review of the operational experience in Run I and Run II

3. Overview of present collimation performance, R. Bruce

- Evolution of settings and protected aperture for small beta*
- Cleaning performance throughout the years
- Performance of IR cleaning (incoming and outgoing)
- Relevant system faults and HL-LHC protected aperture
- System failures, availability and sources of downtime
- Review of beam loss cases inducing damage

4. Beam losses, lifetime and operational experience at 6.5 TeV, B. Salvachua

- Review beam losses and lifetime for protons and ions
- Stability and reproducibility: collimation settings
- Stability and reproducibility: orbit and optics
- Tail population measurements
- Experience with beam failures damaging the collimator

5. Performance of new designs deployed in Run II and plans for Run III, A. Mereghetti

- New jaw design and performance of BPM collimators
- Operational performance of the TCSPM prototype in 2017-2018
- Software improvements and performance in Run II: alignment and BPM interlocks (including machine learning)
- Prospect for further improvements, including machine learning
- Recap. of Run III layouts

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Session 2: Upgrade plans: performance and needs

6. Cleaning upgrades in the dispersion suppressors, A. Lechner

- Review technical solutions for DS around IR7 and IR2
- Studies of different locations for IR7 and final layouts
- TCLD design: settings and material choices. Functional specifications
- Review key/critical points in the ECR (installation, safety, transport...)

7. Quench performance and assumptions: simulations and beam tests, E. Skordis

- Collimation quench tests with protons: can we quench with proton beams?
- Collimation quench tests with ions and BFPP quench tests
- Benchmark of simulations: peak energy deposition for the different test

8. Quench performance and assumptions: magnets and cryogenics, L. Bottura

- Quench limits and possible limitations from cryogenics
- Status of cryogenics limitations for different loss scenarios
- Comparison of present dipole and 11T dipole

9. Operational experience with ions, N. Fuster

- Review of relevant aspects in ions runs
- Plans for bumps in different IRs: IR1/5 without TCLD and IR2 with TCLD (without 11T)
- Are the bump solutions robust enough for the HL-LHC
- Luminosity reach with the present upgrade scenarios
- Brief highlights from the crystal collimation tests with ion beams during Run 2

10. Status of 11T dipole project, F. Savary

- Overview talk from WP11: where we are and what are the plans for LS2
- Final configuration of cold masses and corrector package in new locations
- Summary of LS2's ECRs

11. Impedance models, operational experience and expected limitations, E. Métral

- IR7 upgrade plans in LS2 and LS3
- Experience from Run I and Run II
- Expectations for HL-LHC
- Review of beam tests with the low-impedance prototype
- Other mitigation options for impedance issues (new optics, asymmetric settings, new ATS) and drawbacks: theory and beam test results

12. IR collimation upgrades – incoming beam, H. Garcia or R. Bruce

- Layout for new IR1 and IR5
- Protected aperture and baseline settings
- Proposed material choices and their performance

13. IR collimation upgrades – outgoing beam, F. Cerutti

- Layout for new IR1 and IR5: TCLs and masks
- DS losses at high luminosity: any limitations for proton operations?

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- Status of mask specifications

14. Plans and goals for remote alignment and impact on collimator designs, P. Fessia

- Overview of the overall plans, with specific aspects for WP5
- Review tolerances and specifications
- Timeline for critical decision points

15. Review of hollow e-lenses, A. Rossi

- Recap. previous reviews and status of baseline process
- Design overview: where we are
- Status of process for insertion into baseline

Session 3: Specific design aspects and production status

16. Status of LS2 production and prospect for LS3, I. Lamas

- Review where we are: status of ongoing production for LS2
- Recap. of experience of LS1 production:
- Plans for future productions: what can we expect for LS3.
- Comments on the prospect for in-kind contributions

17. Performance of new HL collimator designs, A. Bertarelli

- Status of collimator design. New collimators for IR cleaning
- Summary of potential failure scenarios and resulting beam impact on the collimator jaws
- Experience without beam with the prototypes
- HiRadMat: overview and results. What is still missing? Needs for Run III (with LIU beams)
- Status of results from radiation damage tests

18. New materials: status, F. Carra

- Review of the performance of the MoGr without and with coating
- How can we optimize the production of MoGR?
- Other viable solutions: status of tests and validation [coated Gr or CFC]
- What is missing to validate the CuCD?

19. Review of vacuum performance, G. Bregliozzi

- Review of vacuum tolerances for carbon-based materials
- Proposed coating process for the collimator jaws
- Observed 'problems' with the prototypes and proposed mitigation steps
- IR7 vacuum tolerance in light of the vacuum bump test with beam.
- Other coating implementations for the HL-LHC other than on the collimator jaws

20. Collimator controls upgrade plans, A. Masi

- Review performance of present system
- Faults driving availability and expectations for HL-LHC
- Solutions being studied for controls upgrade, with timeline
- Synergy with consolidation plans



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21. Crystal collimation for lead ion beams, D. Mirarchi

- Layouts and beam test results. Operational experience with high intensities in 2018
- Cleaning performance for ion beam collimation
- Is it an operational alternative for improving ion beam cleaning?
- Outcome of the Crystal Collimation day in Oct. 2018 (hardware options for LS2)

Executive session (closed session) and close-out