# Minutes of the 102nd WP2 Meeting held on 01/09/2017

Participants: G. Arduini, X. Buffat, I. Efthymiopoulos, M. Fitterer, G. Iadarola, S. Kostoglou, K. Li, N. Karastathis, R. De Maria, L. Medina, E. Metral, A. Oeftiger, A. Patapenka, D. Pellegrini, A. Poyet K. Sjobaek, K. Skoufaris, G. Sterbini, R. Tomas, A. Valishev, F. Van Der Veken.

## General Information (G. Arduini)

The minutes of the previous meeting have been circulated. Gianluigi summarises the outcomes and the actions of the previous meeting.

Elias asks for a deadline for the evaluation of the CC feedback. Gianluigi replies that it could fall in the first part of next year.

People taking care of communication are looking for nice pictures and animations involving beam dynamics e.g.: evolution of the squeeze, beam getting stabilised by the damper, e-cloud evolution in various multipoles being suppressed by aC coating.

Elias reports that the resistivity of the molybdenum coating of the collimator is being checked by Sergey after the measurements of the tune shift, the table will then be updated.

## Experience with the BBLR compensation (G. Sterbini, D. Pellegrini)

Guido explains the setup of the experiment on long range compensation with longitudinal wires done in MD1. Two wires are installed in IR5, for the HL we would like to have wires also in IR1. The chosen observable is the reconstructed beam effective cross section. The fact that the wires are embedded in the collimators does not allow approaching the wires to the beam as much as the expected optimal. Three nominal bunches were injected in B2: one colliding with a train, one with only the HO interaction and a non colliding one.

The MD required aligning the wires horizontally and vertically, the vertical alignment was complicated by the absence of vertical pickups which are desirable for the future. The emittance of B2 was blown up to 5 um with the ADT in order to populate the tails. The wires were cycled together up to a current of 350 A several times. When switching on the wire, an increase of BLM signals was observed in the bunch colliding only HO, when switching it off the increase was observed in the bunch colliding with the train. The dBLMs provided similar results.

The Resonant Driving Terms (RDT) approach for the analysis of the wire impact (pioneered by S. Fartoukh) was revised and applied to the LHC case. In the ideal case with the right aspect ratio at the wire and the optimal distance from the beam, a number of RDT can be effectively compensated. By

targeting high order RDTs many resonances can be attacked, leaving the lowest order to lattice correctors. The method also allows extracting the optimal distance and current of the wire.

Ilias asks how many sigmas are equivalent to six millimetres, Guido replies that it is equivalent to 3.6 or 4.7 sigmas depending on the wire. The explicative plot is on slide 7.

Ilias asks if the emittance of the strong beam enters into the computation. Guido replies that it does not and neither does the aspect ratio of the strong beam.

The RDT map can be recomputed taking into account the phase advances in the IR, showing a less effective compensation. The RDT map for the crossing of 120 urad used in the MD, including a large beam-wire distance and slightly asymmetrical longitudinal positions of the wires, shows compensation restricted to only few orders.

Ilias asks if the IP symmetry can be broken. Guido replies that a numerical engine could help in finding the optimal settings in more complicated cases.

Gianluigi asks why an immediate reduction of the effective “loss” cross section is not observed when turning on the wire. He suggests performing the blow up at every wire cycle to better monitor the DA. He also asks about the status of the halo monitoring instrumentation. Guido replies that it was not available at the time of the MD. In addition more wire scans could also be done in the future. Profile analysis was done by Stefania and Miriam and was presented in the BBL meeting.

Rogelio suggests trying to reconstruct the DA. It is pointed out that accurate profiles are needed. Collimator scans are also suggested as an alternative approach. Dario recalls that the DA scaling laws developed by Massimo require the intensity evolution and transverse profile information. This approach is sensitive to the burn-off correction and it might be hard to apply it on short time scales.

Dario presents recent simulations performed by Kyriacos approaching the MD condition. With the wires placed at 8mm, a modest gain of DA of a fraction of the sigma is observed. The gain becomes more significant for 6mm distance. The increase of DA is larger without rematching the chromaticity when turning on the wire.

Xavier asks by how much one needs to rematch. This was checked offline by Kyriacos: the chromaticity is changed from (15, 15) to (20, 11) when turning on the wire. This increase of DA is aligned with the DA simulations performed in 2016 with asymmetric chromaticities.

Gianluigi asks if the chromaticity was measured during the MD. Dario replies that only the orbit and tunes were monitored and corrected during the MD. For the chromaticity a possibility could be to use the Schottky for a non-invasive measurement and feed-forward in the next MD.

Sasha suggests taking into account the bunch-by-bunch intensity variation of the strong beam, since in his experience this can have large impact on DA.

Footprints were also checked with both MADX and Sixtrack, showing a reduction of extension and good agreement between the two codes.

A simulation using a zero-emittance strong beam was done to try the hypothesis of the strong beam/wire equivalence, used in the theory. The simulation was not showing qualitative improvements and presented a reduction of DA in absolute terms that was not expected.

An attempt to install the wire in HL-LHCV1.3 optics, shows encouraging first results placing the wire at a distance in sigmas equal to the normalised beam-beam separation, in an arbitrary position at 150 m from the IP. At the end of levelling an improvement of DA is also observed for negative wire current, indicating that the simultaneous use of strong negative octupoles and wire can lead to non-optimal solutions.

Dario stresses that in order to work well the distance between the wire and the beam is critical. Gianluigi comments that a material wire cannot be placed closer than collimators. **Action: Propose a realistic configuration using a material wire**.

## Status of the beam-beam tools in the release version of SixTrack (A. Patapenka)

*Due to a connection problem the talk was given by Miriam Fitterer and Sasha Valishev.*

The wire alignment is described with two angles with respect to the beam direction. A proper parametrisation is chosen, the vector potential is derived and from there the Hamiltonian. The wire kick contains the both contributions from the body and from the fringe fields. The orientation is handled by rotating the reference frame before and after applying the kick.

The Sixtrack interface is presented, both for the fort.2 and fort.3. The model limitations are discussed. It is not clear what is the “wire plane”, which the beam should avoid crossing. **Action: To be clarified by Riccardo and Andrei**. **The limitations (if any) should be clearly mentioned in the SixTrack Physics Manual.**

Gianluigi asks about the status of the documentation. Miriam replies it already contains all the details.

The agreement of the kick computed by the wire element is compared to an analytical integrator for a number of different initial conditions. Deviations of few percents are observed only for very limited cases with large tilts. Footprints produced with the two are in very good agreement. The wire is also compared to a beam-beam lens and good agreement is observed.

Riccardo asks if Lifetrack contains a wire. Sasha replies that in the simulations done with Lifetrack the wire is approximated as a beam-beam lens.

Gianluigi asks if comparisons with Lifetrack and Sixtrack have been performed. Sasha replies in the positive: good although not perfect agreement was observed in the considered cases.

Riccardo points out that the current production release of Sixtrack already includes the wire.

*Reported by Dario, Gianluigi, Riccardo and Rogelio.*