**Meeting of LIU SPS-BD WG on 07/02/2013**

**Present:** Theodoros Argyropoulos, Hannes Bartosik, Fritz Caspers, Heiko Damerau, Juan Esteban Muller, J. Fox, Steve Hancock, Wolfgang Höfle, Roland Garoby, Gerd Kotzian, Kelvin Li, Giovanni Rumolo, Elena Shaposhnikova, Helga Timkó, Jose Varela Campelo, Urs Wehrle, Carlo Zannini;

**Presentations:**

**Fritz: Results of Microwave Transmission Measurements**

An update on the analysis of the microwave transmission measurements during MDs in 2012 was presented. The electron cloud is expected to induce a phase modulation of the signal at the revolution frequency. Effective filtering of the signal seems to be crucial for avoiding fake signals due to intermodulation. The main result is that the observed signal is weaker during MDs at the end of 2012 compared to measurements during the scrubbing run in the beginning of 2012.

*In order to draw conclusions from the comparison of these two measurements, the exact beam conditions need to be clarified.*

*The main question, if stronger electron cloud signal was observed during the MD studies with the high intensity 25ns beam at the end of 2012, remains to be addressed and answered.*

**Wolfgang: High Bandwidth Feedback – MDs with Intra Bunch Motion**

A large range of beam parameters was explored during the MD sessions. It became clear that a large transverse emittance (ε~3-3.5μm) is better for exciting intra bunch motion. Low (vertical) chromaticity is crucial for allowing the (vertical) beam excitation. The SPS 800 MHz RF system (with 17% of the 200MHz voltage) had to be used in order to enable longitudinal stability. The longitudinal emittance was typically around 0.3eVs (measured with the BSM in the PS before bunch rotation).

**John: SPS High Bandwidth Feedback Progress Report**

The aim of the project is to build a general-purpose test-bed for studying a high bandwidth transverse feedback system. At the moment a backwards driven 200 MHz strip-line pick-up in combination with a power amplifier installed in the tunnel serves as a “high bandwidth” kicker. The beam excitation system with arbitrary waveform generator reaches at present 4 GS/s, with 16 independent control filters (equivalent to 16 bunch slices). The performed studies include measurements with naturally unstable beams (with negative chromaticity) and studies where the kicker was used to drive the beam (excitation of dipole and internal bunch motion) with variable feedback gain and filter parameters. The measurements with the closed loop system are very sensitive to the bunch parameters. Therefore a set of measurements is acquired for a given set of configurations, which then allows characterizing the system (due to variation of beam parameters). Since the betatron tune for a given measurement cycle depends on the beam intensity, the beam excitation is performed with a chirp crossing multiple frequencies and the beam response is recorded.

*What is the synchrotron tune in a double harmonic system? The effect of the 800MHz system on the synchrotron tune distribution and its effect on the intra-bunch motion should be studied in simulations.*

Studies with unstable beam were performed for example with a chromaticity change to slightly negative values so that the beam exhibits a dipole instability (mode 0). The feedback was able to suppress the instability and as soon as the feedback was switched off, the beam was getting unstable. For another series of measurements with the same machine conditions the feedback gain was varied along the flat bottom within the cycle: a period of high feedback gain and beam stabilization was followed by a period of reduced gain, where the beam starts getting unstable. In the last part of the cycle the gain was increased again so that the feedback is counteracting the bunch motion. In this situation, the beam was sometimes too unstable to be controlled by the feedback. The data analysis to be performed will allow characterizing the system for different beam parameters and measuring the effective damping rates.

*In the analytical treatment the feedback system is linear (in reality the system is non-linear).*

*It could be tried to make use of the fact that the beam passes many turns in order to compensate to some extend for the limited bandwidth of the existing kicker/amplifier system.*

*The RF settings during the excitation studies were usually 1.4 MV for the 200 MHz system and 17% of that voltage for the 800 MHz RF system.*

**Theodoros: Reference measurements of the SPS longitudinal impedance**

The quadrupole frequency shift induced by the reactive part of the SPS longitudinal impedance as a function of intensity was measured for different bunch lengths (quadupole frequency shift has a complicated dependence on bunch length). For direct comparison with previous measurements, similar experimental conditions (small longitudinal emittances between 0.1 eVs and 0.2 eVs measured in the PS) were established. The slope of the quadrupole frequency shift vs. intensity (denoted as “b” parameter) is measured as a function of the bunch length. The average bunch length is thereby estimated from the measurement of bunch profiles in the SPS (during the quadrupole oscillations which last throughout the acquisitions, i.e. the first 1400 turns after injection). Bunch profiles for different intensities (but the same longitudinal emittance) are very similar, thus eliminating the dependence on the particle distribution. All measurements in 2013 give a smaller quadrupole frequency tune shift compared to the 2008 measurements. This can be explained by the serigraphy applied to the MKE kickers since then (now only one out of eight kickers remains to be serigraphed).

A preliminary analysis shows that the results are not consistent with the presently established SPS impedance model (including the resistive part of the beam pipe), which predicts larger quadrupole synchrotron tune shifts. In order to exclude discrepancies due to different bunch spectra, the beam profiles measured in the PS were tracked in simulations up to injection in the SPS and then used as input for the simulations of the frequency shift.

*The measurement technique applied here determines the envelope oscillations (and not the zero amplitude synchrotron frequency). The measurements are meant as reference comparing the results using the same technique in previous studies.*

 *The longitudinal impedance could also be inferred from quadrupole beam transfer function measurements. This was however not done in the past and so a direct comparison with previous results would not be possible.*

**General announcement:**

A new fellow, Jose Varela Campelo, is now working on the impedance of the 800 MHz RF system to study higher order modes (with Fritz and Rama as supervisors).

Minutes written by Hannes Bartosik