

LHC-Beam Commissioning Working Group

Notes from the meeting held on 10 August 2010

Present: Carmen Alabau, Nicholas Aquilina, Gianluigi Arduini, Tobias Baer, Wolfgang Bartmann, Chiara Bracco, Xavier Buffat, Rama Calaga, Marija Cauchi, Guy Crockford, Lene Drosdal, Helmut Burkhardt, Lyn Evans, Massimo Giovannozzi, Per Hagen, Wolfgang Höfle, Eva Barbara Holzer, Lars Jensen, Yngue Levinsen, Mike Lamont, Ewen Maclean, Alick Macpherson, Malika Meddahi, Elias Metral, Ryoichi Miyamoto, Eduardo Nebot, Annika Nordt, Giulia Papotti, Tatiana Pieloni, Stefano Redaelli, Elena Shaposhnikova, Rüdiger Schmidt, Katarina Sigerud, Ralph Steinhagen, Marek Strzelczyk, Ezio Todesco, Rogelio Tomas, Jan Uythoven, Gianluca Valentino, Daniel Valuch, Walter Venturini Delsolaro, Jörg Wenninger, Simon White, Frank Zimmermann.

Excused: Markus Albert, Reyes Alemany, Ralph Assmann, Roger Bailey, Chandra Bhat, Philippe Baudrenghien, Roderik Bruce, Oliver Brüning, Andy Butterworth, Pierre Charrue, Ed Ciapala, Riccardo De Maria, Laurent Deniau, Bernd Dehning, Octavio Dominguez, Stephane Fartoukh Massimiliano Ferro-Luzzi, Kajetan Fuchsberger, Marek Gasior, Rossano Giachino, Brennan Goddard, Jean-Jacques Gras, Werner Herr, Delphine Jacquet, John Jowett, Verena Kain, Emanuele Laface, Thibaut Lefevre, Aurelien Marsili, Valerie Montabonnet, Gabriel Mueller, Lasse Normann, Mario Pereira, Mirko Pojer, Bruno Puccio, Laurette Ponce, Stefan Roesler, Adriana Rossi, Mariusz Sapinski, Andrzej Siemko, Frank Schmidt, Matteo Solfaroli, Glenn Vanbavinckhove, Uli Wienands, Daniel Wollmann, Markus Zerlauth.

1- Comments and Follow-up from the last minutes

Mike Lamont: Possible systems / beam limitations to reach luminosity of 10^{32} in 2010 were discussed at the last LMC. Agreed parameters: stay at 3.5 m all IPs, 150 ns is preferred for the experiments. Steve Myers has asked that the LHC beam commissioning meeting is studying a scenario to operate to ~400 bunches/beam by the end of 2010.

Jörg Wenninger: Need to prevent to continue the squeeze to 2 m in operation.

2- LHC beam commissioning: progress and issues – round table

Monday morning summary of Week 30 (report from Gianluigi Arduini and Oliver Brüning): ([slides](#)). Gianluigi Arduini highlighted few important points:

- Bunch-by-bunch monitoring is highly needed (Schottky ready to be used), but data not yet logged.
- Flat top and after the squeeze: measurement of Q' very difficult (50Hz peaks all around in the tune spectra). To be solved.
- Fixed display available providing the tune spectra online (20 min delay). Correlation with other parameters can be made during operation with the hump presence. It was stressed that it is very important to reduce the present 20 mn display delay by accessing the data of the BBQ FFT via the proxy. **Action: Stephen Jackson.** Gianluigi Arduini prepared a few points to be improved / corrected in the fixed display application and he will send them to **Mario Pereira** for action.
- It would be important to continue to work on the damper for noise reduction on the instrumentation part and for increasing the bandwidth of the system. Wolfgang Höfle

and team are working on that but beam time. Improving the noise levels is certainly a necessary condition to detect and possibly dump the hump.

- It was also suggested to test the use of the transverse feedback all along the cycle and switch off the octupoles completely. This might help for the lifetime at the beginning of the fill with high beam-beam.

On-going analysis of the 4 beam dumps: Annika Nordt (with Barbara Holzer and Eduardo Nebot) ([slides](#)). The 4 events were the following:

Event #1	07/07/2010 20:22:20	dump on MBB L7	beam2
Event #2	30/07/2010 07:26:39	dump on Q4.R5	beam2
Event #3	07/08/2010 2:14:39	dump on Q11.L4	beam1
Event #4	08/08/2010 1:10:47	dump on Q15.L5	beam1

Event #1: B2 loss. During the squeeze. Losses seem to start either at the end of MBB or between the two MBBs. Running sum over threshold is 4 (whereas the rest of the events the dump was triggered on RS5). The losses are also slower (> 1 sec).

Long BLM PM buffer data analysis for event 1 was also done. It allowed checking the losses before the beam dump. It clearly showed that before the dump event, there were also spikes on this BLM before the final event triggering the beam dump (TCHSH went higher than the MBB08L7.B2). Maybe coming from the un-bunched beam?

Event #2: B2 loss. During stable beams. Losses seem to start before the quadrupole (either in the interconnect or at the end of the dipole) and continue over several cells (no dipoles in between the quads). The middle (monitor 2) is lower than the start and the end location (shielding effect from the magnet). Looking at the PM data: no other losses before the dump event.

Events #3 and #4:

B1 loss, the losses seem to start in the dipole before (monitor in position 3 for B2 is the highest of B2 monitors). Dumped as well on Running Sum 5 = 2560 musec. No losses before the beam dump. Shape of losses is similar to event 2. Looking at the BLM downstream: they show the same loss pattern. Events 3 and 4 are very similar.

Comparison of loss patterns with a wire scan data taken which dumped the beam (debris in the vacuum system?): loss patterns are similar, although less symmetric. Losses have a rise time of ~1.5ms and last for ~2ms. To be analysed in more detailed.

Check losses on other monitors (event 4): losses look very similar.

Preliminary conclusions: several data were checked (BCT, BPM, loss maps, PM data, etc...). More detailed analysis is needed and on-going (losses on the TCPs, losses around the beam dump monitor, search for similar events etc...). Being followed up together with MPP. Diamond detectors will be very useful.

Feed-forward compensation of the QFB corrections during the squeeze - Stefano Redaelli ([slides](#))

Motivation: corrections done at the end of the squeeze are significant and should be incorporated. Proposed feed-forward corrections were calculated with the average tune corrections of the fills carried out in the same conditions. The first iteration corrected for the big drifts. Second iteration was done on the fine structure. The overall result is excellent and much improvement has been achieved since the Technical Stop period, to reach an "almost stable situation". The drift of the tune after the squeeze is not yet addressed.

Conclusions: After a few weeks of operation with QFB, the squeeze became too dependent on the FB availability. (OFB not discussed here). The good performance of the feedback systems should not make us forget that there is a live machine behind. Feed-forward compensations of the QFB corrections have been applied to reduce QFB trims

during the squeeze: Can get maximum corrections to ~ 0.002 level; Drift at the end of the squeeze still to be understood.

Outlook:

- Integrate these corrections in Mario's tool.
- Feed-forward of drifts between matched points, computed with MADX-online, for the optimization of a shorted beam process.

3- Status of beam dump system – Jan Uythoven ([slides](#))

Jan Uythoven presented an update on the beam dumping system, concerning the diluter kickers MKB vacuum, the beam losses at beam dump, the new XPOC modules and the importance of the foreseen dump of un-bunched beam.

Diluter magnet MKB vacuum problem:

- For B2 only 4 out of 8 pumps working;
- Two middle tanks without ion pumps reaching 1.0e-6 mbar;
- Danger to further degrade when more pumps switch off;
- Request to change faulty pumps in next Technical Stop: detailed planning ongoing;
- Interlock logic for MKB was based on voting between pumps and gauges. Changed during access Thursday 5/8 as remote reset would not be possible with faulty pumps - or the two central tanks the interlock now only depends on the vacuum gauge, without voting.

Beam losses during beam dump:

- XPOC data of the BLMs often read zero, when they shouldn't;
- However, missing data can be read from the normal logging system, 40 μ s losses - Less detailed info but do get the maximum at moment of dump;
- Temporary solution until new firmware BLM: perform a 'manual XPOC for BLMs
- New BLM firmware to be further tested this week, install everywhere as soon as possible – In progress at the time of the meeting.

Coming soon: New XPOC modules, very useful for better understanding. But will need to apply large limits on some.

Dump of de-bunched beam: Necessary to re-qualify dump protection at 3.5 TeV:

- After changes in orbit and check of collimators
- Good to do regular check
- Planned for tomorrow, Wednesday 11 August

This also applies to dumps at injection, during ramp or before correcting at flat top (3.5 TeV). Asynchronous dump should be protected under all conditions!

4- Luminosity optimisation – Simon White ([slides](#))

The method used was reminded. Mike Lamont clarified that now that the ADT is used in stable beams, we have not seen anymore coherent instabilities leading to losses. So the luminosity scans can be done using the "usual" method.

Very good orbit stability and even better after the cleaning of the orbit (max 50 μ m). The checks of the TCTs w.r.t. the actual orbit, showed a difference of about 100-200 μ m.

Orbit bumps: Displace the beams at the TCT: can compromise machine protection. Should not be used for large corrections.

Luminosity Optimization: New automated method tested and operational. Enforces limits on the trims. Few fills with high intensity showed not losses due to the scans.

Future Steps:

- Need more experience: run like this for a couple of weeks.
- Extend to parallel optimization. Full optimization few minutes.
- Set limits with respect to the reference orbit.

IP2: Colliding with an offset. Cannot apply automatic steering.

Set reference with head-on collisions: Automatic optimization, control separation in both planes, easier to find collisions.

To operation crew: please use this application for the luminosity application. Confident that we are not eating up the 5 sigma requirement at the TCT.

5- Updates on magnetic model and snapback at 10A/s – Ezio Todesco ([slides](#))

Reminder: we are ramping at 10 A/s! According to measurements snapback should increase from 0.2-0.25 to 0.4 units. Same behaviour should be found at 3.5 TeV Trims changed by ~8.5 units – this corresponds ~ 0.2 units of b_3 difference which is in agreement with measurement.

First main difference w.r.t. what specified is that flattop is 600 s and not 1000 s. According to published results, this should have a low impact on snapback (less than 20%).

Second main difference w.r.t. what specified is that the ramp with beam is at 2 A/s. This gives a difference between runs after pre-cycle and runs after runs – measured in the 90's – should be not large [L. Bottura]. Mike finds 5-10 units difference in the trims, i.e. 0.1-0.2 units of b_3 , between the two cases.

The influence of the 10 A/s ramp on the tune was also checked. Nothing was observed. But there was in occasion where a tune shift during a ramp was observed in July (orbit effects?).

MCO corrections: MCO are being used at 2-5 A at injection. In this range, the hysteresis is very large – the model is linear. Resulting correction is 10-30% of what needed for half of the circuits, and 50%-70% larger for the other half (depends on the sign). Can be cured by including hysteresis and splitting the precycle. Up-down precycle for positive settings, down-up for negative. Considered not critical (Massimo Giovannozzi).

MCBYcircuits: A few MCBY are being used at 3.5 TeV with 40-50 A. Very large kicks! Nominal is 72 A, scaling at 7 TeV not ok. One should check if a different correction is possible.

MCD circuits: The current in MCD (decapole spool pieces) has been ½ of what needed for two months. Bug found on July 31st, corrected on August 2nd. Bug active from May 20th to July 31st 2010 (any impact on the beam?).

MSS are being used since May 21st! Correction based on the measured values of the a_3 in the dipoles. Massimo Giovannozzi: there could be a systematic problem with the polarity flag for the skew magnets. Marek Strzelczyk to cross-check the MAD-X LHCX sequence polarity flag with the equivalent quantity in LSA. Follow-up: Massimo Giovannozzi

Report on the precycle has been published

<http://cdsweb.cern.ch/record/1283477/files/CERN-ATS-2010-174.pdf>

Reports on Field model are available on www.cern.ch/fidel and will be assembled in a yellow report.

6- A.O.B – Mike Lamont – Malika Meddahi

The LHC draft schedule for the coming months was discussed ([slide](#)). The goal is to evaluate the feasibility of reaching 1e32 peak luminosity.

Gianluigi Arduini: Week 36 could be anticipated to week 34.

Jörg Wenninger: it does not follow the 10 fill observation time before moving on to the next step in intensity.

Also it is proposed to operate as now on with nominal intensity.

The **second LHC beam operation workshop will take place on 8-9 December 2010.**

The aim is to analyse the first year of commissioning and operation to:

- Identify problem areas and operational weakness and propose improvement strategies
- Identify systems and functionalities where commissioning is still required
- Feed forward the outcomes in time for decisions at Chamonix and the 2011 LHC beam operation.

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

Next meeting: 17 August 2010, 15:30, 874-1-01.

Malika Meddahi