LHC RF Meeting

29th September 2010

Participants: Luca Arnaudon, Andy Butterworth, Edmond Ciapala, John Molendijk, Olivier Brunner, Wolfgang Hofle, Daniel Valuch, Philippe Baudrenghien, Giulia Papotti, Themis Mastorides, Joachim Tuckmantel, Maria Elena Angoletta, Michael Jaussi

1. Noise studies

- Themis presented the study which has been done on noise induced diffusion. The movie of the bunch profiles is here.
- The 1-turn feedback will inject significant amounts of noise, since it brings an extra 20dB of gain at the revolution frequency lines. The 1-turn feedback will be set up for startup 2011 but with a gain less than 20dB. In fact we will start with it off completely.
- Ed asked what is the effect of the synchrotron band crossing the 50Hz line. Philippe replied that the synchrotron frequency remains below 50Hz with the voltage program we have, around 46 Hz with 4 MV at injection. The beam is relatively insensitive to 50Hz excitation at high energy, in fact has been seen that crossing the 50Hz at low energy produces more blowup than many hours at 50Hz at physics energy.

2. ACS

- Arc detectors: It appears the problem of spurious trips has been solved by the changes made two weeks ago (described in the previous meeting's minutes).
- Cavity 4 Beam 1: We see periodic noise spikes. It was originally thought to be due to an excessive offset in one feedback channel. However it has been realised that a small offset in the setpoint is strongly multiplied in the digital part of the feedback. It is thus impossible to measure the offsets in open loop. 3 further possible causes have been identified:
  1. Since the noise is within the bandwidth of the digital feedback, this points to a problem in the Setpoint module's digital voltage acquisition giving a spike at regular intervals. The loop tries to compensate and the setpoint continually runs up and down. We could change the Setpoint board pre-emptively.
  2. Possible bad contact in the antenna cable.
  3. Cabling problem in cavity controller.
- Joachim suggested that it could be multipacting in the antenna connector. We could try sweeping through different power levels to see what effect this has.
- We will try to get RF in this cavity as early as possible after the technical stop (Pierre), or failing this, try to work parasitically during the ions setup.
- Klystron 2 Beam 2: This klystron is currently off due to spurious vacuum activity. It looks as if the klystron will need to be changed, but there will be no time to investigate this properly during the technical stop.

3. Longitudinal blowup

- Elena said that the bunch length looks less stable now we have many more bunches. Philippe replied that the scatter during the blowup is only 50ps. The bunch to bunch length variation is no worse at the end of blowup than with fewer bunches.
- The bunch shape is changing through the blowup process, so the FWHM used by the BQM is not a good metric. It was designed for rapid measurements in the SPS. However, we can also use 30 % and 90 % widths to give a measure of the bunch shape.
- Philippe asked if it would be possible to automate a continuous profile measurement during the blowup.

4. SM18

- The cavity will stay cold until the end of next week. We may need to test the noise injection via the Setpoint module in SM18, and also the setup of the 1-turn feedback using excitation in the modulator (John both developments). We will probably need to negotiate more time cold in about 2 weeks. Conditioning is ongoing when the cavity is not being used for studies (Pierre).

5. **ADT:**
   - The BBQ has been improved: higher voltage diodes have been installed and there is no longer a problem.
   - Eric is currently measuring the power amplifier gains.
   - Delphine needs to wait for a new release of LSA to include the normalised gains. This may still be possible for Friday.
   - For damping of the hump, the damper is running with very high gains. During a test, beams with 1um emittance were put into collision (this lasted about 1 minute).
   - Abort gap cleaning: This has been successfully tested, and used once during filling. It will now be left on at injection. Eliana will do some more measurements when the abort gap cleaning is operational.
   - Injection cleaning test: A mechanism is needed for advancing the pulse timing at each injection. Delphine will implement this in the sequencer.
   - Zero-crossing glitch: not fixed but no problems operationally, Wolfgang and Daniel will decide what to do.
   - Loss maps: The changes needed for this will be done during the shutdown.
   - Multi-bunch acquisition from damper pickups (software from Verena), Maarten and Fred are sorting out some FESA/firmware issues. This is useful for hump tracking and beam-beam effects.
   - Currently every 10 seconds a logging of damper data over 8000 turns is made into the measurement database. This should be put into the logging DB, but only when the data is useful (i.e. when there is beam in the machine). We can filter the data in the front-end to reject acquisitions which contain only zeros, or alternatively condition the logging by the machine mode.
   - Cables: Following the request from J-C Guillaume asking if more RF cables need replacing between SR4 and UX45, a sample of the smooth walled Andrew cable will arrive soon.
   - During the shutdown: Noise measurements will be made on the analogue parts of the damper, and also a measurement of the 40MHz resonance in the amplifier/kicker combination.

6. **Startup after technical stop**
   - Protons: The bunch spacing will remain at 150ns after the stop for some physics production. It will move to 50ns sometime before the end of the proton run.
   - Injection setup for ions:
     - 4 or 15 bunches per injection.
     - Longitudinal blowup in SPS giving 1.2ns bunch length into 8MV in LHC. A large emittance is needed due to IBS. The voltage in SPS is 6MV, which is lower than for protons.

7. **Setup for 2011:**
   - Klysron DC power considerations: Up to 400 bunches should be OK this year with the counterphasing as used currently. However, beyond this intensity counterphasing becomes unworkable due to beam loading. Decreasing the Q_{ext} is a possible solution, but at injection with Q_{ext} = 15k we would only use 30kW. A Q_{ext} lower than 10k is not possible.
   - A possibility which has not yet been explored is that of detuning the cavities, which will increase the reflected power.
   - Reducing DC power: Decreasing the klystron HV keeps the gain roughly constant, but the saturation drive level would need to be adjusted. Also there is a danger of provoking crowbars. Changing the cathode current with constant HV reduces the gain but the saturation drive level remains roughly constant.
   - When the polar loop is closed the klystron gain remains constant (within the limits of available power) when changing the current or HV. However, switch-on takes place in open loop, and valid settings would have to be found for this. It would be possible to leave the klystron polar loop closed and record the gains and phases to be fed forward into the switch-on settings.
   - 9 new drive amplifiers are available with compression at 450W and reduced group delay. These should be installed when setting up a new working point.
   - OP agrees that we can try this with beam this year.

- Chromaticity measurements during injection: the tune measurement needs to be compatible with the damper.

8. AOB

- Future of US-LARP collaboration: We want to continue with the noise studies. Also new tools may be needed for setting up with different klystron working points.

A. Butterworth, 22nd October 2010