**Meeting of LIU SPS-BD WG on 04/09/2014**

**Present:** Theodoros Argyropoulos, Hannes Bartosik, Thomas Bohl, Fritz Caspers, Heiko Damerau, Juan Esteban Müller, Roland Garoby, Jonas Ghini, Giovanni Iadarola, Verena Kain, Alexandre Lasheen, Elias Métral, Yannis Papaphilippou, Benoit Salvant, Elena Shaposhnikova, Jose Varela Campelo;

**Excused:** G. Rumolo

**Agenda:**

1. Studies for an SPS optics with intermediate gamma transition – H. Bartosik
2. Single- and multi- bunch instabilities on the SPS flat top – T. Argyropoulos
3. Longitudinal Impedance of the SPS Shielded Pumping Ports – J. Ghini
4. Possible reduction of the SPS vacuum flanges impedance – J. Varela Campelo
5. Preliminary SPS MD planning – G. Rumolo/H. Bartosik
6. **H. Bartosik – Studies for an SPS optics with intermediate gamma transition**

The possibilities for SPS optics with intermediate transition energy were studied in view of achieving a better compromise between RF power requirements and TMCI threshold for the 25 ns LHC beam. The most interesting option found is the “Q22” optics with γt=20.

* The TMCI threshold obtained from HEADTAIL simulations based on the present SPS transverse impedance model is close to the intensity required for the 25 ns HL-LHC beam. To be checked in MDs if the intensity margin is sufficient.
* The dispersion function in the region of the RF cavities is about twice higher in the Q22 optics compared to Q20 and Q26, therefore synchro-betatron resonances might be an issue.
* The plots of the RF power required during acceleration correspond to the present situation of the 200 MHz RF cavities and power plants. To be recalculated for the situation after the LIU 200 MHz RF upgrade.
1. **T. Argyropoulos – Single- and multi- bunch instabilities on the SPS flat top**

The latest results of macroparticle simulations for the SPS flat top were presented, including for the first time multi-bunch simulations. The longitudinal impedance model used in the simulations includes the known SPS impedance sources.

* The threshold intensity scaling observed in single bunch simulations behaves similar as the one of microwave instability due to a narrowband impedance. For a given RF voltage in double RF, the threshold intensity as a function of longitudinal emittance is increasing with the slip factor (i.e. higher in Q20 than in Q26). For a given RF voltage in double RF, the threshold intensity as a function of bunch length is independent of the slip factor.
* The simulations are initialized at flat top, matching the particle distribution to the bucket including intensity effects. The bunch lengthening measured before the bunch rotation during the AWAKE MD can be reproduced in the simulations, even though a direct comparison with the measurements is difficult since there the instability happens already during the ramp.
* First results of multi-bunch simulations with 6 bunches (no phase loop, without 200 MHz impedance) show qualitative agreement with experimental observations, i.e. strong reduction of intensity threshold compared to single bunch, higher thresholds for double RF, higher thresholds in Q20 compared to Q26, single bunches in multi-bunch regime become unstable, …
* The studies will be ongoing in order to confirm if the vacuum flanges are the main source of the longitudinal instabilities observed with LHC beams.
1. **J. Ghini – Longitudinal impedance of the SPS Shielded Pumping Ports**

The longitudinal impedance of the shielded pumping ports and its sensitivity to possible mechanical deviations from the design were studied both in simulations and measurements. The aim is to identify contributions to Im(Z)/n in view of the longitudinal instabilities observed with LHC beams.

* Misplaced RF fingers of shielded pumping ports can generate a larger contribution to the low frequency Im(Z)/n compared to an unshielded pumping port, since the resonant modes shift towards lower frequencies. These low frequency modes found in simulations are in good agreement with bench measurements.
* It is not known how many pumping port shields have mechanical deviations from the design. Assuming that 10% of the pumping port shields have mechanical errors results in an increase of about 1/3 Ohm of Im(Z)/n.
* X-ray imaging could be a possible technique for checking the correct positioning of RF fingers. It was pointed out that the X-ray scan needs to be taken from the right angle in order to be able to detect the position of the RF fingers. The tomography used in the LHC cannot be used in the SPS as the measurement apparatus does not fit into the tunnel.
* A possible way of detecting a gap between the pumping port shield and the adjacent vacuum chamber (i.e. RF fingers have no contact) could be to measure the beam induced signals using the electrical feed-through of the attached ion pump.
1. **J. Varela Campelo – Possible reduction of the SPS vacuum flanges impedance**

First ideas about possibilities for reducing the impedance of the SPS vacuum flanges have been studied. The different types of flanges have been categorized into two groups according to similarities in geometry. Up to now only the group of flanges responsible for the 1.4 GHz resonance (i.e. QF type chambers) has been looked at.

* The Q of the 1.4 GHz resonance can be damped by either redesigning the damping resistors presently installed in the flanges or installing additional damping elements such as current loops or resonant mode couplers. However, these solutions often lead to additional resonances at lower frequencies and their impact on beam stability needs to be addressed in macroparticle simulations. The option of mode couplers look interesting, but in many cases the installation of the feedthroughs is not evident due to tight space constraints.
* The option of installing shieldings into the flanges is mainly a mechanical problem. Wrongly installed shieldings, e.g. non-touching RF fingers, could lead to an even more harmful impedance spectrum compared to an unshielded flange.
* A complete redesign of the vacuum flanges / bellows would allow for the most effective impedance reduction since geometrical transitions can be reduced to a minimum, but would be the most expensive option.
1. **H. Bartosik – Preliminary SPS MD planning**

A preliminary planning of the SPS MD time in 2014 was presented. Parallel MDs on Mondays will be devoted to transverse studies, Tuesdays will be devoted to longitudinal studies, Thursdays and Fridays to ions. Dedicated MDs of 12h will take place on Wednesdays.

* The scheduling of the dedicated MDs needs to be revised, since some of the MD users are not available during weeks 46 and 47 due to the HB workshop and the HiLumi meeting.

Minutes written by Hannes Bartosik