Minutes of the 61st WP2 Task Leader Meeting held on 27/11/2015

Participants: G. Arduini, R. Bruce, R. De Maria, M. Giovannozzi, T. Levefre, S. Fartoukh, E. Métral, R. Tomás, Y. Papaphilippou, D. Draskovic, S. Redaelli, R. Jones.

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

Minutes of the previous meeting 9/10, 16/10 have been approved.
Elias commented on an action from the meeting on 9/10: the plot presented by G. Iadarola in slide 5 referred to the heat load from one slot with infinite length for the nominal beam with 2808 bunches.

Actions to be follow-up:

- New definition of blind area for the position of the triplet BPMs given the recent MD ➔ this meeting
- Position and aperture of the BPM of the arc side of D1. **Action: Riccardo with the integration team**
- New hardware choice to have increased shielding in the triplet interconnection. **Action ongoing by C. Garion and F. Cerutti.**

In the last technical committee the study of the injection protection were presented. There were still some small differences in the definition of the tolerances to be applied to the injected beam (e.g. injection oscillation and energy spread and errors) that were clarified during the meeting and will be summarized in a note under publication. The status of the studies of dump system (beam size at the TCDQ) does not allow to freeze the optics requirements in particular for the TCDQ. A new update will be given in the middle of the year.

Asynchronous dump free ATS optics for LHC & HL-LHC (S. Fartoukh)

All ATS optics have close to pi/2 between MKD to TCT.IR5B2. This has implications for the required retraction of the TCTs with respect to TCDQ and TCSG and therefore on the minimum beta* reach for machine protection in case of asynchronous dump. The recommendation from Machine Protection is to have a maximum phase advance of +- 40 degree (modulo 180 deg.) for MKD to TCT.

The most difficult case to fix for the phase MKD to TCT.R5B2. Several options have been studied.

- Option 1/3: act on left side of IR6 to reduce the phase or increase the phase respectively
- Option 2: remove constraints in the strong ATS ARC56 and recover achromatic properties through adjustments of the phase advance at the cost of constraining the optics in all arcs and insertions.

Option 3 has been found to be feasible thanks to a non-connected zone of tune ranges in IR6 that results in additional 90 degrees phase advance between the MKD and IP5, which fix the issue. Another advantage is a reduction of the strength needed in Q5 as compared to the present HL-LHC IR6 optics. The ATS squeeze optics with a pre-squeeze β^*=36 cm have been found which allow to reach β^*= 9cm and β^*=30cm/7.5cm for the LHC. Q5 right could be kept nominal and an upgrade of Q5 left of point 6 is still needed for pushed flat optics.
The injection, ramp and pre-squeeze optics are ready for machine studies for the ATS optics with the correct phase advance between MKD and TCT and with the same phase advance between IP1 and 5 for

the 2015 LHC optics (where the IP1 to IP5 phase changed for Beam2 w.r.t. to Run I)* has been produced. The telescopic squeeze needs to be produced and the minimum β* achievable without Q5 upgrade for both round and flat optics configurations compatible with the optics constraints needed by the dump system (betas at the dump and at the protection elements TCDQ and TCDS, low dispersion, phase advance MKD-TCT and MKD-TCDQ, etc.). **Action: Stephane**.

The question on optimal IP1-IP5 phase advance difference between beam 1 and beam 2 is still open and as there is no obvious choice so the values of the 2015 LHC optics have been used. Presentations from Y. Alexhain indicate that such difference (between the clockwise IP15 phase for Beam 1 and IP51 anti-clockwise for Beam 2) should be kept away from 0 and possibly close to 180 degrees to avoid instabilities. Stephane suggested that the bad/good phase should be reversed. Few slides to clarify the point will be produced. **Action: Elias.** In this respect, Stéphane re-expressed the need to set up an IP15 phase knobs (with limits to be established for the beta-beating induced) and invest its impact on the beam life time in MD (or even operation, end of fill).

LHC IR Stripline BPM MD Results (D. Draskovic)

For the HL-LHC there is a request to optimize strip-line directivity in order to minimize the sensitivity of the beam position readings in the common regions to the temporal separation between the passage of a bunch of beam 1 and one of Beam 2. The mechanical design for circular and octagonal interconnection has been started.

An MD has been carried out to test the interference of one beam on the orbit measurements of the other beam in the triplet BPM as a function of the distance of one port from the long-range counter. Two electronics front-ends have been tested: WBTN (Wide Band Time Normalizer) and DOROS (Diode ORbit and Oscillation System). A bunch in Beam 1 and Beam 2 have been observed from the two stripline ports. Cogging allowed to synchronize in time domain the signals, this corresponds to place the long range encounter in the middle of the BPM. Then cogging of one beam was used to separate in time the two signals until the orbit reading were stable. The analysis has been carried out for 3 scenarios (beam cantered, offset in position and difference by a factor two in the intensity of the two counter-rotating bunches) in both IR 1 and 5 and in both horizontal and vertical planes. As an example the results for Point 1 vertical show that the orbit stabilizes at around 2ns (time separation between the beam induced signals at the stripline) for DOROS and 7 ns for WBTM. On average for the BPM the worst case scenario shows that one needs 3 ns time separation for DOROS and 7ns for WBTN. For HL-LHC better directivity has the potential to reduce slightly the time separation needed. The presence of 80MHz LP filters, suggest that the results are representative for bunch length variation up to 2 ns, although the test has not been carried out.

Blind area specification from BPM MD (R. De Maria)

Riccardo showed how the observed performance translates in specification for the longitudinal position of the BPMs in the common region with respect to the long range encounter. The specification of 3ns time separation correspond then to a blind area of ±57 cm from the long range encounters to the centre of the BPM (assumed to be 12 cm long). With this specification of the position of BPM for layout V1.2 from the integration team, one can see that a displacement of the Q1 assembly (and correspondingly the others) by at least 183 mm towards the IP is sufficient to restore good reading for all the BPMs. This solution has been endorsed by WP2 and WP13 to be implemented.

Reported by Gianluigi and Riccardo