# Meeting of LIU SPS-BD WG on 14.12.2017

Present

Elena Shaposhnikova, Patrick Kramer, Joël Repond, Verena Kain, Hannes Bartosik, Markus Schwarz, Michele Carla’, Aaron Farricker, Christine Vollinger, Giulia Papotti, Fritz Casper, Thomas Bohl, Heiko Damerau, Alexandre Lasheen, Ezgi Sunar, Nasrin Nasresfahani, Kevin Shing Bruce Li, Theodoros Argyropoulos, Benoit Salvant, Ezgi Sunar, Danilo Quartullo, Helga Timko, Jaime Perez Espinos.

Agenda

1. The TMCI and instability studies in Q22 – M. Beck
2. Transverse beam dynamics and MDs in 2017 – H. Bartosik
3. Studies of the SPS Impedance in 2017 – C. Vollinger
4. End-of-year summary – E. Shaposhnikova

Actions

* aa

**1 – The TMCI and instability studies in Q22 – M. Beck**

The talk presents the investigation of the TMCI threshold in Q22 optics compared with predictions and simulations.

* The modes coupled depend very strongly on bunch length.
* Measurements in Q20 and Q26 optics already done in the past.
* The typical signature of the TMCI is observed on the head-tail monitor.
* The intensity scan exhibits a threshold at $I=2.5×10^{11}$ ppb.
	+ Flat bottom, voltage scaled from 4 MV in Q20.
	+ Nominal longitudinal emittance.
	+ Threshold scales like expected with smaller emittance.
* Instability too fast to measure the growth rate.
* The main contribution to the instability is the broadband impedance 🡪 kickers.
	+ **C. Vollinger**: Does the transverse model of the kickers different from the longitudinal one?
		- **M. Beck**: Yes, the models are different.
		- **M. Beck**: In the case of the MKE, the model try to reproduce the heating effects and can be less realistic for the broadband part.
		- **E. Shaposhnikova**: The beam stability is affected mainly by the broadband part of the impedance. The model has to be updated and measurements are necessary to define which model is the most representative.
		- **A. Farricker**: Three kickers are removed from the machine during YETS
			* **E. Shaposhnikova**: Are they radioactive?
			* **C. Vollinger**: Measurements can be achieved.
		- **E. Shaposhnikova**: If the modes excited can be known, it is possible to estimate which impedance is responsible for the instability.
* Chromaticity scan shows that a higher chromaticity leads to a higher TMCI threshold.
* **E. Shaposhnikova**: Do you plan to look at the multi-bunch TMCI threshold in simulations?
	+ Measurement are more complicated.
	+ If the impedance model is reliable for a single bunch, multi-bunch stability can be probed in simulations.
* **H. Bartosik**: Now it is the time to look more carefully to the impedance model for multi-bunch case.
* With a good machine setup the TMCI threshold would be sufficient high for HL-LHC intensity.
* The effect of the damper + transverse wideband feedback have to be tested for the HL-LHC intensity.

**2 – Transverse beam dynamics and MDs in 2017 – H. Bartosik**

This talk summaries the main transverse studies effectuated during the LIU-SPS MDs.

* Unexpected momentum aperture limitation observed in the interior of the machine.
	+ Detailed scan of the aperture give a systematic smaller aperture in the horizontal plan 🡪 design flaw of MBB-QD transitions.
	+ Corrections will be applied during the YETS.
* Impact on losses of the working point and the non-linear chromaticity studied.
	+ Important tune spread observed due to dipoles non-linearity.
	+ Current working point close to optimum.
	+ Tune spread along the batch observed for high intensity ($2.0×10^{11}$ ppb).
	+ **E. Shaposhnikova**: Is it possible to include the effect of the transverse damper in simulation?
		- **H. Bartosik**: Yes, its effect can be included. Multi-bunch simulations ongoing.
	+ No detuning observed for an intensity below $0.4×10^{11}$ ppb. Fast drop in tune shift along the batch above the threshold
		- **B. Salvant**: Could it be an unexpected electron-cloud effect?
			* **H. Bartosik**: more studies needed
* **H. Bartosik**: The tomoscope would be needed in operation next year.
	+ **E. Shaposhnikova**: A. Lasheen is working full time for the PS, another person must be found to make it available. A lot of work is needed to make it operational.
	+ **A. Lasheen**: The quality of the pickup used for the mountain range is not sufficient to be used for tomography.
		- Another line is available in the Faraday cage but not available on the technical network.
		- The BQM could be used but quite rigid in terms of triggers
		- A new line should be made available?
			* For next year can be difficult, to be seen with T. Bohl.
			* From the software side, an easy-to-use script can be made available quickly but the acquisition of the beam profile is the bottleneck.
	+ **H. Bartosik**: The most important is to be able to measure the bunch length bunch by bunch along the batch.
* Horizontal single bunch instability observed when multiple batches are injected.
	+ Increased chromaticity can suppress the instability or alternatively octupoles +chromaticity.
	+ The transverse damper absorbs the coupled bunch modes 🡪 improvement from 2015.
		- Without transverse damper, multi-bunch instabilities observed.
* Emittance growth observed along flat bottom especially in the vertical plan.
	+ Increases with intensity.
* WBFB successfully stabilizes the TMCI.
* Power-converter ripples: blow-up and losses enhanced by the quadrupole ripples.
* The mechanism of capture losses are understood but not under control.
* The flat bottom losses have to be studied in details next year.
* **E. Shaposhnikova**: After LS2, with the new low-level RF, the Q22 optics should be more efficient but very difficult to prove it now with limited power.
* **H. Bartosik**: The LHC will ask the highest intensity possible next year.
* Q26 optics should be studied again for ions.
	+ Larger aperture, larger momentum acceptance, smaller PC ripples.
	+ **E. Shaposhnikova**: Beam-loading in Q26 could be sufficiently low with ions.
* Changes in MD scheduling:
	+ Crab cavities MD take most of the Wednesday time.
		- **E. Shaposhnikova**: Who will acquire the longitudinal measurements during the crabs MDs? 🡪 To be seen with R. Calaga.
	+ On Thursday, 10 hours parallel MD but full ramp cycle.
	+ Normal parallel MDs rest of the week.

**3 – Studies of the SPS Impedance in 2017 – C. Vollinger**

Summary of the 2017 impedance studies.

* Short straight section QF shielding.
	+ Different possible shield were presented which exhibit the same performance in terms of impedance reduction
	+ The mechanical robustness is however different, the RF fingers being the weaker.
	+ RF fingers were chosen because of time limitations.
* Sector valves VVSA/B: Problematic without shield, a significant impedance peak is present at 1 GHz.
	+ **E. Shaposhnikova**: The installation of shielded VVSA/B may be reconsidered.
		- **C. Vollinger**: Discussions are on-going.
* HOM 630 MHz in the 4-section cavity: damping by a factor 3 possible on paper. Confirmation using wakefield solver needed.
* New damping scheme needed for 3-sections cavity 🡪 different solutions to achieve damping.
	+ Damping by factor 3 achieved in eigenmode solver.

**Merry Christmas and Happy New Year !**

Minutes written by J. Repond