**Minutes of the 62nd WP2 Meeting held on 04/03/2016**

Participants: G. Arduini, R. Bruce, X. Buffat, F. Cerutti, J. Coello De Portugal, R. Corsini, R. De Maria, B. Di Girolamo, I. Efthymiopoulos, S. Fartoukh, F. Galan, D. Gamba, M. Giovannozzi, K. Li, E. Métral, G. Sterbini, R. Tomás, A. Tsinganis, F. Van Der Veken, S. Valishev.

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

Minutes of the last three meetings approved with comments from Elias, Stephane and Xavier.

After discussion with the task leaders it has been decided to enlarge the audience of the meeting and to include here the discussions that were before included in some of the task meetings. Rogelio has kindly accepted to take the role of deputy WP2 Leader.

Date and day of the meeting might have to change and Tuesday morning from 10:00 to 12:00 is proposed as a possible day.

Proposal on the emittance reference value for parameter normalization (G. Arduini)

The normalized emittance used for aperture calculations and DA without beam-beam has been about 3.5 μm. However, the normalized beam-beam separation and DA with beam-beam are given using an emittance of 2.5 μm. Stefano commented that a rounding at 0.5 σ of some target would be useful.

Gianluigi reviewed all the values of the aperture target, collimator settings, and minimum dynamic aperture. A target for DA at injection with beam-beam needs to be clearly indicated. So far, it has been assumed that the dynamic aperture at injection should not be affected by beam-beam effects. Stephane commented that on the contrary the dynamic aperture at injection is presently dominated by long-range beam-beam effects, bringing it down to about 8 (collimation) sigma, both for LHC, where the minimum beta* (and maximum crossing angle) at injection has been fixed precisely for this reason, and also for HL-LHC (see e.g. https://cds.cern.ch/record/1591296/files/CERN-ACC-2013-0164.pdf).

Gianluigi proposed to use a reference normalized emittance of 2.5 μm for all proton studies. With scrubbing, the injection emittance could increase to values close to 3.75 μm and therefore we should guarantee that sufficient physical and mechanical aperture is available at injection for such beam.

For ion operation 1.5 μm translates into a proton emittance of 3.5 μm. It might be good to have a separate set of definitions for ion operation.

Stephane argued that the change could lead to a misleading optimism on the margins with other groups. Gianluigi commented that margins, when needed, should be set explicitly. The simplification could instead avoid some confusions.

Yannis commented that the new conventions uncovered that the minimum 6 σ dynamic aperture with beam-beam is smaller than the TCP opening at 6.7 σ. Rogelio and Stephane commented that perhaps a target of the DA below the TCP may be beneficial similarly to the e-lens proposal for halo control. Xavier commented that the hollow e-lens would reduce the DA but in a controlled way. Rogelio replied that simulations should be done in both configurations to verify cleaning efficiency. Roderik asked what would

be the operational complication if DA were below TCP settings. Gianluigi illustrated that the collapse could lead to fast losses, but at the same time with β* levelling the DA will be still higher than the TCP settings. Stephane commented that a fast DA reduction, enough to lead to fast losses is improbable. Gianluigi noted that in the past (2012) the DA was already below the TCP aperture, but not in 2015. Gianluigi concluded that we should review this target and update the values if needed. **Action: Gianluigi/Rogelio/Yannis to discuss with WP5 and 7**.

LHCb at high luminosity: Update, maximum crossing angle (R. De Maria)

Riccardo presented an update of the LHCb scenario. With respect to the first proposal the LHCb team decided to keep IP in the same location as now. Ilias commented that the experiments might want still to change the layout of the detector with an additional spectrometer. Ilias will check with the experiment: **Action: Ilias**. In addition, the spectrometer polarity changes could be reduced to once per year. With that smaller $\beta^*$ could be considered possibly down to 1 m but the minimum acceptable pair $\beta^*$/crossing angle form the point of view of beam-beam must be determined.

This leads to a study of the vertical crossing angle range as already proposed in the past for the LHC. In that case at $\beta^*$=1m one can obtain 260 μrad full crossing angle with a target 14.2 sigma aperture (in this case the internal crossing angle will always add to the external crossing angle). In addition there is vertical margin due to lower TCTV retraction (Roderik confirmed that few sigma could be gained), orbit offset, triplet offset (suggested by Stephane). Moreover, one can still add horizontal crossing angle to add beam-beam separation and/or reduce internal crossing angle for radiation purposes.

The next step is to perform Beam-Beam simulations and evaluate Pacman effects to establish the minimum crossing angle need as a function of β*. Stephane asked about the levelling scenarios. Riccardo mentioned that the baseline levelled scenarios might not be necessarily the best with LHCb running at full luminosity due to the large head-on tune spread. Using parallel separation in IR1/5 may reduce the tune spread. Then the question would be if is better to have the smallest β* in 1 & 5 at reduced head-on or largest β* at largest head-on. Gianluigi proposed to evaluate the impact of the additional collisions in IP8 (in case of LHCb operation at $2x10^{34}$ $cm^{-2}s^{-1}$ the separation at the IP will be zero for most of the fill) on the baseline $\beta^*$ levelling scenario in IP1 and 5 (both for the case of levelling in IP1 and 5 at nominal and ultimate luminosity). The option of running at a constant levelled luminosity of ~$10^{34}$ $cm^{-2}$ $s^{-1}$ would limit the total head-on tune spread along the fill thanks to the separation in IP8. Running at ~2 $10^{34}$ $cm^{-2}$ $s^{-1}$, implies running with the maximum tune spread, which might be reduce the luminosity lifetime and might bring a limited gain.

Stephane commented that experiment target is to have 300-500 $fb^{-1}$ which is above the limit of the triplet lifetime (https://indico.cern.ch/event/373549/contribution/0/attachments/1163616/1676475/HL-LHC-LHCb-TC-Oct-1-2015.pdf). F. Cerutti added that the life time of the present IR8 triplet may even be below 300 1/fb due to the spectrometer. Gianluigi clarified that the run should last 6 years and the aim of the experiment is to approach the triplet maximum acceptable integrated radiation. Francesco commented that in addition to TAS and TAN one would probably need liners in the triplets. Ilias and Gianluigi clarified that the scenario is only a proposal for the time being.

*Reported by Gianluigi, Rogelio and Riccardo*