Minutes of the 107rd WP2 Meeting held on 13/10/2017

Participants: A. Alekou, G. Arduini, R. Bruce, X. Buffat, R. De Maria, D. Gamba, A. Garcia-Tabares, F. Giordano, R. Jones, N. Karastathis, S. Kostoglou, M. Krupa, T. Lefevre, G. Mazzacano, E. Metral, A. Oeftiger, Y. Papaphilippou, D. Pellegrini, B. Salvant, G. Sterbini, R. Tomas, F. Van Der Veken, M. Wendt.

General Information (G. Arduini)

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

Riccardo reports the discussion with Roderik and Stephane for asymmetric TCT settings to profit from the different phase advances.

The contribution on the heat loads to the TCC will be on 2nd November. Thibaut asks if estimates have been performed for the heat load in the case where no carbon coating is applied to the triplet BPMs in IR2 and IR8. Gianluigi replies in the positive, Gianni has all the values and a note is being finalized.

Requirements for the BPM system (R. De Maria)

Riccardo presents a couple of brainstorming slides. Concerning the IP orbit feedback, the requirement is that the short term reproducibility is less than 2 microns at the BPMs. Manfred asks about the beam size at the BPM. Riccardo replies that it is about 2~3mm, he clarifies that the centre of charge is both what is measured by the BPM and what matters for the luminosity.

Davide asks what the resulting jittering at the IP is. Riccardo replies that it will be around 5~7 microns. It is clarified that we are not measuring angles but positions.

Another requirement is a short delay for the data processing in order to use it for the feedback. The requirements for the correctors also need to be discussed. Rhodri reports Jorg comments on the good reproducibility of the machine, which, in principle, would not require feedback.

Davide asks about the typical movements of the BPM assembly. Gianluigi replies that the ones attached to the cold mass will move with the same frequencies, but for the ones outside there are probably no data.

For the AC dipole optics measurements the scaling error needs to be <2%. The phase also has to be stable to 1e-4. The requirements are particularly enforced for the frequencies excited by the AC dipole.
Riccardo clarifies that the phase is important for far away BPMs; while in the triplet area up to (Q4, Q5) the amplitude is more important.
Manfred asks about the excitation amplitude. Rogelio reports 1 mm in the arcs, and a factor ~10 more in the triplet. Rhodri is worried by the non-linearity; he says that it would be easy to improve on the phase measurement, but not so much on the amplitude. Riccardo clarifies that extracting the β-function measure from the phase in the triplets requires extreme accuracy (1e-9~1e-12), while we are much more sensitive to the amplitude in the triplet.

Riccardo asks if we could have different calibrations of the BPMs for different crossing angles. Gianluigi replies that this is the same as constructing the full calibration curve.

Thibaut clarifies that the non-linearity of the comes from the electronics. He explains that the BPM calibration consists in injecting a signal with a function generator to calibrate the electronics, however this signal produced by the calibrator is not close enough to the one generated by the beam. The electronics can be improved for better stability e.g. w.r.t. temperature. Manfred asks about noise. Rhodri replies that by keeping the AC dipole on for longer times, the noise is effectively averaged out.

Thibaut points out that we need to clarify if we need two different electronics for different part of the machine (IRs and Arcs). Currently there is only one type of electronics. Rhodri clarifies that the different types of BPMs are made in such a way that the output signal is similar and the electronics can be the same.

Status and plans for the BPM system (T. Lefevre)

Thibaut shows document EDMS 327557. Table 6 collects the required precisions. Riccardo comments that the reproducibility on short and long term is not well stated in the document. Rhodri agrees.

Rogelio reports that in the IR an RMS of 4% is seen.

Rhodri suggests highlighting the points that need improvement in the document, in order to produce a new reference.

The BPM system is composed by two parts: WBTN (Wide Band Time Normalizer) which has a very fast response (40 MHz) and performs the bunch-by-bunch acquisition used by the orbit feedback; and the DOROS (Diode ORbit and Oscillation System) which aims at providing the highest possible resolution for the orbit data running at 1 Hz but not bunch-by-bunch

Work is in progress for a bunch-by-bunch system capable of handling exotics beams such as doublets. The system relies on fast digitalisation (3 GSa/s) and will allow using the bunch-by-bunch BPM signals for the beam dump BPMs in LSS6.

The improvement plan of the DOROS aims at achieving faster orbit acquisition (25 Hz) and turn-by-turn acquisition. Bunch-by-bunch will remain impossible for the DOROS.

The WBTN is also going to be improved, but it will remain difficult to measure doublets.

Rogelio asks if everything will share the same electronics. Rhodri replies that the interlocking system will be apart but for the rest it is desirable. Manfred points out that most of the system relies on analogue electronics and that by going digital one avoids issues such as temperature sensitivity and ageing. Rhodri comments that the use of optical fibres and radiation resistant electronics constraints the parameters of the systems in the arcs, in the LSS there is more freedom.

Thibaut asks if optics measurements are requiring bunch-by-bunch measurements. Rogelio clarifies that bunch-by-bunch capabilities are required to perform measurements with high intensity beams by exciting a single bunch and measuring it with all the BPMs, this is use for example for coupling measurements.

Gianluigi summarises that we should start from Table 6 in the EDMS document, reviewing and/or adding the specs and work in a small team. Rhodri should get inputs from Rogelio for the different measurement

techniques and from Riccardo and Davide for the feedback. **Action: Rogelio, Riccardo, Davide, Roberto in collaboration with Jorg.**

Prospects for the hollow e-lens review (R. Bruce)

The previous review was in October 2016. The conclusions from the panel were that active halo control is required for HL-LHC, the e-lens is capable of providing it and the recommendation was to implement it.
Replying to Elias, Roderik explains that the analysed data was from 2012, 2015 and 2016. Scaling from 2012 would require the e-lens, while 2015 and 2016 will probably not require them, but the recommendation was made anyway due to the uncertainty.

The review planned for 19-20 October 2017: "The charge of the review is to see if CERN has all information at hand to estimate the individual cost items for the hollow e-lens and to prepare a tentative production schedule (including potentially required prototype developments and R&D milestones) for implementing the e-lenses during LS3 and to assure sufficient space and infrastructure in the designated areas for the installation of the hollow e-lenses during LS3".

Roderik presents the indico timetable for Thursday. On Friday there are no scheduled talks, it will be used by the panel.

The ColUSM page, maintained by Stefano, collects the specifications. Roderik quickly explains the reasons driving several e-lens parameters collected in this document.
The halo depletion rate is object of discussion. Gianluigi concludes that it should be better quantified. Rogelio points out that Alice may have requests for the number of particles in the halo to provide physics.
Manfred asks if there will be intensity modulation of the gun. Rhodri replies that the default is 11 kHz pulsing every turn, further modes of operation are to be seen.

The review is open, everybody is welcomed to join and WP2 members are encouraged to attend.

Impedance of the e-lens (G. Mazzacano)

The e-lens design was simulated with CST. The first mode is beyond 2.19 GHz and the computed shunt impedance is well below the limit that is expected to have an impact on the beam. The total impedance is a tiny fraction of the LHC total impedance. In general the device is good from the impedance point of view.
There are small modifications to the design such as the removal the curvature from the junction and of the orthogonal ports at the junction, which are being evaluated.
Benoit points out that the bellows before and after should be shielded. He adds that this design is much better than the original one installed in Fermilab as impedance guidelines were followed and avoided creating unnecessary cavities. It could be further improved, but it looks already good enough.

Roderik asks about the amount of time needed to evaluate the latest update. Giacomo replies that about two weeks of simulations are needed.

Reported by Dario, Gianluigi, Riccardo and Rogelio.