

Minutes of Special Joint HiLumi WP2/WP5 Meeting

Participants: C. Accettura (CA), H. Bartosik (HB), R. Bruce (RB), X. Buffat (XB), R. Cai (RC), F. Carra (FC), M. D'Andrea (MDA) (*scientific secretary*), R. De Maria (RDM), C.N. Droin (CND), M. Giovannozzi (MG), P.D. Hermes (PDH), S. Kostoglou (SK), B. Lindström (BL), L. Mether (LM), E. Metral (EM), M. Modena (MM), N. Mounet (NM), F.X. Nuiy (FXN), K. Paraschou (KP), A. Perillo-Marccone (APM), J.B. Potoine (JBP), T. Pognat (TP), S. Redaelli (SR) (*chairman*), V. Rodin (VR), R. Tomas Garcia (RTG) (*chairman*), M. Zerlauth (MZ).

[Indico link.](#)

Actions from this meeting

- Discuss geometry databases at the upcoming WP2 PSM (RTG).
- Organize a dedicated discussion on magnet (re)alignment strategies (RTG, MG, RDM).
- Check the consistency between TCL/TCT specification documents and vacuum layout document (RDM).
- Circulate the functional specification documents as soon as ready and in parallel agree on the alignment references for 2-in-1 devices (SR, RDM, MG, FXN).
- Trigger a discussion at the AWG aspects related to collimator alignment procedure for the 2-beam devices (FXN, MG).
- Define strategies and add new scenarios (as smaller magnet pool for TF sorting) for magnet sorting depending on the timeline and available information (MG).
- Rerun DA simulation studies for nominal filling scheme (SK).
- Verify what is the ideal filling scheme for 2200 bunches in terms of granularity and (LM) as input for beam-beam simulations of a hybrid scheme (SK).
- XB to collect data from octupole polarity reversals in MDs and follow up with future MDs if needed.

1 General information

SR announced that the [next ColUSM](#) will take place on Friday March 10th, featuring topics related to crystal collimation. He also shared the news that, following the discussion at the [last LPC meeting](#), the experiments expressed their preference to run at the maximum energy of 6.8 Z TeV for the Run 3 Pb ion runs. RTG went through the [minutes](#) of the previous joint meeting, recalling the emerging actions. The minutes were approved with no further comments. MG reported on the latest [WGA meeting](#), where discussions about geometry databases and necessary updates were resumed. RTG proposed to address this topic at the upcoming WP2 PSM. RDM shared that, following a detailed analysis by the survey team, the expected uncertainties on the alignment of magnets were found to meet the required targets. However, uncertainties originating from manufacturing imperfections need to be taken into account and can only be checked by measurements with beam. Realignment procedures need to be agreed upon with Machine Protection. MG suggested to organize a dedicated discussion.

2 Review of functional specs of TCL/TCT (R. Bruce) [slides]

Summary of the presentation

RB showcased the latest updates on the functional specifications for the TCL and TCT collimators. An extensive number of changes and additions were collected over the past months, including material choice, re-use of existing LHC TCTs and spares, updated TCL mask design, coating on beam pipe of non-collimated beam, geometric constraints and more. The updated EDMS documents, called LHC-TC-ES-0011 and LHC-TCL-ES-0002, to be finalized and circulated soon, were then showcased.

Discussion

- MZ recalled past discussions on the feasibility of coating of the tapering. FXN replied that this has already been done in the past, final tests are planned but no issues are expected. SR, FC and APM clarified that this actually applies to secondary collimators, which are not addressed by this document. Regarding the TCTs, changing the material to Inermet allowed using standard metallic (copper-alloy) tapering with no coating needed.
- RTG recalled an open point regarding the choice of Inermet over copper for the masks. SR and FXN replied that the material and geometry were optimized in many iterations with the impedance team, which NM confirmed ([CoUSM #150](#)). The open points were solved and the final material choices for mask is part of the updated functional specifications.
- SR proposed to circulate the updated documents before the upcoming PSM if there are no objections, and asked RDM to verify that the specifications are consistent with the document on vacuum layout. The document could then be released in the following days.
- RDM asked if there are any news on the installation drawings since these collimators will soon be aligned in the mock-up. FXN replied that there is a pending action from the survey team to provide the references for the alignment. SR proposed to follow this up in a dedicated discussion, for example at the WGA. This topic is however considered more suited for an engineering specifications document or a collimator installation procedure document. It was therefore agreed not to add this topic to the functional specs.

3 Update on sorting activities (M. Giovannozzi) [slides]

Summary of the presentation

MG summarized considerations on the benefit of magnet sorting. Based on past LHC experience, sorting allows creating a safety margin against unknown deviations (in terms of mechanical aperture, dynamic aperture and β -beating) compared to random installation. For HL-LHC it is proposed to base the installation strategy on three observables (mechanical aperture, transfer function, field quality) with hierarchy to be defined. Documents and presentations detailing the estimated benefits are referenced in the slides.

Discussion

- RTG asked about the assumed deviation for triplets of about 1.7 mm. RDM replied that it comes from manufacturing errors in the beam screen shape and from mechanical deformations due to gravity (vertical plane). The latter effect was observed also at the

LHC and could be mitigated thanks to the fixed crossing plane at the IPs, but this strategy cannot be applied to HL-LHC.

- RDM suggested to consider sorting the beam screens too. MG replied that this was done for the warm quadrupoles of the LHC. RTG noted that the required measurements were not planned, so the feasibility should be verified. MG added that it is important to gather all necessary information in advance not to block the second phase of cryostating.
- MZ commented that it might be necessary to start the cryostating phase before all of the magnets have been measured, so the option to perform a first optimization on a subset of magnets followed by the remaining ones at a later stage should be considered. MG agreed and added that the optimal workflow is being defined together with alternative scenarios.
- MG noted that the extension of key personnel contracts would be beneficial to respect the strict timeline.
- MM commented that, according to the theoretical planning, there is not much difference in time between the preparation for IP1 and IP5, so it should be possible to adjust the installation accordingly. RTG noted that the left-to-right asymmetry could however impact the sorting pool.

4 Update on DA studies for flat optics (S. Kostoglou) [[slides](#)]

Summary of the presentation

SK presented the first results of DA studies aiming at understanding the sensitivity to different parameters via Xsuite simulations. The set of simulations presented here focused on the end of the luminosity leveling using the 8b4e filling scheme. Reducing the chromaticity allows gaining significant margins in terms of DA and allowed bunch intensity. Reversing the octupole polarity also has a beneficial effect. No significant improvement was observed when increasing the crossing angle. More detailed studies are needed to understand bunch-by-bunch variations.

Discussion

- RTG asked how the picture would change for nominal filling scheme. SK replied that simulations were done in the past but with incorrect octupole values, so they should be rerun.
- NM noted that a higher teleindex should be needed for negative polarity. XB replied that a slightly higher teleindex or octupole strength would be needed compared to positive polarity, but not by much. RTG concluded that the octupole polarity reversal is very promising, specially in case higher values of chromaticity have to be used.
- RDM commented that not all bunches collide exactly head-on due to beam-beam long range interactions and wondered how taking this into account would affect the DA. XB replied that the effect would be of the order of a fraction of a σ (as the offsets for the two beams compensate each other at the main IPs, so the separation only comes from the other IPs).
- RDM asked how many bunch classes are there in these simulations. SK replied that a class decomposition will be done also to simplify the simulations.

- RTG asked LM what would be the ideal filling scheme for 2200 bunches. LM replied that this will be checked. RTG added that it would be interesting to simulate a hybrid scheme.
- RTG asked if the polarity reversal was done in MD. XB replied that it was tested a few times with marginal beam degradation but instabilities in the non-colliding bunches in some cases (but no dumps). The use of this strategy in Run 3 has not yet been decided.