**Meeting of LIU SPS-BD WG on 17/09/2015**

**Present:** Hannes Bartosik, Chandra Bhat, Thomas Bohl, Juan Esteban Muller, Alpo Juhana Valimaa, Verena Kain, Alexandre Lasheen, Kevin Li, Elias Métral, Danilo Quartullo, Toon Roggen, Giovanni Rumolo, Benoit Salvant, Elena Shaposhnikova, Jose Varela Campelo, Christine Vollinger;

**Agenda:**

1. Update on longitudinal instabilities study - A. Lasheen
2. Recent space charge MDs - H. Bartosik
3. Analysis of uncaptured beam loss on flat bottom - M.Schenk/H.Bartosik
4. **Alexandre Lasheen – Update on longitudinal stability studies**

* Recent studies concentrated on identifying the most harmful impedance sources. The effective voltage and phase of the 800 MHz cavity as fitted in previous studies (see last LIU-SPS BD meeting) was used in simulations.
* The impedance spectrum of the QD type flanges considered in the simulations appears more scattered compared to the QF type flanges. The reason for the difference needs to be investigated.
* The HOMs of the 200 MHz cavities were added to the model. The strongest HOM is at 900  MHz.
* Single bunch simulations show that removing QF-type flanges from the impedance model results in a considerable increase of the instability thresholds, while the effect of removing QD-type flanges is much smaller. When removing all flanges, a region in the beam parameter space (intensity vs. longitudinal emittance) becomes in fact more unstable. This is explained by the change of the synchrotron tune spread, which is different without flanges. Simulations with the impedance of shielded flanges are still to be done.
* First simulations with 12 bunches show that the multi-bunch instability is not dominated by a single impedance source. The QF-type flanges have a bigger impact on the threshold compared to the QD flanges, in particular if the HOMs of the 200 MHz cavities are suppressed at the same time. It seems there is not a single impedance source that is dominating all the others.
* Further simulations with longer bunch trains will be performed. The impact of the different HOMs on the instability thresholds will also be addressed. The simulation results will be used to define the specifications for the required suppression of the HOMs. The remaining discrepancy between the measurements and the simulation studies for the multi-bunch cases is ongoing. Further experimental studies will be performed once the new LL-RF for the 800 MHz cavities is commissioned.

1. **H. Bartosik - Recent space charge MDs**

* A systematic working point scan was performed on a 3 second flat bottom cycle with a single high brightness bunch such that for each working point the transverse emittances and the losses were recorded.
* Losses below 0.5% and emittance growth below 3% were observed for the best working points. Losses increase to more than 3% for vertical coherent tunes higher than 20.33. The corresponding betatron resonance still needs to be identified.
* Part of the observed emittance blow-up could come from the interaction with the wire of the wire scanner. This effect still needs to be quantified.
* The optimal working point for 25 ns e-cloud dominated beams could be quite different compared to the single bunch case. In the past the SPS working point for LHC beams was in fact modified and adapted to accommodate the tune spread due to e-cloud and space charge.

1. **H. Bartosik – Analysis of un-captured beam loss on flat bottom**

* The amount of uncaptured beam caused by the bunch rotation at PS-to-SPS transfer was quantified using three different methods, using the tune kicker cleaning empty part of machine circumference, comparing the PS extracted intensity with the intensity increase on the SPS BCT and by assessing the losses at beginning of acceleration.
* The analysis shows that about 5% of the injected beam was not be captured during the 2015 high intensity 25 ns scrubbing run with 2e11 p/b. Similar percentages of uncaptured beam were also found for the nominal beam intensity of 1.1e11 p/b during the LHC filling for the 2012 LHC scrubbing run, while one would expect that the capture losses increase with intensity due to beam loading the SPS cavities. The reason could be that the RF settings were not optimized during that period in 2012. Additional studies with different intensities in the same machine conditions are needed.
* The possibility of minimizing losses by optimizing the longitudinal particle distribution using additional RF cavities or higher voltage for the PS bunch rotation should be reinvestigated.
* Apart from optimizing the transmission through the SPS and minimizing losses, another concern are the losses at LHC injection due to particles that are captured in longitudinal buckets that fall on the rising and falling edge of the MKIs. These particles could be removed in the SPS by firing the tune kicker or the SPS injection kicker after the last injection. However, the reliable technical implementation is not evident.

Minutes written by Hannes Bartosik