



# Minutes of the LIU-PS BD WG #26 on the 8<sup>th</sup> of February 2019



**Agenda** (<https://indico.cern.ch/event/792789/>)

1. *Summary of priorities for 2019 and follow-up tasks*
2. *Present status of studies on the prototype Wire Scanner commissioning*
3. *Measurements with the 80 bunches scheme*

## **Present:**

Fanouria Antoniou, Foteini Asvesta, Wolfgang Bartmann, Hannes Bartosik, Denis Cotte, Marc Delrieux, Ilias Efthymiopoulos, Jonathan Emery, Matthew Fraser, Oliver Hans, Wolfgang Hofle, Eirini Koukovini-Platia, Pawel Kozlowski, Alexandre Lasheen, Branko Popovic, Haroon Rafique, Federico Roncarolo, Hampus Sandberg, Eugenio Senes, Guido Sterbini, James Storey, Frank Tecker, Mihaly Vadai, Ben Woolley

## **1. Summary of priorities for 2019 and follow-up tasks (A. Huschauer, H. Damerau, Matthew Fraser, [pdf](#))**

The list of topics to be studied in 2019 in the longitudinal and transverse planes are detailed in the slides, as well as the new organization of the LIU working groups.

Concerning the review and upgrade of the longitudinal tomography, Heiko indicated that a technical student in the RF/BR section will be working on translating the tomography algorithm. Hannes transmitted a comment from Verena Kain, stating that the upgrade should be applied in the other machines as well. Heiko answered that the beam dynamics concepts of the tomography will be discussed in the beam dynamics meetings, while the operational software implementation should be covered by the commissioning working groups and coordination.

## **2. Present status of studies on the prototype Wire Scanner commissioning (E. Senes, [pptx](#))**

Eugenio described the design of the new wire scanner and underlined the point that one of the possibilities will be to perform bunch-by-bunch acquisitions.

Heiko asked whether the design is the same as for the other machine. Federico answered that the concept is identical, but that the fork length and flanges are different for integration reasons.

The first set of tests consisted of comparing the measured beam position with respect to the BPMs. The radial displacement is set with orbit bumps or radial steering, in both cases the agreement between the WS and the BPMs is good (<4-5%, not accounting for BPMs calibration error). Concerning the radial steering, Heiko and Federico suggested to compute the displacement of the beam from the revolution frequency which is measured with very good precision.



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The second setup is the calibration on the optical bench, comparing the new WS with respect to the previous ones (in PSB and PS). A calibration using a model based on the WS geometry is used to evaluate the errors on the WS mechanical parameters (e.g. disk, fork alignment). Jonathan noted that the alignment between the disk and the forks is not trivial and need tests to get the correct projection and eventually arrive to the required precision. Federico added that the model will be tested before series production to check if we can simply rely on the analytical model or if variations are to be expected.

The out-scans are consistently delivering reasonable measurements, but not the in-scans. The non-Gaussian bunch profiles for the in-scans need to be understood. Some ideas are that the wire loosens and vibrates a bit. The wire scanner will be brought back to the calibration bench for further investigations and the optical disk replacement. Matthew asked whether it could be the beam. Eugenio answered that there is no reason to believe it comes from the beam shape. Eugenio also indicated that this effect was observed both if in/out-scans are done directly one after the other or not.

Frank asked whether the calibration done with the laser done with the same wire speed, and if this effect could be seen with the calibration. This is to be investigated. Another set of comparison would be to compare with the data acquired with the BGI in November, if there was an overlap in the measurements.

Concerning the sensitivity of transverse emittance with respect to the error in the tomographic reconstruction of  $dp/p$ , Fanouria specified that the propagation of error in  $dp/p$  on the transverse emittance is small after some tests (error in the order of 2%). Further investigations are required.

Massimo asked if measurements were done with split beams. Eugenio answered that measurements were done, but the different islands were too close to be clearly distinguished on the LIU WS. He reminded that the pre-LS2 wire scanners have scintillators, on the inner and other side of the PS ring. Federico will investigate if the new wire scanners have no impact on the measurement of split beams.

### 3. Measurements with the 80 bunches scheme (G. Sterbini, [pptx](#))

Guido reminded the concept and motivation for the 80 bunches scheme, and other variants providing with more flexibility for the PS batch composition. The 80 bunches scheme can be a mean to maximize the luminosity (maximizing LHC filling factor). Unfortunately, the improved performance is associated with a larger e-cloud production. This special beam is presently intended to be used only for MDs, and not for production or scrubbing runs.

Guido presented the two methods to kill bunches in the PS. The first option is to use the kicker KFA71 to kill a single bunch in  $h=21$ . The observations are that the bunch is kicked out fast (single turn) and efficiently, with minimal impact on the other bunches. The method is not viable for multi-bunch killing of adjacent bunches and the losses are not diluted in time.

Heiko asked if no halo/satellite bunches are left using KFA71 as bunch killing mechanism. Guido answered that no visible beam is left in PS (profiles/BCT) and that no complaints rose from for LHC.



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Federico asked how to ensure that losses are only from the killed bunch, and not from the other bunches. Guido answered that no bunch by bunch measurements were done but assuming that the splitting is ideal, it should remain 2/3 of the intensity, which is what is observed. Heiko underlined that the splitting may indeed not be ideal.

Heiko indicated that the inclusion of a 3<sup>rd</sup> Wall Current Monitor is ongoing (beyond LS2, first YETS maybe). This could help for bunch by bunch longitudinal profiles and intensity logging and could be used to monitor the efficiency of the bunch killing.

Heiko noted that no losses are visible in the Beam Loss Monitors at any other moment except the kick time. Guido showed a slide in appendix for a test with the HIRADMAT beam where the losses are mainly concentrated at the time of the kicker. Losses are also visible at the start of the ramp.

Wolfgang asked how much losses are a problem. Guido answered that it is likely that the beam can only be used for LHC MDs, and not for operational LHC filling. In the frame of an MD which is limited in time, losses are certainly more acceptable.

An overall suggestion is to evaluate means to localize the losses (e.g. septum), Guido answered that, in his opinion, for the moment this option was not studied.

Hannes asked about the interest of killing non-adjacent bunches. Guido answered that it could be useful in the eventuality of MD with custom bunch spacing, not for production.

The second method is to use the Transverse Feedback for resonant excitation, gated on one or more bunches in the batch. The method is more complex, slower and less efficient than with KFA71, but losses are less concentrated in space and time and open the possibility to kill non adjacent bunches.

Denis asked whether the excitation is done in both planes. Guido answered positively.

Referring to the off-momentum and amplitude detuning, Piotr asked if it was tested to sweep tunes to increase loss efficiency. Guido answered that measurements were done 2016 with low chromaticity also to reduce the impact of the off-momentum detuning but without tune sweeping. This choice was adopted to reduce the complexity of the parameter space.

Marc suggested the possibility to use KFA04 to kill a second bunch, provided that the kicker can be pulsed sufficiently often for this kind of operation and that the fall time is not too long. Matthew noted that the ideal would be a vertical kicker to get closer to aperture.

*Minutes by [A. Lasheen](#)*