



# Minutes of the 130<sup>th</sup> WP2

## Meeting held on 18/09/2018

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## 1 GENERAL INFORMATION (G. ARDUINI)

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The minutes of the previous meetings will be circulated shortly.

## 2 UPDATE ON V1.4 OPTICS (R. DE MARIA)

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In view of preparation to the TCC **Riccardo** presented a draft version of his slides for discussion within the WP.

Overall, the changes of v1.4 involve the number of crab cavities (CC's) per IP side per beam (4 to 2), Q4 and Q5 quadrupoles, remote alignment system, extended D1 dipole beam screen, TCTPV/H and TCLX collimators, corrector lengths and strengths, IR7 and IR2. The yet missing parts include the final positions of corrector within the Corrector Package (CP), a comparison with mechanical drawings, accounting for the nominal vs design magnetic length, and a Beam Position Monitor (BPM) displacements close to D2.

Several issues were raised during discussion, including possible crossing angle optimization, non-conformity of one of the MCBY correctors, TCDQ gap, and the choice of the crossing plane.

- For the layout, **Riccardo** proposed waiting for the missing items to stabilize the optics. **Gianluigi** proposed instead including them in another version and make a list of things that are not included in v1.4. **Gianluigi** suggested to make the slide more compact to improve the readability, asked to highlight that the new optics version is no longer compatible with 4 CC's and emphasize the

presence of remote alignment. **Yannis** inquired on the status for the wire compensators. **Riccardo** replied there is the space reserved for them in the drawings, a marker can be added to point where they are supposed to be.

- On the crabbing angle optimization, **Gianluigi** proposed to clarify the message to the TCC. Following the discussion, **Riccardo** suggested putting two separate slides: the first on the Q7, where at the ultimate field of 214 T/m is asked (**Rogelio** reminded that such a test was planned for LS2), and the second – on the optics optimization with the focus on the possible implications for the hardware and the question if one should go for it. **Gianluigi** asked to clarify how the optimization of the crossing angle is achieved. **Riccardo** explained that the positions of the cavities are kept the same, and the asymmetry between the transverse  $\beta$ -functions is used to increase the angle, thus the hardware constraints are not expected. The resulting gain is not very large – around 5%. **Rogelio** asked if with the Q7 tested, one would be able to operate at the ultimate energy. **Riccardo** clarified it would not be possible.
- On the corrector budget, **Gianluigi** noted that some of the correctors appear to be used at 100% of their current and inquired about the situation with the non-conforming MCBY corrector. Riccardo showed that the non-conforming corrector is accounted for; it is in a family with another corrector that is absorbing the strength deficit. **Gianluigi** emphasized that it is important to mention the caveats: it is acceptable only if the non-conforming corrector remains the only one. The reason of non-conformity is not well understood yet. If more correctors do not meet the specifications, there might be problems. **Riccardo** agreed to make slide dedicated to the MCBY non-conformity problem. **Massimo** noted that from the presented figure it is not clear if the remote alignment is used and proposed to clarify the point. **Gianluigi** stressed that one has to show the picture with the remote alignment along with the margin in case of its failure.
- Regarding the aperture considerations, **Gianluigi** proposed improving the readability: reducing the amount of numbers, clarifying the title, highlighting that the aperture limit is in the triplet. **Rogelio** inquired what the difference between the three presented cases: ‘Mech’, ‘Beam’, and ‘Offset’ is. **Riccardo** replied it accounts for various machine tolerances, beam imperfections, and the remote alignment. **Rogelio** questioned the need to present the intermediate numbers. **Gianluigi** concluded that the aperture seems to be above  $12.6 \sigma$  with all the tolerances included, and there are no additional aperture bottlenecks. He proposed clearly listing the assumptions, main ideas, and putting the final number.
- For the IR4 optics, **Riccardo** presented a plot showing the evolution of the optics functions within the region. The plot is important for BI to see if the instruments retain their sensitivity. **Sergey** asked if it is still an open question, **Riccardo** confirmed. **Gianluigi** proposed specifying for which instruments the analysis is still required (critical only). **Rogelio** suggested showing that the important instruments: BSRT, Wire Scanner are not affected. Riccardo agreed to put the locations of the critical beam diagnostics tools on the plot.
- During a discussion on the TCDQ constraints **Rogelio** brought to attention the results of the recent MD by Stephane done with the tight collimator settings. **Riccardo** showed that for the HL-LHC case the leveling could help achieving  $10.1 \sigma$  for Beam 2 instead of  $9.6 \sigma$ , although  $9.6$  is still acceptable, according to **Roderick**. Thus in the improvement from levelling is marginal. Gianluigi asked to clarify the main message to the TCC. **Riccardo** suggested that it could be the solution exists but one has to either (1) agree on the new TCDQ gap and reduce the interlock, or (2) otherwise need to improve the hardware (TCDQ). Otherwise one would suffer a loss of the  $\beta^*$  reach.

- **Rogelio** suggested cutting the amount of text in the table summarizing the aperture margins depending on the choice of optics and crossing plane. The aperture is insufficient (-1.5 sigma) for the flat optics with H crossing in IP1. **Gianluigi** proposed summarizing that the Vertical crossing in IP1 seems better as it works for both flat and round optics with the only concern being the implications forward physics. **Riccardo** noted that from the HEP point of view there are pros and cons for every option. **Gianluigi** concluded that in the current baseline we optimize for the round optics, meaning the crossing in H plane in IP1; for the TCC the question should be when the crossing plane has to be frozen.
- **Gianluigi** suggested, in general, focus the presentation on several critical points and remind the key points in the conclusion.

**ACTION (Riccardo):** Update the presentation, taking into account the suggestions, and focusing it around a few key points: TCDQ interlock, MCBY corrector non-conformity, etc.

### 3 UPDATE ON TMCI THRESHOLDS FOR DIFFERENT COATING SCENARIOS (D. AMORIM)

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Following his talk at the 125<sup>th</sup> WP2 meeting on 24/07/18 **David** presented an update on the HL-LHC TMCI thresholds. The study cases supplemented with an uncoated MoGr collimator option for the IR-7 secondary collimators and with the tight collimator setting. For all presented scenarios, including the partial collimator upgrade the simulated TMCI threshold is significantly (a factor of two-three) higher than the HL-LHC bunch intensity. The simulated threshold of  $5 \times 10^{11}$  with the tight collimator settings matches the one measured with equivalent collimator gaps. When compared to the present-day LHC threshold of  $2.6 \times 10^{11}$  ppb it clearly shows the effect of Mo coating.

- **Elias** noted that the gain in the TMCI threshold for HL-LHC comes from both the coating and the looser collimator gaps. **Rogelio** inquired what the threshold would be for Run III with tight setting. **David** replied that, while this particular case has not been studied, from pure scaling it would be a bit lower than  $5 \times 10^{11}$  of HL-LHC with tight settings, perhaps around  $4 \times 10^{11}$  ppb, still significantly higher than the bunch intensity of  $\sim 2 \times 10^{11}$  envisioned for Run III. **Elias** noted that the TMCI is clearly not a limitation for LHC, nevertheless it is useful for benchmarking the models and understanding the impedance of the machine, which it turn may limit the performance through the octupole threshold. **Gianluigi** concluded that there is a large margin in terms of TMCI threshold for all collimator upgrade scenarios.

### 4 ROUND TABLE

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The next meeting is scheduled on the 25<sup>th</sup> of September.