

Minutes of the WP2 Task Leader Meeting held on 05/12/2014

Participants: G. Arduini, O. Brüning, R. De Maria, M. Giovannozzi, R. Kersevan, E. Métral, Y. Papaphilippou, T. Pieloni, E. Todesco, A. Valishev.

Minutes, Follow-up of Actions, General Information (Gianluigi)

The minutes of the previous meeting have been approved without comments.

Follow-up of actions:

- All the deliverable reports have been submitted before the KEK meeting
- Massimo has transmitted to Ezio the latest information concerning the requirements for the b10 and b14 multipoles. Massimo noted that the estimates of the b10 and b14 specifications are based on a field error table provided Ezio and he asked whether the starting assumption is still valid. Ezio confirmed.
- The preliminary design report has been circulated in preparation of the steering committee at KEK and it is being finalized.

Operational Scenarios (E. Métral, N. Biancacci, K. Li, T. Pieloni, B. Salvant, C. Tambasco)

Elias reviewed the proposed operational scenario and the underlying assumptions. The aim is to have a clear identified set of parameters to be used for the simulations. The main assumptions are listed below:

- Mo-Gr collimators and 5 μm Mo coating are installed;
- Significant reduction of the crab cavities impedance due to the large beta functions at their position, the extent is being reviewed with WP4 taking into account that the beams will be in collision from beta* of 70(45) cm for the levelling scenario at $5.0(7.5)\times 10^{34} \text{ cm}^{-2}\text{s}^{-1}$;
- Beta* levelling in 1 and 5 is assumed as baseline mechanism for luminosity levelling

The settings for the nominal scenario with $5\times 10^{34} \text{ cm}^{-2}\text{s}^{-1}$ are listed below:

Stage	ADT damping time	Q'	LOF	half separation in 1/5	Full crossing angle 15	Beta* 1/5
Injection	50 turns	+3	+10-20 A	2 mm	590 μrad	6 m
Ramp	50 turns	+3	to +590 A scaled with Energy	2 mm	590 μrad	6 m
Flat top	50 turns	+15	+590 A	0.75 mm	590 μrad	6 m
Squeeze	50 turns	+15	+590 A	0.75 mm	590 μrad	6 m to 70 cm
Collide	50 turns	+15	+590 A	0.75 \rightarrow 0.00 mm	590 μrad	70 cm
Stable beam	50 turns	+15 to +2	+590 A	0.00 mm	590 μrad	70 cm to 15 cm

During the discussion Riccardo noted that it will be very difficult to have simultaneous luminosity levelling in IP1 and IP8 without deploying the ATS telescopic squeeze for IP1 before starting the levelling otherwise the optics will lock the levelling factors between these two points. It was agreed to assume parallel separation as baseline scenario for the IP8 levelling in order to keep full flexibility in the optics choices in IP1. Separation is assumed also for IP2 due to the large luminosity reduction needed. (β^*

levelling in IP* has been proposed by the experiment due to the sensitivity of the instantaneous luminosity with orbit variations when very large separations are needed to achieve much lower luminosity than ATLAS and CMS and for the potential risk of an unwanted head-on collision. This is discussed in the paper of R. Jacobsson <http://arxiv.org/abs/1410.3663>).

The feasibility of operating with the proposed octupole and chromaticity settings up to collision should be studied from the point of view of dynamic aperture.

Gianluigi reminded that the parameters for IP2 and IP8 should be added. The parameter list considered for the Annex of the beam and machine parameters in the Preliminary Design Report should be used (including signs) unless reasons for changing it are evidenced and motivated. At present 340 μ rad have been considered at injection in point 2 and 8.

The case of levelling at $7.5 \times 10^{34} \text{ cm}^{-2} \text{ s}^{-1}$ should be considered for the simulations.

During the discussion Riccardo explained that the default crossing angle at injection for IP1 and IP5 has been chosen to be 590 μ rad because there is enough mechanical aperture to keep it constant during the fill. It should be verified whether 340 μ rad provides sufficient beam-beam separation at injection and/or whether this angle can be increased. **Action: Review crossing angle at injection and update scenario with IP2 and IP8 settings: Riccardo, Massimo, Tatiana.**

Elias will summarize the scenario in a short document along the lines discussed and he will circulate it. **Action: Elias by the end of 2014.** After the meeting, Tatiana proposed to have a presentation of stability analysis for HL-LHC by C. Tambasco.

Review of open actions (G. Arduini)

Gianluigi presented the pending open actions together with those resulting from the KEK annual meeting:

- 1) Iterate on triplet/matching section layout following the presentations of P. Fessia at the KEK workshop and the results triplet review that will take place next week. **Action: Gianluigi to organize a meeting with Paolo, Massimo and Riccardo at the beginning of January.**
- 2) Tools for Beam 2 for HL-LHCv1.0. **Action: Riccardo by Mid January.** It was agreed that since HL-LHCv1.1 maybe be short-lived due to the change of layout, tools and squeeze of IR1/5 will be postponed to next version. Squeeze of IR6 and VDM squeeze of IR2/IR8 can instead be completed.
- 3) Requirements (BPM accuracy, K-modulation) for optics measurement and correction taking into account beta* levelling in IP1 and 5. **Action: Rogelio to present at WP2 TLM by End of January.**
- 4) Review of TAS aperture at injection and with IP transverse displacement and definition of new criteria for aperture calculation at injection. **Action: Massimo, Riccardo, Roderik to present at WP2 TLM by End of February.**
- 5) Joint meeting to finalize powering requirements. **Action: Massimo, Miriam, Riccardo to organize a Task 2.2/WP3/6 meeting by Mid February.**
- 6) Tolerances for tilt-angle of the matching sections. **Action: Massimo, Miriam present the requirements at WP2 TLM by Mid of March.** For the triplet, the specifications are included in the milestone MS28 (1 mrad r.m.s.).
- 7) Sensitivity of dynamic aperture on individual multipole errors in the presence of beam-beam. **Action: Danilo, Tatiana to present at WP2 TLM by Mid January.**
- 8) Effect of large chromaticity and octupoles on dynamic aperture with/without beam-beam. **Action Massimo, Danilo, Tatiana to present at WP2 TLM by Mid March.**
- 9) Review SixTrack tools for crab cavity field quality studies and review of criteria for emittance growth in strong-strong simulations. **Action: Massimo and Tatiana to organize joint task 2.3/2.5 meeting.**

- 10) Impedance of crab cavities: Task 2.4 **Meeting scheduled on 10/12/2014.**
- 11) Summarize the beam screen heat-load estimates in a note. **Action: Elias.**
- 12) Instability thresholds in the presence of electron clouds in areas where the threshold SEY is <1.2-1.3. **Action: Giovanni to present at WP2 TLM by the end of March.**
- 13) Electron cloud build-up with/without beam screen baffles. **Action: Giovanni to present at WP2 TLM by the end of March.**
- 14) Estimates of the synchrotron radiation effects in the long straight sections. Adriana Rossi did these estimates for LHC and she could be a good candidate for repeating that for HL-LHC. **Action: Massimo to discuss that with Adriana.**
- 15) Follow-up of impedance open actions (triplet BPMs, beam screen design, unshielded vacuum valves for 11 T dipoles). **Action: Elias to present at WP2 TLM by end of February.**
- 16) Implementation of new beam-beam module interface and documentation in SixTrack. **Task 2.5 meeting scheduled before the end of the year.**
- 17) Benchmark, analysis of PACMAN effects predicted by the TRAIN code. **Action: Tatiana to present at WP2 TLM by end of March.**
- 18) Minimum crossing angle in IP2 and IP8 during the LHC cycle. **Action: Tatiana, Danilo to present at WP2 TLM by end of March.**
- 19) Minimum crossing angle for round and flat optics (e.g. 30/7.5 cm) with and without crab cavities, in particular looking at emittance blow-up and luminosity lifetime, impact on dynamic aperture and halo depletion. **Action: Sasha to present at WP2 TLM by the end of February.**
- 20) Beam-beam compensator module in SixTrack. **Action Yannis and Tatiana to organize a Task 2.5 meeting by end of January where the work done by A. Patapenka et al. is summarized.**
- 21) Updated scenario and simulations for the BBLR LHC test. **Action: Yannis to present at WP2 TLM by the end of February.**
- 22) Specifications for HL-LHC BBLR compensation with Wire embedded in TCT (present design) and e-lens scenarios. Required currents and expected minimum crossing angle achievable with flat optics (e.g. 30/7.5cm) with and without crab cavities. **Action Sasha to present at WP2 TLM by the end of February.**

The following actions are open within other work packages:

- 1) Imperfection model of BPM. (WP13 Thibaut)
- 2) D2 and Q4 correctors (WP3, Ezio)
- 3) Transfer function spread among triplets and difference between in field quality between MQXFA and MQXFB (WP3, Ezio).
- 4) Optimal crossing angle orientation taking into account machine protection (WP5, WP7, WP10)

Next meeting will take place on 23rd January 2015.

Reported by Gianluigi and Riccardo.

Tentative agenda of the next WP2 Task Leaders' Meetings:

- **WP2 23/1/2015:**
 - (7) TP: DA sensitivity of multipole errors with beam-beam.
- **WP2 20/2/2015:**
 - (2) RDM: tools Beam 2 (1.0), Squeeze VDM IR2 and IR8 (≥ 1.0), Squeeze ATS IR6 (≥ 1.1).
 - (3) RT: Requirements (BPM accuracy, K-modulation) for optics measurement and correction taking into account beta* levelling in IP1 and 5.
- **WP2 27/2/2015:**
 - (4) MG, RDM, RB: Criteria for aperture margin at injection, review TAS aperture at injection and with IP transverse offset.
- **WP2 6/3/2015:**
 - (19) AV: Minimum crossing angle for round and flat optics (e.g. 30/7.5 cm) with and without crab cavities (emittance blow-up and luminosity lifetime, impact on dynamic aperture and halo depletion).
- **WP2 13/3/2015:**
 - (15) EM: Follow-up of impedance open actions (triplet BPMs, beam screen design, unshielded vacuum valves for 11 T dipoles).
 - (21) YP: Updated scenario and simulations for the BBLR LHC test.
- **WP2 20/3/2015:**
 - (22) AV: Specifications for BBLR compensation with Wire embedded in TCT (present design) and e-lens scenarios. Required currents and expected minimum crossing angle achievable with flat optics (e.g. 30/7.5cm) with and without crab cavities.
- **WP2 27/3/2015:**
 - (17) TP: Benchmark analysis of PACMAN effects predicted by the TRAIN code.
 - (18) TP, DB: Minimum crossing angle in IP2 and IP8 during the LHC cycle.
- **WP2 10/4/2015:**
 - (6) MG, MF: Tolerance on tilt-angle for the matching section.
 - (8) MG, DB, TP: Effect of large Q' and MO on DA with and without beam-beam.
- **WP2 24/4/2015:**
 - (12) GR: Instability thresholds in the presence of electron clouds in areas where the threshold SEY is $< 1.2-1.3$
 - (13) GR: Electron cloud build-up with/without beam screen baffles