

## LHC-Beam Commissioning Working Group

Notes from the meeting held on  
**20 April 2010**

Present: Gianluigi Arduini, Ralph Assmann, Wolfgang Bartmann, Chiara Bracco, Roderik Bruce, Oliver Bruening, Marco Buzio, Rama Calaga, Pierre Charrue, Bernd Dehning, Lene Drosdal, Lyn Evans, Massimiliano Ferro-Luzzi, Kajetan Fuchsberger, Massimo Giovannozzi, Brennan Goddard, Per Hagen, Lars Jensen, Mike Lamont, Yngue Levinsen, Malika Meddahi, Ryoichi Miyamoto, Giulia Papotti, Mario Pereira, Stefano Redaelli, Federico Roncarolo, Frank Schmidt, Rüdiger Schmidt, Elena Shaposhnikova, Katarina Sigerud, Matteo Solfaroli, Ralph Steinhagen, Marek Strzelczyk, Ezio Todesco, Rogelio Tomas, Jan Uythoven, Glenn Vanbavinckhove, Louis Walckiers, Jörg Wenninger, Simon White, Uli Wienands, Daniel Wollmann, Markus Zerlauth.

Excused: Carmen Alabau, Reyes Alemany, Tobias Baer, Roger Bailey, Helmut Burkhardt, Laurent Deniau, Rossano Giachino, E. Barbara Holzer, Delphine Jacquet, John Jowett, Verena Kain, Thibaut Lefevre, Alick Macpherson, Gabriel Mueller, Stefan Roesler, Laurette Ponce, Bruno Puccio, Adriana Rossi, Walter Venturini Delsolaro, Frank Zimmermann.

**1- Follow-up – Issues** – Mike Lamont ([slides](#))

### **To note:**

Pierre Charrue: Over the last week-end, Friday at 14h14 and Sunday at 06h40, the SIS dumped the beam twice because the communication was lost with Ralph Steinhagen's OFSU devices. Joerg Wenninger increased the YASP timeout to prevent dumping the beam again and Ralph Steinhagen is in contact with CO to understand what happened with his FESA server and where in the chain it crashed. CO is closely looking and monitoring his FESA servers and his ProLiant machines, waiting for the next communication issue to happen.

This morning Brennan Goddard organised a meeting with BT, BI and CO to discuss the recent IQC and XPOC communication issues with BCT and BLM devices. A list of actions was written up and will be followed-up.

Ezio Todesco: The measurements done in SM18 during the production were not enough to establish a good estimate of the b5 snapback speed. Therefore, it was set to the same value as the b3. Recent measurements done in 2010 with the fast rotating probe allow estimating this parameter, which proves to be much smaller than the b3 one. A correction in LSA should be envisaged. Concerning b3: measurements showed that a b3 correction of 0.5 is needed (vs. model prediction of 0.1). Therefore, a 0.5 correction has been put in.

Ralph Steinhagen: LHCb BPM drift: temperature loop is under preparation; should stabilise the temperature drift. Residual drifts with temperature correction are not expected to improve the measurement systematics better than 50-70  $\mu\text{m}$ .

Elena Chapochnikova: Varying beam emittance beams (0.25 eVs to 1 eVs) are now ready in the SPS for injection into the LHC. Thanks for Thomas Bohl.

Squeeze: 2-2-2-2 looked good. All IPs to be squeezed at once: ready to try tonight (1200s long optics change). Knobs are available.

## 2- Hump: status and what's next? – Gianluigi Arduini ([slides](#))

### What we know:

- Up to 5 peaks seen
- Broad peak which represents the movement of a narrow peak with time; broad line is at ~9.15 kHz, moving around with a period of ~7mn
- No dependence on momentum offset or tune variation
- Dipolar excitation in the vertical plane – or transverse offset (c.o. distortion) in a quadrupole? But no change in tunes being seen – Rogelio Tomas: Emittance growth time is different if it comes from dipolar or quadrupolar source: **tlc from logging**. Could also come from ground motion. But should not scale with energy.
- Frequency correlation B1/B2
- It decreases linearly with energy (this rules out beam screen vibration, or mechanical vibration of the cold mass)
- No difference whether there is one or both beams
- It blows mainly the vertical emittance of beam 2
- We can exclude effect of
  - Experimental dipoles / compensators (all OFF)
  - TL magnets and 60-120-600 A orbit correctors (all OFF)
  - RCO/RCD/RSS
  - Damper
  - AC dipole
- In general we observed an improvement of the lifetime after a reduction of the capture voltage (better matched) and of the voltage at injection. Possible explanation (qualitative): reduced momentum spread will reduce tune spread and therefore leads to smaller overlap with hump
- BLM measurements on beam 1: 9.15 kHz seen with RF on and off, no major change; 8 kHz line disappears when RF off. Data taken with beam 2 is much noisier. To check the background, i.e. noise present even without beams. BLM data were taken with tungsten collimators
- RF voltage changes: Changed total voltage from 8 MV->4 MV->8MV: did decrease the hump amplitude and slightly changes the tune peak width; but changing the RF voltage changes the bunch length and bunch peak amplitude and therefore the BBQ signal amplitude. To note: relative momentum spread is changing the same way during the cycle.
- Additional data from the schottky

### What's next?

- BLM spectra should be pursued:
  - Understand noise in B2: measure background without beam
  - Use higher intensity. Would allow killing the beam to measure?
- Repeat measurements RF ON/OFF looking at BLM spectra
  - For beam 2 first of all
  - For different vertical tunes for B1 and B2: in particular V-tune “on-hump” and “off-hump”
  - For different values of the RF voltage for B1 and B2
- If BLM measurements for B1 confirmed also for B2:
  - No correlation among 8 kHz noise and hump → UPS ruled out
  - Although the 8 kHz line seems to go through the RF → We should try to switch OFF UPS for the RF and nearby equipment and/or identify offending element by switching off selectively the klystrons

- To provide oscillations in the 10 nm range (JB Jeanneret)
  - $BL = 10^{-7}$  Tm – very small
  - Could be a varying current of a few mA in a power line 10m-long, longitudinal below or above the beam (searching for horizontal B-field). Common beam1&2 areas are better candidates, so are experiments.
  - ATLAS solenoid and toroid were all the time ON. Can we switch them off? Will be off next Thursday when we go back to beam operation, to take advantage of it.
  - What about detector power lines? Possible to switch OFF detectors?
- Vibrations induced by He flow in beam screens (compatible with energy dependence?). Act on valves feeding the beam screens in 1 sector (initially)
  - Block all valves at a given (optimum) position and observe
  - Increase the He flow and observe
  - Close all the valves → interlock on 60 A correctors after some minutes (pilot)
- Switching off UPS in one sector. Requires bypassing a series of interlocks. Probably not justified if confirmed BLM data on B1 and verified that RF is responsible for the coupling to the beam

Lyn Evans: Coherent excitation on the beams is being seen, and the Hump comes on top of it. So in parallel of all hump investigation, we must clean all sources. When firing, thyristor supplies are a hard process and are seen as a spike perturbation in the magnet field; the perturbation on a single magnet was already measured and found to be  $BL = 10^{-5}$  Tm. PC colleagues are looking into it: First, at the next Technical Stop, the perturbation signal will be recorded (Right of IP8), a correction applied on the PC, and re-measurement performed. A general “cleaning campaign” of the power supplies will be done.

Uli Wienards: If the hump comes through the RF, how comes we don't see it in both planes. Lyn Evans: could come from a place where beta V is big for beam 2?

Elena Chapochnikova: Changing the momentum spread while keeping bunch length constant should be tried.

Oliver Bruening: Data logging: amplitude of tune signal is observed. Could this be recorded differently (tune fit on the hump? Log the frequency of more than one peak?)

Louis Walckiers: Cryogenics system: did you look for something moving with a 7 mn period (persistent current?), or generally are we looking at any general service equipment? But still in conflict with this scaling with energy observed. *Added after the meeting: Gianluigi Arduini said that Serge Claudet has not found any 7 minute period in the cryo observables.*

Oliver Bruening: Hump did have a detrimental effect on beam 1? Yes, beam 1 did suffer from beam 2 seating on the hump. However, beam 2 is suffering much more. Can again be related to beta function.

Ralph Assmann: Recording the hump thought few ramps could be done and squeeze.

### **3- Injection and beam dump systems** – Brennan Goddard on behalf of Chiara Bracco ([slides](#))

Beam 1 measurement of extracted beam aperture: Issues: strange losses in P3, last absorber, for some phases.

Beam 1 higher intensity: had to adjust offset of TCDIH.29205 by -0.5mm to lower the losses at the MQM8 and allow for over-injection. Reminded: no space for shielding.

Emittance and vertical tune shift measured as a function of the intensity. Looks good. Longitudinal bunch length and emittance were also recorded and did increase – more detailed analysis required. The switching between PROBE and INDIV in the SPS now works well and RF re-phasing was good. The only manual change was for the BQM gain (solution to be found). As for beam 2, losses on TCDIs decreased with intensity.

**4- What's next?** – Mike Lamont ([slides](#))

Squeeze: golden orbits – TCTs – establish operational procedures

Higher intensities: Collimation, Injection and beam dump systems, n1, Abort gap cleaning.

Others: beam beam, RF ...

Full list of TO-DO: slides

Strategy: Skip stable beams, continue 24 hrs commissioning beam efforts.

**A.O.B.**

**Daily 8:30 HWC meeting in the CCC conference room (09:00 at weekends).**

**Daily 17:00 Beam commissioning meeting /OP, CCC glass box.**

**Next meeting: 27 April 2010, 15:30, 874-1-01. Agenda will be sent in due time.**

Malika Meddahi