Minutes of the LIU-PS BD WG #32 on the 11th of July 2019

Agenda (https://indico.cern.ch/event/833548/*)*

1. *Introduction*
2. *AOB: Measurements of low-intensity beam with prototype wire scanner*
3. *Performance estimates with RF upgrades after LS2 (bunch-by-bunch variation)*
4. *AOB*

Present:
Simon Albright, Heiko Damerau, Jonathan Emery, Matthew Fraser, Klaus Hanke, Alexander Huschauer, Alexandre Lasheen, Federico Roncarolo, Frank Tecker, Mihaly Vadai

1. AOB: Measurements of low-intensity beam with prototype wire scanner (F. Roncarolo, pdf)

This AOB is the continuation of the presentation given during meeting #30 by Jose Sirvent, where the results for low-intensity beam remained to be analyzed. Federico underlined that Jonathan Emery will continue the work, till the arrival of a fellow in October to support the BI and OP groups.

Federico presented the analysis from measurements using an LHCINDIV single bunch. The indication was given that another fitting routine than the one used by Jose was used but delivered the same results. Measurements were done for different voltage settings for the photomultiplier (PMT) to find the best parameters to allow measurements at injection and flat top, which was demonstrated during the presentation.

Alexander noted that the output of Channel 2 and 3 are identical in the overview plot (Slide 5), although the noise on the profile is different (Slide 6). Federico stated that the noise has little influence on the result if there is no saturation.

Concerning noise, Federico informed that the profiles are filtered using a running average. Alexander asked whether any dependence of the noise with frequency was noticed. Federico answered that this was not checked.

Frank asked how the saturation is determined. Federico answered that the indicator is the integral number of charges, which was tested in the lab and showed excellent results.

Federico underlined that there is still some margin for lower intensity measurements since the PMT voltage can be increased, e.g. at injection (saturated on Channel 1 with 800 V). The conclusion is that there does not seem to be a limitation at low intensity.

Federico stated that the PSB WS calibration would be finishing by the end of the meeting week, before the calibration of the PS WS is carried out.

2. Performance estimates with RF upgrades after LS2, bunch-by-bunch variation (A. Lasheen, pdf)

Alexandre presented simulation results showing the expected influence of the remaining RF upgrades on the bunch-by-bunch variability at PS extraction. The RF upgrades to be installed during LS2 were listed with the expected impedance reduction.

The following beam loading feedbacks were modelled in simulations: the one-turn delay feedback (1TFB) and the Multi-Harmonic Feedback (MHFB). The models do not use the exact filters as implemented in the machine, but the filters are adjusted to obtain a comparable final transfer function. The transient behavior of the feedbacks is also included. Heiko underlined that the impedance at the central RF harmonics may not be perfectly represented since the AVC loops are not included in the model.

The double splittings at flat top and triple splitting on the intermediate plateau were simulated with the different RF upgrades and variable beam intensity. In all cases, the parameters of the splitting (RF phase and amplitude) are optimized in order to minimize the bunch-by-bunch spread in intensity. Alexandre underlined that since only the intensity spread is optimized, without considering the bunch length spread.

The result of simulations for the present configuration are comparable to the observations in operation. With the remaining RF upgrades, it is expected that the bunch-by-bunch spread remains well below the defined criterion (< +-10% spread in intensity and bunch length).

The influence of the Finemet cavity impedance was also tested in simulations. According to simulations, the quality of the splitting is degraded when the 1TFB is enabled with the addition of the Finemet cavity impedance, which was not expected. Heiko noted that this configuration could not be tested in operation, since there is no way to reach the LIU beam intensity without the Finemet cavity being active for the coupled-bunch feedback and without 1TFB. Further investigations will be done.

Heiko suggested to make a plot of relative phase during simulation to better understand the influence of the Finemet cavity during the triple splitting. Heiko also underlined that the 1TFB indeed has an important contribution in operation and was especially noticed for cavities on harmonic 7 since first tests with the 1TFB.

Heiko asked about the dominant effect responsible for the emittance growth along the batch during the double splittings. Alexandre answered that it is an instability-like mechanism, where the high frequency impedance contribution (80 MHz) induces high frequency structures in longitudinal phase space (see LIU-PS RF upgrades and mitigation strategy meeting). Alexandre indicated that even if the observation on the bunch length is comparable, as well as the threshold in intensity and the behavior while changing the 80 MHz impedance configuration, it is difficult to prove that this is the actual mechanism.

Heiko asked what is most important between bunch length or intensity spread for the SPS. Alexandre answered that simulations performed by Markus Schwarz for the LIU-SPS Beam Dynamics Working group showed that bunch length spread had more impact in terms of losses (more bunch tails not

captured in SPS RF buckets). For the optimization of settings, losses should be considered as the SPS criterion.

Minutes by A. Lasheen