**Meeting of LIU SPS-BD WG on 11/12/2014**

**Present:** Theodoros Argyropoulos, Hannes Bartosik, Thomas Bohl, Fritz Caspers, Juan Esteban Müller, Giovanni Iadarola, Gerd Kotzian, Alexandre Lasheen, Kevin Li, Danilo Quartullo, Giovanni Rumolo, Elena Shaposhnikova, Helga Timko, Jose Varela Campelo, Carlo Zannini;

**Agenda:**

1. Longitudinal space charge on the SPS flat bottom – A. Lasheen
2. New contributions to the SPS impedance budget – J. Varela Campelo
3. Latest news from the SPS MDs – H. Bartosik
4. Observations of transverse instability with damper - G. Kotzian
5. End-of-year talk – E. Shaposhnikova
6. End-of-year celebration
7. **A. Lasheen – Longitudinal space charge on the SPS flat bottom**

The longitudinal space charge impedance represents an important contribution to the total longitudinal impedance in the SPS at injection energy and needs to be included properly in the modeling of the SPS longitudinal beam dynamics.

* Analytical expressions of the longitudinal space charge impedance for different transverse beam distributions and vacuum chamber geometries have been compared. For the typical beam parameters used during SPS MDs, an imaginary Z/n of about 1.5 Ohm is obtained when assuming a bi-Gaussian transverse distribution and elliptical vacuum chambers.
* The results have been compared with LSC, a longitudinal space charge impedance code developed at SLAC, which gives about 10% smaller values for the same beam parameters. The reason for the difference might come from the assumptions made on the geometrical factor in the analytical expression. The comparison of the analytical expression for uniform elliptical beams with the LSC code shows good agreement.
* It was proposed to perform a scan of the transverse emittance to study the sensitivity of the space charge impedance on the beam parameters.
* The main issue for the modeling of the longitudinal space charge in BLonD is numerical noise. The slicing needs to resolve the frequencies included in the impedance. To reduce noise, smoothing algorithms are applied which can lead to unphysical results especially if the beam is unstable.
* First simulations of the debunching at SPS injection with longitudinal space charge included show a high frequency modulation of the bunch profile potentially caused by numerical noise. Another possibility could be a negative mass instability caused by the longitudinal space charge.

1. **J. Varela Campelo – New contributions to the SPS impedance**

The status of the studies on the SPS longitudinal impedance reduction was presented.

* The two configurations of QD bellows installed in the machine (with and without VVSA valve) have been analyzed and added to the impedance model. A perfect pumping port shielding was assumed for the simulations. The transition to the adjacent vacuum chamber creates a low frequency broadband impedance, which was fitted by a resonator with low frequency and very low Q. The bellow itself has a resonance at 2.3 GHz with about 230 kOhm and R/Q of about 690 Ohm. The VVSA valves next to 17 out of 88 QD bellows create resonances at 1.3 and 2.3 GHz with an impedance of about 150 kOhm.
* Preliminary results of the simulations of the 7 BBS tanks installed in the machine (3 containing the beam scrapers and 4 belonging to UA9) were presented. The simulations show high Q resonances up to 1.3 GHz with up to 25 kOhm. In the case of the BBS tank with the UA9 Cherenkov detector, the impedance reaches up to 65 kOhm at 1.3 GHz with a Q of about 5000.
* The status of the ZS simulations was presented. Due to the complicated structure of the individual ZS tanks and the adjacent pumping ports, accurate impedance evaluation requires the simulation of the whole configuration of 5 ZS tanks. First results for two ZS tanks show clear differences compared to the simulation of a single tank, i.e. the impedance is not just the sum of the impedance of the individual modules.
* First simulation studies of the laminated core of the MSE/MST septa were shown. Similar to the ZS, the complete structure of 5 tanks with pumping modules in between will need to be simulated for accurate impedance evaluation.
* The updated SPS longitudinal impedance model was presented, now including the long QD bellows and the BBS tanks. As before, the indirect space charge is not included in the model but will be treated separately in the beam dynamics simulations.

1. **H. Bartosik – Latest news from the SPS MDs**

An overview of the high intensity scrubbing run and the dedicated MD in week 50 was presented. The main observations were:

* The high intensity standard 25 ns beam with up to 1.9e11 p/b suffered clearly from e-cloud effects, such as instabilities (mainly in the horizontal plane), emittance growth and poor lifetime.
* During doublet beam studies with acceleration to 450 GeV transverse instabilities and strong beam degradation were encountered; Even when injecting intensities up to 1.9e11 p/b, the maximum intensity at flat top was limited to 1.3e11 p/b due to strong losses at the flat bottom and the beginning of the ramp.
* The 8b+4e beam was tested for the first time. No indications for e-cloud effects were observed. However, there was outgassing and sparking on the ZS. The reason for that is not understood.
* The BCMS beam was also qualified. It is in a good shape apart from too large losses at the beginning of the ramp, which were also observed for the 8b+4e beam. Further optimization of the LHC cycle is still needed.

1. **G. Kotzian – Observations of transverse instability with damper**

Observations of the coherent motion measured with the transverse damper pick-up were shown.

* Horizontal oscillations were observed on the fourth batch right after its injection. These oscillations were not stabilized by the damper.
* A regular pattern of the bunch-by-bunch horizontal position was observed for the bunches of the first three batches. This observation could be related to the beam structure coming from the PS. Investigations are ongoing.

1. **E. Shaposhnikova – End-of-year talk**

The main achievements and studies of 2014 were reviewed and the priorities of studies in 2015 were presented.

* Two important decisions for the LIU SPS project need to be taken in 2015, namely the decision about coating or scrubbing and the impedance reduction of the flanges.
* The intensity limitations and longitudinal instabilities will need to be addressed both in beam measurements and simulation studies.
* The production and acceleration of the doublet beams need to be studied further. The losses encountered so far are due to the production mechanism but maybe also due to electron cloud. They need to be better understood.

Minutes written by Hannes Bartosik