**Meeting of LIU SPS-BD WG on 18/06/2015**

**Present:** Theodoros Argyropoulos, Hannes Bartosik, Thomas Bohl, Alexandre Lasheen, Juan Esteban Muller, Verena Kain, Patrick Kramer, Danilo Quartullo, Elena Shaposhnikova, Helga Timko, Jose Varela Campelo;

**Agenda:**

1. Multibunch measurements and simulations – T. Argyropoulos
2. Overview of the last scrubbing runs – H. Bartosik
3. **T. Argyropoulos – Multibunch simulations**

* During MDs in 2014/2015 the onset of the longitudinal multi-bunch instability along the ramp was measured for different beam intensities using single RF. No clear dependence of the instability threshold on the bunch intensity is observed, but the energy thresholds are rather clustered between 150 GeV and 350 GeV for bunch intensities in the range of 0.5-2e11 p/b. A systematic difference of the thresholds is observed for different MD sessions, which might be due to a change of the longitudinal emittance of the injected beams from session to session.
* Contrary to the measurements, a clear monotonic dependence of the instability threshold on the intensity is observed in macroparticle simulations along the ramp using the BLonD code. The discrepancy is probably due to the longitudinal feedback loops (phase loop, feedback, feedforward and damper), which were used in the measurements but are not included in the simulations yet.
* The effect of the different impedance sources on the instability threshold for trains of 12 bunches was studied in the simulations for single RF. Removing the impedance of the flanges from the model results in an almost twice higher thresholds for the microwave instability at flat top (while there is only a small improvement for the instability due to loss of Landau damping along the ramp).
* Simulations and measurement studies with double RF are needed as a next step to quantify the impact of the flanges impedance on the instability thresholds in operational conditions. In general the 800 MHz improves the loss of landau damping and therefore the main concern in double RF operation is the microwave instability at flat top, for which the vacuum flange shieldings are expected to help.
* Based on the present simulations and measurement results it is still not easy to answer the question if the vacuum flanges shielding campaign would push the multi-bunch instability threshold high enough such as to reach the intensity requested for HL-LHC. However, it seems that an increase of the threshold by a factor 2 at flat top is possible. Furthermore, reducing the impedance of the machine is generally a good thing. Performing the impedance reduction campaign during LS2 would leave some time during Run 3 to find additional measures for reaching the HL-LHC target beam parameters in case of need.

1. **H. Bartosik – Overview of the last scrubbing runs**

* The last part of the 2015 scrubbing runs with high intensity 25 ns beams (up to 2e11 p/b) was performed during week 23 and week 25. As before, the total number of integrated proton intensity in the machine was limited by the outgassing of the MKP4 injection kicker due to beam-induced heating.
* Detailed studies with the standard beam with 2e11 p/b showed single bunch instabilities in the vertical plane in the tail of the batch for chromaticity close to zero. High-order coupled bunch instabilities are observed in the horizontal plane, which for the moment cannot be controlled with the transverse damper. It was found that the beam can be stabilized with LOF octupoles at positive K settings. It is not clear yet if it the beam stabilization is generated by the amplitude detuning or the second order chromaticity induced by the octupoles.
* No emittance blow-up along the batch was measured with the high intensity 25 ns beams when suppressing the coherent instabilities with the LOF octupoles, but losses of up to 20% within 3 seconds are observed for the last bunches of each batch. The question if these losses can be tolerated for reaching the LIU target beam parameters will be an important criterion for the decision about scrubbing or coating.
* Based on the losses observed after firing the tune kickers and the injection kicker at different times on the injection plateau, the amount of un-captured beam was estimated to be about 4%.
* Trains of 48 bunches of the standard 25 ns beam were compared with the BCMS beam for the same intensity of about 1.7e11 p/b (the present limit for BCMS of the pre-injectors). The same settings of octupoles could be used for both beams for mitigating coherent transverse instabilities. Less losses were observed with the BCMS beam.
* First tests of accelerating the high intensity 25 ns beam were performed. Up to 1.6e11 p/b were achieved at flat top when injecting about 2e11 p/b on a cycle with a 1.5 times slower ramp compared to the operational LHC cycle. The strong losses at the beginning of the ramp are probably due to un-captured beam and limitations in the RF power.

Minutes written by Hannes Bartosik