Minutes of 63th Collimation Upgrade Specification Meeting

Participants: O. Aberle (OA), C. Adorisio (CA), A. Bertarelli (AB), N. Biancacci (NB), C. Boccard (CB), R. Bruce (RB), R. De Maria (RdM), D. Duarte Ramos (DD), H. Garcia (HG), (scientific secretary), L. Gentini (LG), A. Lechner (AL), A. Mereghetti (AM), D. Mirarchi (DM), E. Quaranta (EQ), H. Rafique (HR), S. Redaelli (SR), (chairman), A. Rossi (AR), M. Serluca (MS), J. Wagner (JW).

Remote: T. Markiewicz (TM), S. Tygier (ST).

Indico event [here](#).

1 Decisions and actions for this meeting

Decisions taken at this meeting:

– “Cold” solution for the vacuum design of the other beam, opposite to the TCLD collimator (see details in presentation of D. Duarte Ramos).
With the decision on baseline active length of 60 cm, taken at the 51st ColUSM of January 30th, 2015, this finalizes the design of the TCLD and the by-pass cryostat for the installation between 11 T dipoles.

– The TCLD prototype built by EN/MME will be make with Inermet (tungsten heavy alloy) jaws.

– The design of the TCLD is based on finger - and not ferrite - for impedance reduction.

Actions from this meeting:

– Preparation of HiLumi Annual meeting, WP5 programme (S. Redaelli and WP5 task leaders).

– Study optimum materials for the TCLD collimators in IR7, for the phase advances of the last HL optics baseline (R. Bruce).

– Continue integration studies in the TAXN/D2 regions of HL-LHC (A. Rossi):
  – Review tolerance to be applied;
  – Check transverse integration for a TCTP location next to the Q4 magnets (on the non-IP side).

– Merlin simulations of HL presqueeze. Actions: determine settings of TCTP collimators versus $\beta^*$ (R. Bruce), setup Merlin for HL optic version 1.2 (H. Rafique), run the relevant cases by the end of October (S. Tygier).
2 Status of by-pass design and options (D. Duarte Ramos)

[slides]

2.1 Summary of the presentation

- DR recalls the last results shown in previous meetings about the 11 T cryostat design and the integration of the collimators in the new layout. He explains that is not possible to fit the collimator nor sector valves between standard bus bar lines. There exists the possibility of new end covers may be made to route the bus bars in a way to provide enough space for the collimator.

- DR shows the current baseline where the connection cryostat between two 11 T magnets is modeled to integrate the collimator. The busbar routing is now in the shadow of the beam screens and CWT.

- DR shows the cross section of the connection cryostat and two different vacuum options, one for a “cold” and one for a “warm” vacuum layout for the pipe of the non-collimated beam. Among these two options, which were presented to the 51st ColUSM of January 30th, it has now been decided to take as baseline the “cold” solution that does not require vacuum sectorization.

- DR concludes that the concept has evolved to a sound design for integration of a 60 cm collimator active length without compromising other systems. All the interfaces are now fully understood. The design of a prototype cryostat is ongoing and final details of the bypass cryostat being addressed.

2.2 Discussion

- SR welcomes the finalization of the baseline design for the connection cryostat between 11 T dipoles. We have now all elements to proceed with the preparation of the TCLD prototype following the presented design (see also next slide).

- In view of a possible implementation of cleaning solutions in IR2 based on orbit bumps without 11 T dipoles, SR asks if the design worked out of the integration between 11 T dipoles can be easily adopted for integration into the connection cryostat. DR says he can only start detailed design work starting after the end of this year. On the other hand, he reckons that, even detailed work must be done, one should not expect significant issues if the same solution if adopted for the connection cryostat. SR recalled that the final decision about bump solutions in IR2 will be finalized after collecting operational experience during the ion run, so we should be able to trigger the studies sometimes in the first half of 2016. Will this be early enough for a production of units for IR2? DR replies that this should leave enough time for the detailed design work of the adapted connection cryostat.
3 Status of TCLD design and plans for prototyping (L. Gentini) [slides]

3.1 Summary of the presentation

- LG shows the layout of the new TCLD collimator. This design now adopts the active length of 60 cm. The jaw design is completely new compared to that of the standard collimators. Details of the design are given in LG’s slides.

3.2 Discussion

- Recalling that in IR2 it was estimated that for ion beams it would be sufficient to use copper jaws, AB asked if we should consider this option for the prototype to be built. This would save some money (material cost, plus less machining). One could build a Glidcop solid block. After discussing this point, there was a general agreement that for the prototype it is better to use the Inermet-based design, suitable both for IR2 and IR7. There is still time to finalize the final material choice for IR2, by the time that the production of 2 units + 1 spare is launched.
  Decision: TCLD prototype will be made of Inermet.

- **Decision**: the present TCLD baseline design is based on RF finger, and not on ferrites, to mitigate RF modes. SR and AB commented that they re-iterated this question to the impedance team, in light recent indication that ferrites with better vacuum performance can be achieved. E. Métral iterated that we should still assume RF fingers as a baseline, though.

- RB pointed out that material choice is very important for IR7. Since in our baseline the TCLD will sit at 10 sigmas, their phase location compared to the dump must be checked for the final HL optics. It is not excluded that more robust materials than Inermet shall be considered. This will be followed up through asynchronous dump simulations (action: RB and collimation tracking team).

- SR suggested that we should consider the possibility to build a prototype that is conform for installation in LHC: this would potentially serve as a spare, saving the corresponding money.

4 TCTP/TCLX integration studies (A. Rossi) [slides]

4.1 Summary of the presentation

- AR presents the studies for the evaluation of the required TCTP and TCL stroke for HL-LHC, in the region between TAXN and D2 of IR1/5. Present collimators have a maximum half gap of 30 mm, given by mechanical design. [RB slides on ColUSM 29]

- AR explains that because of the larger beta functions in the IR, the stroke of the present design is not enough sufficient. The maximum aperture could be as small as 14σ that is considered not to be sufficient for a fixed collimator.
• In addition to the TCT aperture constraints, AR points out that the present collimator tank actually does not fit transversally in the available space because the HL optics required also the other beam pipe to be larger.

• For flat optics, the maximum opening is just below $12\sigma$ if a nominal configuration is considered but a 10 mm stroke is missing when orbit and collimator alignment errors are considered.

• A possible solution could be to move the TCT on the non-IP side of Q4.

4.2 Discussion

• SR commented that the solution to move the TCTP on the non-IP side of Q4 is a good option but it is not feasible to study it in detail before the annual meeting. Studies should be completed with the present optics version. In any case, more detailed studies are needed to understand implication of transverse issues on the TCLX design. The TCLX cannot be moved from its present location.

• RdM comments that triplet is the limiting factor if the present tolerance set is applied. If things go well and better than expected, the TCT might become the aperture bottleneck.

SR replied that this approach is not fully consistent. We should defined a set of tolerances and stick to it, otherwise we pout ourselves in a weak position by presented the agreed tolerance set as pessimistic.

After some discussion, it was agreed that the people involved should sit down offline and review in details the tolerance (Action: AR, RdM).

5 Recent results of Merlin loss maps simulations
(S. Tygier) [slides]

5.1 Summary of the presentation

• ST presents the last results from simulation of loss maps for the LHC at 4.0 TeV using Merlin, addressing a pending action to understand difference on TCT loads that were estimated to be much lower than in SixTrack.

• ST explains that a lot of checks have been performed including inputs, optics files and code functions. Some small discrepancies in the aperture models were found but cannot explain the difference. Comparisons of individual particle’s trajectories pointed to a disagreement with the crossing angle of IR8. Fixing this made a significant improvement.

• Some small differences in loss maps still remain but their are considered not fundamental. Merlin can be used again for production runs.

• ST presents the last updates of the code that include new scattering routines and hollow electron lens among others. The code is now merged.
5.2 Discussion

- SR proposes to start, indeed, production runs with Merlin with the goal to produce some results for the HiLumi annual meeting. We should profit of the presence at CERN by Haroon Rafique (visiting us for 2 weeks) to setup the Merlin simulations for the HL optics 1.2 (action: HR), with thick lens studies. We should then proceed with high priority with the planned simulations of physics cases: presqueeze and final squeeze with ATS. (Action: ST). This requires the definition of TCT settings versus $\beta^*$ (action: RB) to be provided to the Merlin team. SR recalled that this input is also to be provided to the impedance team.