

LHC RF Meeting

29th September 2010

Participants: Luca Arnaudon, Andy Butterworth, Edmond Ciapala, Frederic Dubouchet, John Molendijk, Olivier Brunner, Frode Weierud, Wolfgang Hofle, Daniel Valuch, Philippe Baudrenghien, Giulia Papotti

1. Arc detectors

- ✚ Many spurious trips have been seen from the waveguide arc detectors. These detect the light from the arc using a photodiode mounted at the end of an optical fibre. The spurious trip rate appears to have increased with beam intensity: could these be radiation triggering the photodiodes? We should check the RADMON data from the detectors mounted on the Faraday Cages (Andy).
- ✚ The detectors are arranged in pairs and were originally intended to be used in coincidence (logical AND), but until recently they were used with logical OR for greater sensitivity. All have now been changed to AND from OR, except the ones on the end cavities, where those closest to the cavity have been deactivated completely.
- ✚ The specification for the detectors is that they should trip when a light intensity of 1 to 2 lux over 1 to 2 microseconds. A study has been restarted to quantify the specifications for new arc detectors for LINAC4, which could also be used to replace those in LHC. In parallel the optical fibres will be replaced. A complete upgrade is envisaged in the winter shutdown. Daniel originally designed the arc detectors for test purposes and they were never intended for use in the radiation environment of the tunnel. He will put in place a measurement of the analogue signals from the diodes.

2. Cavities

- ✚ C3B2 is currently limited to 1 MV, and runs without problem. No fibre optic damage has been seen, compared with the situation at 1.4 MV where the fibres were clearly damaged. This indicates that the radiation was significantly higher at 1.4 MV. Oliver proposed to increase gently the voltage on this cavity, but it was decided to leave it at the current level for the time being to avoid the risk of generating beam dumps on He pressure.
- ✚ Spurious trips on HOM temperature have been seen on this cavity and others. The trips were due to Allen Bradley thermometers which are conditioned by a single conditioner. The system has been modified to look at both temperature sensors of the HOM and to trip if both are above the limit. At the same time the limit has been reduced from 10K to 6K (two weeks ago). This is documented in the OneNote logbook. It is now believed that if multipacting occurs in the cavity, the HOM temperature interlock will trip before the He pressure gets too high and we can therefore avoid false beam dumps.
- ✚ The HOM signals are now available on the surface, since Daniel has made the RF multiplexer operational.

3. HV and klystrons

- ✚ Crowbars: one was seen yesterday and one today. One crowbar was replaced, with a fault in the electronics due to a burnt TTL chip which generates the trigger pulse. A study is underway to find a more stable off the shelf solution using thyristor stack to replace the thyatron. Needs modification to oil box but should be less sensitive to earth disruptions (Daniel, Olivier).
- ✚ Klystron 2B2 shows vacuum activity giving HV trips and is currently disconnected. We will do a heater curve during ion run and try to condition it. As the plan for the 2010/11 stop is to replace the collector boilers on 4 cavities, we will choose 2B2 as one of the four and replace this klystron if necessary.

4. Cavity controller C4B1 problems

- ✚ A spectrum analyser measurement shows lots of sidebands pumping up and down slowly. It is amplitude noise. In the time domain we see a spike every 20ms in the cavity return voltage. The klystron forward power shows a slower reaction. As the voltage spikes are seen in both boards, it

must be something common. Could be the LO, or the variable attenuator bit flipping? This would give a 0.1dB modulation in amplitude.

- ✚ John will do an open loop test, which does not need an access.
- ✚ Giulia thinks this maybe already happened in April or May. We will look back through the logbook and TIMBER logging.
- ✚ As a more general point, we need to install some diagnostics on amplitude noise, as we have nothing at the moment.

5. Longitudinal blowup

- ✚ The blowup functions have been redone for the 10A/s ramp and the blowup works well.
- ✚ The BBQ and tune feedback are having problems with bunch trains, apparently due either to the bunch length (which currently never drops below 1.05 ns) or to the blowup excitation and/or longitudinal oscillations. However it also happened during the first part of the ramp when we are not exciting, and even at flat bottom, so this is not clear. As the number of bunches increases, the BBQ fails progressively earlier during the ramp. A proposal was made in the LHCBCWG to do a test using the blowup on the flat bottom to see whether we can reproduce the effect.
- ✚ Now with shorter bunches of 1.2 ns in physics, the bunch length increases by about 10 ps/hour due to IBS, compared with no bunch length increase when we had longer bunches. It is supposed that this was due to clipping as predicted by V. Lebedev.

6. ADT

Wolfgang presented some [slides](#) summarizing the ADT performance and future plans.

- ✚ The damper is currently turned off during the squeeze since at the moment it cannot follow the tune changes. Also the BBQ needs a good signal to be reliable for the tune feedback.
- ✚ Vertical B2 damping is much stronger than the others: this can be explained by the combination of beta functions and calibration values. The two vertical gains are in fact practically identical, and the two horizontal ones are also identical but 2.5 dB lower.
- ✚ It is planned to trim the gain in the ramp proportional to the energy. After discussion with Delphine it has been decided to trim in a physical quantity (normalised gain) and also fold in a calibration factor which needs to be measured.
- ✚ Damping of the hump:
 - The damper can only act in the tune region where the FIR filter has less than +/-90 degrees phase shift. This limit appears as 2 bars on the plots due to the amplification of noise at these points.
 - The hump is attenuated (it is an external perturbation) but the attenuation scales with the beam transfer function so it is less effective when the hump is far away from the betatron tune.
- ✚ Abort gap cleaning:
 - It is proposed to use a short pulse which will clean the beam only if it is moving in the abort gap.
 - The proposed scheme for momentarily reducing the RF voltage at injection may cause losses if the beam has significantly blown up due to IBS on the flat bottom, and this risks populating the abort gap.
 - The abort gap monitor is now working, at least qualitatively.
- ✚ Zero crossing glitch: The new algorithm using CORDIC was introduced to be insensitive to the phase change introduced by changing the attenuation and so avoid the need for calibration with different attenuation settings. However, in the new algorithm, the decision plane for the sign needs to be perpendicular to the vector, and finding the phase of the vector doesn't work well when the amplitude is close to zero. So the current proposal is to use the old algorithm for operation and the new one only for calibration.
- ✚ Loss maps: A request has been made from Ralph Assmann to use the damper to excite single bunches for collimation studies. This would involve exciting with shaped noise as for the longitudinal and transverse blowup systems.

7. LLRF bunch by bunch data acquisition

- ✚ An observation buffer allowing observation of 8 individual bunches has been implemented in the transverse position measurement module. The limit of 8 bunches comes from the available memory.
- ✚ Philippe proposed that we study a solution for high-rate recording of all bunches over a time span significantly longer than is possible with the present observation buffers. For the beam control this would allow observation of instability growth rates and would require turn by turn acquisitions of all bunches over several seconds or minutes. This is not currently possible due to the size of the on-board memories and the limited data bandwidth of the VME bus, but a technical solution might be found using gigabit SERDES links to stream data to a specially designed memory board or an external PC.

A. Butterworth, 4th October 2010