**Meeting of LIU SPSU-BD WG on 25/09/2012**

**Present:** Theodoros Argyropoulos, Hannes Bartosik, Thomas Bohl, Alexey Burov, Chandra Bhat, Fritz Caspers, Rama Calaga, Roland Garoby, Eric Montesinos, Juan Esteban Muller, Benoit Salvant, Elena Shaposhnikova, Giovanni Rumolo, Mauro Taborelli, Helga Timkó, Carlo Zannini;

**Presentations:**

**Benoit: Where are we on the impedance simulation of RF cavities?**

The impedance of the SPS RF cavities was simulated with CST using simplified 3D models based on the available CDD drawings. Up to now mainly time domain wakefield simulations were done and the results included in ZBASE.

*The models are based on periodic structures plus the waveguide ports. In reality however there are coaxial lines for the 200 MHz cavities. Furthermore the model structure is closed after 11 cells (corresponding to one section), while the actual cavities consists of 54 or 43 cells. However this should not change the frequency spectrum significantly.*

*Simulations of the 200 MHz cavities: a strong resonance in the longitudinal impedance is found below 600 MHz, while from measurements it is expected at 629 MHz. The horizontal impedance is extracted by simulation with a small horizontal offset (chosen according to the mesh-size). The main transverse resonance is close to 460 MHz. The model predicts also a resonance at 1.4 GHz for the horizontal impedance.*

*Simulations of the 800 MHz cavities: It would be interesting to know R/Q especially for all the small peaks in the impedance spectrum. In principle this could be extracted from the performed time domain simulations but is rather tricky, since the wake field is dominated by the large resonances.*

*We are looking for a source of longitudinal impedance with resonance frequency at 1.4 GHz to explain the measurements of the longitudinal bunch spectrum, while the model predicts this resonance in the transverse plane for the 200 MHz cavities. It is thus not clear at the moment if the measured resonance at 1.4 GHz in the longitudinal spectrum is due to the 200MHz cavities. It could also be caused by other big objects like the ZS for example.*

**Theodoros: RF measurements during floating MD in Week 40**

The floating MD in week 40 was devoted to studies of beam stability and beam quality of the 25ns beam in the Q20 optics with intensities between 1.25x1011 p/b (nominal intensity) and 1.45x1011 p/b (high intensity) at injection. After optimization of the SPS controlled longitudinal blow-up and the voltage program, the beam was stable (with 800 MHz on) and of good quality with the nominal intensity at flat top. The transmission (from “Larger”) was around 95%. Higher intensities were injected during the last part of the MD. The transmission was still good (~92%) with intensities up to 1.3x1011 p/b at flat top, however the beam was unstable resulting in a large dipole oscillations and large spread of bunch lengths along the bunch train on flat top. Further studies are needed for optimizing the settings and stabilizing the high intensity beam.

*Transmission is tricky to quantify for multiple injections, since during the injection a part of the uncaptured beam already circulating in the machine is extracted by the injection kicker (and this fraction of beam intensity is not taken into account for the computation of the transmission). Therefore the transmission in “Larger” is usually overestimated.*

*The bunch length was observed to decrease slightly along the flat bottom, especially in a constant voltage (no dips). This could (at least partially) explain the “slope” of the bunch length distribution along the bunch trains at flat top.*

*The “U-shape” of the bunch length distribution along each batch observed on the flat top is sometimes already there at the beginning of the ramp but it is always enhanced by the blow-up. A small improvement was achieved by optimizing the “scale” parameter of the controlled longitudinal blow-up (the scale parameter shifts the noise spectrum for compensating synchrotron tune shift due to potential well distortion). It is hoped that the optimization of the low-level RF settings could further improve beam stability and bunch length evolution along the batches.*

*Beam stability for high intensity was really bad and the bunch length at flat top was too high to be accepted by the LHC. Even long bunches after the uncontrolled blow-up were not stabilized. Further MD time will be needed to assess these limitations and optimize the settings for this beam.*

**Theodoros: Single bunch instabilities in a double RF system**

Single bunch instabilities in a double RF system were studied by analytical calculations based on finding Van-Kampen modes and by numerical simulations. Both simulations and the analytical calculations applied to the case of a pure inductive impedance reproduce the observations during the SPS ppbar operation: bunches with too large longitudinal emittance became unstable, but it was possible to stabilize them by introducing a significant phase shift between the two RF systems (20 deg) in bunch lengthening mode (the double RF system, at 100 MHz and 200 MHz, was used in bunch lengthening mode to increase the bucket area).

*The threshold of the single bunch instability as a function of longitudinal emittance is increasing only slowly for a single RF system and is significantly higher only when the bucket becomes non-linear. Higher thresholds for small emittances are obtained for the bunch lengthening mode, however the threshold is decreasing for large emittances due to the extremum of the synchrotron frequency, appearing inside the bunch distribution function. This is particularly pronounced for higher (then second) harmonics RF systems. In the bunch shortening mode, on the other hand, the synchrotron frequency distribution is monotonic and thus the intensity threshold is increasing for larger longitudinal emittance. This is one of the reasons why bunch shortening mode is presently used for stabilizing the LHC beams in the SPS.*

*For the case of the present SPS and LHC beams, the zero intensity synchrotron frequency distribution at injection seems to determine the beam stability rather than the distribution after filamentation in the non-matched bucket.*

Minutes written by Hannes Bartosik