**Meeting of LIU SPS-BD WG on 07/01/2016**

**Present:** Hannes Bartosik, Thomas Bohl, Heiko Damerau, Wolfgang Höfle, Verena Kain, Gerd Kotzian, Alexandre Lasheen, Kevin Li, Juan Esteban Muller, Danilo Quartullo, Toon Roggen, Giovanni Rumolo, Elena Shaposhnikova, Francesco Velotti;

**Agenda:**

1. Summary of the 2015 ion run (longitudinal plane) – T. Bohl
2. Transverse damper performance during 2015 ion operation – G. Kotzian
3. Injection kicker rise time – F. Velotti
4. **Thomas Bohl – Summary of the 2015 ion run (longitudinal plane)**

* The Pb ion beams are operated in fixed frequency acceleration (FFA) mode in the SPS, since in the usual fixed harmonic mode the required frequency swing between injection and flat top is beyond the bandwidth of the travelling wave cavities. Despite using an optimized RF frequency at injection in order to improve the frequency matching with the PS, the phase error at injection can be up to 20 degrees in case of injecting 4 bunches. After the last injection the frequency is changed for acceleration.
* Bucket quite full at injection (even though slightly larger bucket area in Q20 compared to Q26).
* In general it is observed that lower intensity results in better transmission, independent of bunch length at injection.
* A spike in the bunch length measurement is observed after transition crossing where the bucket area is minimal, followed by bunch length oscillations in the rest of the cycle. The effect can be reduced by injecting bunches with a larger longitudinal emittance. Similar observations where made already in 2009 with Q26. In addition a larger bunch length spread is measured at flat top when injecting beams with shorter bunch length. Therefore longitudinal blow-up was applied in the PS routinely.
* A higher intensity was achieved on the long LHC cycle compared to 2013. A significant improvement of the transmission was obtained after optimization of phase loop gain and transverse settings (tunes, chromaticity) after transition crossing.
* Bunch shortening on flat bottom was reduced compared to 2013 (although similar RF hardware).
* Losses were observed on the last injected bunch pair for the 150 ns batch spacing. For these bunches the damper was off.
* The quadrupole oscillation amplitude as indicator for beam instability could be improved towards the end of the year.
* A series of MDs were performed in view of slip stacking. The Radial steering limits at top energy without extraction bumps were determined as +- 20 mm before the onset of losses. This should be fine for slip stacking, for which radial excursions of 8-10 mm are considered so far. Measurements with phase loop off were also positive. Nothing problematic observed on low level signals. Only a small blow-up was observed, but nothing alarming within 400 ms (similar to what will be needed for slip stacking).

1. **Gerd Kotzian – Transverse damper performance during 2015 ion operation**

* The dedicated SPS transverse damper module for ions could not be used for the 2015 ions run. Instead the LHC proton modules were configured to cope with intricacies due to the Fixed Frequency mode at injection energy. Only 1 module was used in the horizontal plane because using the second one in addition (as usually done for protons) led to beam dumps during transition crossing – to be noted that the damper was not active during the ramp.
* Roughly 1 ms damping time was achieved on the 4th batch.
* The Frequency Shift Keying technique – as a result of the Fixed Frequency Acceleration mode – is generated by the RF system to operate the cavities within the design bandwidth. However due to the spatial distance between the RF in BA3 and the damper in BA2 this results in a shifting of the signal processing time, which accumulates along the batch. The proper solution for this problem is to add adequate signal delay in BA2 by means of length adjusted fibers (work planned for 2016). For the moment the damper was operated without these fibers, which degraded the performance for injected batches 5 and 6, as well as 11 and 12 at the end of the train.

1. **Francesco Velotti – Injection kicker rise time and amplitude detuning measurements**

* The SPS MKP injection kicker system consists of 3 S type magnets with faster rise time and 1 L type with more kick strength but longer rise time, which is used in addition to the three other kickers for LHC type proton beams with 26 GeV injection energy.
* Measurements of the kicker rise time for injecting ions with 3 and 4 kicker modules were performed by recording bunch oscillations of the circulating and of the injected bunches with the LHC BPMs (bunch-by-bunch) for different kicker delay settings.
* A jitter of 30 ns was observed and traced back to a problem in the pre-pulse handling. After hardware modifications the jitter could be reduced to 5 ns and the nominal rise time of 150 ns with 3 kicker modules was achieved. A quick check with 4 generators showed also promising results of running the LHC proton beams with the nominal 200 ns kicker gap.
* Measurements of amplitude detuning were performed in order to quantify tail population and emittance growth induced by large injection oscillations. The measurements show a larger amplitude detuning in the vertical plane. Simulation studies on filamentation and tail creation are ongoing.

Minutes written by Hannes Bartosik