**Meeting of LIU SPS-BD WG on 29/10/2015**

**Present:** Hannes Bartosik, Juan Esteban Muller, Thomas Kaltenberger, Alexandre Lasheen, Danilo Quartullo, Benoit Salvant, Elena Shaposhnikova, Christine Vollinger;

**Agenda:**

1. Summary of the LIU/HL-LHC day – E. Shaposhnikova
2. Synchrotron frequency shift – A. Lasheen
3. Effect of HOM damping– A. Lasheen
4. Update on space charge studies – H. Bartosik
5. **Elena Shaposhnikova – Summary of the LIU/HL-LHC day**
* Good prospect to reach HL-LHC intensity request after SPS longitudinal impedance reduction campaign (flanges, HOMs)
* The SPS optics with intermediate transition energy (Q22) might be needed because of limited RF power in Q20. MDs should start next year to study whether there is enough margin with respect to the TMCI threshold at injection.
* Possible impact on longitudinal instabilities from 80 bunch scheme with 3 batches (less total intensity in SPS but longer PS batches) needs to be studied.
1. **Alexandre Lasheen – Synchrotron frequency shift**
* The Synchrotron frequency shift as function of intensity was measured for a wide range of bunch lengths.
* Macroparticle simulations based on the present SPS longitudinal impedance model including space charge show a similar qualitative dependence of the synchrotron frequency shift on the bunch length as observed in the measurements. However the simulation results are shifted towards shorter bunch lengths (about 100ps) and/or smaller tune shifts. This might be an indication for missing impedance contributions (constant Z/n of more than 1.5 Ohm).
* The effect of a larger Z/n on beam stability will be studied in a future simulation campaign to check if this would be compatible with the experimentally observed instability thresholds.
* The space charge contribution to Z/n is quite large and the discrepancy between measurements and simulations could also stem from uncertainties in the space charge impedance. Future experimental studies will be performed at higher energy to reduce the impact of space charge.
1. **Alexandre Lasheen – Effect of HOM damping**
* The expected longitudinal instability thresholds for different options of the impedance reduction campaign were studied in macroparticle simulations with 24 bunches. The largest intensity gain is expected from shielding the QF type flanges in combination with damping of the HOMs of the 200 MHz RF system (shielding QF-type flanges alone would not bring lot of improvement since threshold is very similar to instability caused by HOMs).
* The instability threshold will be still very low in single harmonic and thus operation with double RF cannot be avoided.
* The HOMs around 630 MHz were identified as the most critical contributions to the instability. First simulation results show that a reduction of R/Q of all these HOMs by a factor of up to a factor 4 gives the maximum gain in beam stability. It seems that in case of a further reduction the HOMs could become critical for the instability driven by broad band impedances. Further studies are needed.
* In simulations performed so far the impedance of all HOMs around 630 MHz were assumed to be reduced by the same factors. Future studies need to clarify the relative importance of each individual HOM, since some of them might be easier to damp than others but also less critical for the instability. Some HOMs are already damped with the presently installed HOM couplers and further damping might be difficult.
1. **H. Bartosik - Recent space charge MDs**
* Detailed measurements of the SPS machine non-linearities have been performed in both Q20 and Q26 optics in view of building an SPS non-linear model. A clear improvement of the measured non-linear chromaticity could be achieved by correcting for the effect of detuning with intensity based on the SPS transverse impedance model.
* Measurements of the transverse emittance growth and losses as function of the working point in the Q20 optics with high brightness single bunch beams (space charge tune spread of 0.2) revealed two important resonances, the normal sextupolar resonance Qx + 2 Qy and the octupolar resonance 4 Qy. These resonance are sufficiently far away from the tune area of interest for high brightness beams and may allow to accept vertical tune spreads of up to 0.3 in the future or working point optimization in view of e-cloud.

Minutes written by Hannes Bartosik