**Meeting of LIU SPS-BD WG on 27/09/2012**

**Present:** Gianluigi Arduini, Hannes Bartosik, Nicolo Biancacci, Thomas Bohl, Alexey Burov, Heiko Damerau, Roland Garoby, Steve Hancock, Giovanni Iadarola, Christos Lazaridis, Elias Métral, Juan Esteban Muller, Yannis Papaphilippou, Benoit Salvant, Elena Shaposhnikova, Mauro Taborelli, Carlo Zannini;

**Presentations:**

**Juan: First results of the SPS MD in W39 with 25 ns beam in Q20 optics**

Four batches of the 25ns beam with nominal intensity (~1.15e11 ppb) were accelerated to flat top for the first time with the Q20 optics in 2012. The setup of the longitudinal parameters was not completed but will be done in the next MD.

*Controlled longitudinal blow-up is needed for stabilizing the beam at flat top when raising the voltage to 7MV for shortening the bunches. Further optimization is needed, since the head and tail of batches exhibit larger longitudinal emittance (bunch length) “U-shape”. This could be due to the poor control of the induced voltage in the 800MHz cavity and will be followed up in the next MD.*

*For reference: the typical bunch length at flat top of the 25ns beam with nominal intensity in the Q26 optics is around 1.65ns.*

**Hannes: Transverse observations of the 25ns beam in Q20 during the MD in W39**

The usual transverse setup for the 25ns beam with nominal intensity was done. The emittance measured for four batches at flat top showed very good results (below 3μm in both planes) and the total transmission without scraping was more than 95%.

*An absolute comparison of the emittance measurements between the different machines is difficult due to calibration issues. The measurements in the SPS will be validated with measurements on the LHC flat bottom once the 25ns beam is injected into the LHC.*

*The bunch-by-bunch mode of the SPS wirescanners in 416 after changing the scintillator location for lowering the signal on the photo-multiplier will be tested in upcoming MDs.*

**Thomas: Beam quality of the 50ns LHC beam with Q20 2012-09-26**

An analysis of the last few LHC fillings with the 50ns beam from the Q20 optics shows that the beam stability and beam quality (e.g. bunch length distribution) on flat top (FT) depends on the voltage of the 200 MHz system on flat bottom (FB) and the settings for the controlled longitudinal emittance blow-up (BU) during the ramp.

*Slope of increasing bunch length along the batch: The effect is less pronounced with 4.5MV on FB, but seems to be enhanced when using the BU. Further cases to be studied are 3MV with BU and the voltage dips from 3MV to 4.5MV. It would be also interesting to increase the length of the flat bottom slightly (a few hundred ms) to ensure similar beam conditions for all four batches (allow for time to filamentation of 4th batch). This will be followed up.*

*Such a clear slope along the bunch train (quite reproducible) was not observed with Q26, which showed on the other hand other patterns during the 2012 run (“U-shape” for example).*

**Elena: Longitudinal instabilities in the SPS and beam dynamics issues with high harmonic RF system**

The source of the longitudinal instabilities with LHC beams in the SPS is not known. In the single RF 200 MHz system, the coupled bunch instability is observed earlier for the 25ns beam than for the 50ns beam (bunch intensity is lower for 25ns, but total intensity is 50% higher). On the other hand the instability is quite similar for one and four batches, but is not reproducible with only six bunches. This seems to indicate that the instability is driven by a “short range” wake field and the narrow band impedance threshold considerations might not be applicable for the observed instability.

*The character of the instability changes when switching on the 800 MHz cavity: the instability threshold is very similar for single bunch, 50ns and 25ns beams.*

*Further studies on the scaling of the instability threshold with single bunches on the flat top are needed for better characterization of the instability and for improving the SPS impedance model.*

The 800 MHz 4th harmonic RF system of the SPS used to stabilize the LHC beams is operated in bunch shortening mode, since the phase control between the two RF systems is less critical in this mode and the synchrotron tune distribution has no local extrema for a large range of voltage ratios (many particles with similar action having the same synchrotron tune leads to loss of Landau damping).

*The low-level RF control for the 800 MHz system will be upgraded during LS1 to allow for compensation of the beam induced voltage.*

*The beam induced voltage in the 800 MHz cavities is of the same order of magnitude as the voltage applied from the RF power supplies. Therefore the beneficial effect from powering the 800 MHz cavity could be partially due to the fact that the beam induced voltage is compensated.*

*If a double harmonic RF system for beam stabilization would be installed nowadays in the SPS, it would probably be using the second harmonic (400 MHz) since this would provides a synchrotron tune spread over a larger range of longitudinal emittances (the 800 MHz cavities in SPS were originally installed in 1979 to blow-up the beam during slow extraction).*

**Discussion: Remaining MD studies for 2012 and potentially beginning of 2013:**

A clear planning should be prepared for the rest of the year to profit the most of the remaining MD time. It will be followed up if MD time is available for flat bottom studies in the beginning of 2013. Radiation should impose restrictions to MD studies with bunch trains on the SPS flat bottom. Remaining studies before LS1 include:

Longitudinal measurements with single bunches:

* Instability thresholds on flat top (to be done in 2012)
* Reference impedance measurements on flat bottom

Transverse measurements with single bunches:

* Reference impedance measurements on flat bottom
* Space charge effects and brightness limitations (also with acceleration to flat top 🡪 to be done in 2012)
* Impedance localization on flat bottom

Studies on the 25ns beam:

* Study potential electron cloud effects on the beam (also with acceleration to flat top) with higher than nominal intensity – mainly with Q20, but also with Q26 for comparison
* Emittance preservation of the high brightness h9 beam (25ns) up to SPS flat top
* Further measurements on the electron cloud behavior in the coated chambers to study conditioning effects after one year of operation (electronics for powering the solenoids need to be installed before the measurements)

Tests of LL 800 MHz control:

* Can be done only starting from December and not during LHC filling

MDs with ions:

* Further studies on RF noise reduction on flat bottom
* Possibilities of using Q20 for operation with Ions for LHC filling

Minutes written by Hannes Bartosik