# Meeting of LIU SPS-BD WG on 03.11.2016

Present

Thomas Roland Kaltenbacher, Patrick Kramer, Joël Repond, Christine Vollinger, Hannes Bartosik, Alexandre Lasheen, Kevin Shing Bruce Li, Nasrin Nasresfahani, Markus Schwarz, Branko Kosta Popovic, Nicolo Biancacci, David Amorim, Angela Saa Hernandez, Sergey Antipov

Agenda

1. Minutes and actions – E. Shaposhnikova
2. Follow-up of new design of vacuum flange shielding – C. Vollinger
3. Beam stability after LS2 and 630 MHz HOM – J. Repond
4. Requirements for transverse HOM damping in 200 MHz TWC– N. Biancacci/ D. Amorim
5. Discussion of the SPS MDs in 2017 – H. Bartosik

Foreword

* + H. Bartosik will chair the meeting.
	+ Presentation of new comers:
		- Angela Saa Hernandez: working with Hannes Bartosik on ions.
		- Markus Schwarz: BE/RF/BR, working on SPS impedance.
		- Sergey Antipov: BE/ABP.
		- Branko Kosta Popovic: BE/RF/BR.
	+ E. Shaposhnikova’s talk will be presented on the next meeting.
1. **– Minutes and actions – E. Shaposhnikova**

* Next meeting.

**2 – Follow-up of new design of vacuum flange shielding – C. Vollinger**

The SPS has a flat beam pipe with many type of transitions (round, diamond shape, flat...), which should be as smooth as possible. This talk follow-up the presentation of the new braided flanges design.

* Difficulties encountered with sliding fingers in the past.
	+ They should not be installed in future?
	+ **Action:** See the status of sliding fingers with vacuum people.
* From Impedance Working Group:
	+ A similar design of braided flanges has been rejected 6 years ago because of possible aperture reduction.
* From RF point of view (impedance), the braided flanges are superior.
	+ **Action:** Input from TE/VSC (vacuum group) now needed to fix a time line for the shielding.
* From measurements with soft clamps:
	+ No need of insulated vacuum flanges.
	+ **Action:** Take a decision about closing or not the gasket gap.
* From TE/CRG (cryogenics group) experts:
	+ Similar braided structures are used routinely (in-house experience).
	+ The braids exist in all flexibility range (lateral, longitudinal movement) and variety (size, shape).
	+ Custom-made piece of braid for all type of diameters.
	+ No breaking observed till now.
* If the beam is lost and hit the braid?
	+ Braids in stainless steel, like the beam pipe 🡪 can drill a hole.
	+ A whole study is needed to obtain more information (deformation with temperature for example).

**3 – Beam stability after LS2 and 630 MHz HOM– J. Repond**

A tuning of the 200 MHz main harmonic could be required for the new SPS cavities. A shift of the 630 MHz longitudinal HOM (critical one for stability) of a few MHz seems also achievable by modifying the couplers. This talk show the impact on beam stability of a tuning (spreading/shifting) of the 630 MHz HOM.

* Spreading of HOM peaks from 6 cavities in frequency is equivalent to damping.
* Spreading by 4 MHz gives equivalent stability threshold as damping of the 630 MHz HOM by a factor 3.
* Shifting/spreading in positive frequency direction is more favorable.
* Removing the load on the 938 MHz transverse coupler (acting on the 630 MHz longitudinal HOM) improves the stability by 10%.
* Shifting the 630 MHz peaks as a whole shows that 630 MHz is in a minimum of stability and 620-640 MHz are more stable resonant frequencies.
	+ Even with a single resonator.
	+ The instability is a coupled-bunch.
	+ The frequency dependence is not symmetric between 620 and 640 MHz.
	+ Peak of stability every 20 MHz.
* This behavior can be understood with a simple single-macroparticle per bunch model with two-particle interaction.
	+ Predicts the 20 MHz spacing for Q=200 and 25 ns bunch spacing.
	+ Symmetric dependence in between.
* The asymmetry still need to be understood.
	+ Take into account more than 2 two particles in the interaction.
	+ Take into account the bunch distribution.
* This effect holds even with the full impedance model.
* Should we worry about the accuracy of high frequency (above GHz) resonator in the SPS impedance model?
	+ Assess the accuracy of measurement and CST/eigenmodes simulations at high frequency (above GHz).
	+ Study the microwave instability threshold.

**4 – Requirements for transverse HOM damping in 200 MHz TWC – N. Biancacci/ D. Amorim**

The 938 MHz transverse coupler enhances the longitudinal HOM at 630 MHz. Requirements for transverse damping is necessary to assess what can be done with the transverse coupler. This talk studies the transverse stability margin if the 938 MHz mode grows when optimizing the 630 MHz one.

* To keep in mind: Transverse 938 MHz couplers installed in the past for the fixed target beam.
* Stability simulations:
	+ Use the SPS transverse impedance model (without 200MHz cavities) and a transverse resonator (Fr = 938.5 MHz and Q=1000) (SL-Note 96-49 RF).
		- The mode is simulated in vertical plan 🡪 to be checked.
	+ Growth rates obtained with DELPHI:
		- Vertical plan.
		- 924 bunches spaced by 25 ns, 10^11 ppb.
		- Zero chromaticity, no transverse damper.
* The effect of the resonator non-negligible for $R\_{s}>10 GΩ/m$
	+ - Nasrin: Combination of *Q*=1000 and$ R\_{V}>10 GΩ/m$ is not realistic. For this value of *Rv*, *Q* should be much higher.
* From analytical considerations (cancellation of coupled-bunch spectrum lines):
	+ For Q ~ 1000 🡪 transverse stability not impacted by the resonator at 938.5 MHz.
	+ Q ~ 20’000, instabilities could be driven.
* Next step:
	+ Check the corresponding single bunch stability margins (effect of R/Q).
	+ Run simulations for 4620 bunches (5ns).
	+ Study in more details coupled-bunch instability as a function of resonator parameters.
	+ Implement a realistic HOM with values from impedance simulations.

**5 – Discussion of the SPS MDs in 2017 – H. Bartosik**

The injector MD day and the LIU coordination meeting will take place soon. A plan for the 2017 MD session is now required.

* Main subjects:
	+ Losses characterization and minimization.
		- Optimization of rotation in the PS.
		- 8b4e studies (LLRF specifications) to improve beam loading compensation.
		- Measurements with different beam type to isolate e-cloud effect and lack of RF power.
	+ Q22 optics.
		- Not clear, even after RF upgrade, if the power limitation during ramp will be outperformed 🡪 Q22 optics (larger transition energy) could be a solution to minimize the power requirement.
		- Commissioning MD cycle, including transverse damper.
		- TMCI threshold, longitudinal instabilities and comparison with Q20.
	+ Longitudinal instabilities.
		- Instability threshold.
		- Impedance measurement.
		- Longer bunch extracted to LHC.
		- Bunch rotation.
		- Longitudinal space charge at different energies.
	+ Transverse coupled bunch instabilities.
	+ Transverse damper and high-bandwidth feedback.
	+ E cloud and high intensity.
		- Should we request few days of dedicated floating MD?
	+ Space charge and non-linear model (ions).
	+ Studies in view of collimation system (high concentration of losses)
* H. Bartosik: The year starts with less SPS operators in charge and more work (LEIR, AWAKE, …)
	+ Focus with simpler MD in the beginning of the year (type of beam already setup and known).
	+ Wait till the end of summer for more complicated MDs.

Actions

* See the status of sliding fingers with vacuum people.
* Input from TE/VSC (vacuum group) now needed to fix a time line for the shielding.
* Take a decision about closing or not the gasket gap.
* Schedule the 2017 MD session of the SPS.

Minutes written by J. Repond