

LHC-Beam Commissioning Working Group

Notes from the meeting held on 17 August 2010

Present: Carmen Alabau, Nicholas Aquilina, Tobias Baer, Wolfgang Bartmann, Chiara Bracco, Xavier Buffat, Helmut Burkhardt, Andy Butterworth, Rama Calaga, Lene Drosdal, Massimiliano Ferro-Luzzi, Per Hagen, Eva Barbara Holzer, Lars Jensen, Yngue Levinsen, Malika Meddahi, Ryoichi Miyamoto, Gabriel Mueller, Eduardo Nebot, Annika Nordt, Kazuhito Ohno, Giulia Papotti, Tatiana Pieloni, Bruno Puccio, Stefano Redaelli, Mariusz Sapinski, Elena Shaposhnikova, Rüdiger Schmidt, Katarina Sigerud, Ralph Steinhagen, Marek Strzelczyk, Ezio Todesco, Rogelio Tomas, Gianluca Valentino, Jörg Wenninger, Daniel Wollmann, Frank Zimmermann.

Excused: Markus Albert, Reyes Alemany, Gianluigi Arduini, Ralph Assmann, Roger Bailey, Chandra Bhat, Philippe Baudrenghien, Roderik Bruce, Oliver Brüning, Marija Cauchi, Pierre Charrue, Ed Ciapala, Guy Crockford, Riccardo De Maria, Laurent Deniau, Bernd Dehning, Octavio Dominguez, Stephane Fartoukh, Kajetan Fuchsberger, Marek Gasior, Rossano Giachino, Massimo Giovannozzi, Brennan Goddard, Jean-Jacques Gras, Werner Herr, Wolfgang Höfle, Delphine Jacquet, John Jowett, Verena Kain, Emanuele Laface, Mike Lamont, Thibaut Lefevre, Ewen Maclean, Alick Macpherson, Aurelien Marsili, Elias Metral, Valerie Montabonnet, Lasse Normann, Mario Pereira, Mirko Pojer, Laurette Ponce, Stefan Roesler, Adriana Rossi, Andrzej Siemko, Frank Schmidt, Matteo Solfaroli, Jan Uythoven, Daniel Valuch, Glenn Vanbavinckhove, Walter Venturini Delsolaro, Simon White, Uli Wienands, Markus Zerlauth.

1- Comments and Follow-up from the last minutes

On the list to follow-up:

- Fixed display available providing the tune spectra online (20 min delay). Important to reduce the present 20 mn display delay by accessing the data of the BBQ FFT via the proxy. **Stephen Jackson**.
- Improved / corrected in the tune spectra fixed display application. **Mario Pereira**

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

Monday morning summary of Week 32 ([slides](#)). Malika Meddahi - Jörg Wenninger

Loss maps: Stefano Redaelli ([slides](#)).

Reminder: Loss maps are needed on a weekly basis. They are mandatory in the preparation process for the next intensity increase. The operation experience was so far very positive.

Beam losses on the horizontal and vertical 3rd order resonances had been performed. Loss duration was about a few seconds. For these loss maps, the Roman Pots were at 20 and 25 sigma (V/H). Collimator hierarchy was respected with a cleaning inefficiency of 99.945% (previously loss maps made on 18th June showed about 99.974% cleaning inefficiency). The BLM signals are still at about 0.6% of hit thresholds, therefore with the current data, theoretically a factor ~160 in intensity increase could be envisaged, depending on the lifetime assumption. There are some spurious signals of some BLMs, in some cases, the monitor (e.g. Q6), sees the shower from the collimator, therefore the dose to the superconducting magnets is over estimated. This is a known issue which is

being followed up by the BLM teams. Stefano Redaelli gave the summary of the inefficiency. The loss peaks were calculated for the 1.3 s integration time. Losses in the limiting locations are up to a factor 2 worse than 2 months ago.

Momentum losses were performed (RF trim of -100 Hz), in the usual beam colliding conditions (squeeze to 3.5m). Points with higher loss rates were analyzed for beam 2. A factor 100 leakage between primary collimator and TCTs is still provided and the cold elements are protected. The beam 2 loss peaks are to be understood and another loss map is being done for beam 2.

Summary and outlook:

- Performed loss maps with collimator settings used routinely in the physics operation of the last two months - Two semi-dedicated "pilot" fills (combined to orbit studies)
- The cleaning performance and the hierarchy are still good!
- Preliminary analysis indicates a degradation of the cleaning performance (still factors 160-200 below BLM thresholds!) - No problems for the next steps in intensity!
- Momentum loss maps show larger losses at the TCTs - Present configuration is ok but we need a dedicated loss map with one bunch 2 only.
- Request another loss maps at the end of the "stable" weeks of physics to review the limitation for the > 1.5 MJ range!
- Analysis of other running sums ongoing.

To note:

Other loss maps on 3rd order resonance are needed before the end of the week.

Ruediger Schmidt said that the rMPP suggested that the switch to 48b is done at the beginning of next week, when these loss maps are done and more observations on stable beams with 25 bunches are made.

Questions from Massimiliano Ferro-Luzzi and answer by Stefano Redaelli: Can we perform these loss maps at the end of physics fills, on one bunch. No, as we would need to mask the BLMs.

If we find again the same behavior with beam 2 what should we do? We would analyse the data, but this time with one beam at a time, which will ease the data analysis but in any case, the machine is protected. However, the situation would have to be reviewed for intensity increase.

Beam dump and injection systems- Chiara Bracco ([slides](#))

Chiara Bracco reviewed the reproducibility of the loss pattern in TL and injection region during 25 bunch injection period, the estimated allowed increase of beam intensity for injection and the reproducibility of trajectories.

She also gave the results of the analysis of the provoked asynchronous beam dump. On beam 1, the distribution of the loss pattern has changed along TI2: The loss peak uses to be at the location of the BLMI.29053, but since the 12/08, the losses are larger at the off-momentum collimator. To investigate what has changed around that time (nothing evident found). The loss pattern in the injection region remains rather stable.

For beam 2, there is a stable loss pattern in TL and injection region. To note: there is no off-momentum collimator installed in TI 8 (lack of available free place), therefore we do not see the change as for beam 1 after 12/08.

B1: Injected increase in intensity can be up to a factor 30 (overall in TL and injection into LHC - TBC).

B2: Injected increase in intensity can be up to a factor 10 (TBC).

Orbit and trajectory: SPS about 0.2 mm, TL about 0.7mm.

Asynchronous beam dump: Many BLMs saturated both in point 6 and point 7 but the losses at the TCTs were as expected.

Summary:

- Trajectories and beam loss patterns in the TL and in the injection regions stayed stable over 10 days (change in longitudinal beam dynamics on 12/08 to be understood)
- Safe margin wrt BLM thresholds in the injection region → injected intensity can be increased by a factor of 10 = 40 nominal bunches per shot (to be confirmed)
- Asynchronous beam dump: losses at TCT as expected. New RC filters needed in point 6 (@ TCSG). Losses above the BLM threshold in point 7 from B2 particles.

Bunch evolution during the fill- Giulia Papotti ([slides](#))

Summary for the different fills was shown. Percentage of losses after 2 hours of stable beams were compared between the various fills. A clear improvement is observed (chromaticity is reduced at the end of the squeeze, emittance has been increased again to nominal, intensity increase). More analysis required to correlate these observations with beam parameters.

Optics measurements- Rogelio Tomas ([slides](#))

Optics measurements were done during the 10 A/s ramp rate trial. At 450 GeV the beta beat is similar to the values measured exactly 3 months ago. Measurements done at 1.3 TeV are also in excellent agreement with the previous measurements. At 3.5 TeV the comparison shows a very good agreement within the 3 month period data taking.

Summary:

- 5-6% $\Delta B/\beta$ peak differences are observed with injection optics (450 GeV and 3.5 TeV).
- 10 A/s energy ramp does not make any change.
- 10% $\Delta B/\beta$ peak differences for collision optics ($\beta^* = 2\text{m}$).
- There is no statistics for $\beta^* = 3.5\text{m}$ beam 2!! (and poor statistics for beam 1)
- If this reproducibility is a problem (in the future?) global corrections are the only way.

More measurements to be done again at 3.5 TeV, squeezed, with one dedicated ramp and squeeze with safe beam.

10A/s ramp –

Successfully tried last Sunday 15 August - Mike Lamont. Will be completely commissioned when switching on crossing angles in all IPs from injection to end of the ramp and train operation.

3- Triplet alignment – Rogelio Tomas ([slides](#))

At 2 m it is mandatory to correct the IP coupling. The prediction pointed to the triplet correction on both side of pt 5 with an equivalent tilt error between 0.5 – 2 mrad in the triplet. The recent SU data shows that indeed MQXB.B2L5 shows a mis-alignment of 0.57 mrad. The other discrepancies affect less important magnets. If SU error is put in the model, it explains about 40% of the total coupling in the IR5.

Su: measurements of fiducial. Why such a big movement? Natural sinking of the floor.

Summary and outlook:

- SU data shows tilt shift of 0.57 mrad in Q2.L5
- It explains 40% of the IR5 coupling! It is worth correcting it.
- Maybe, it is better that SU re-measures in the next shut-down (need 2 days).

- Correction can be remote.
- This correction will require retuning coupling.
- Simon White is looking into the impact of the IPcoupling on luminosity and luminosity calibration.

4- BLM updates – Christos Zamantzas ([slides](#))

Main objective of the new firmware release: cure the problem of PM and XPOC missing data.

Solution applied: add the ability of writing half packets. Correction (clean-up) is tend one by front-end before dispatching.

System verification tests have been done. The data were checked in the PM and XPOC buffers. Extensive tests were also done last night with pilot beam, on debunched beam and on injecting on “more” closed collimator jaws. All behaviors were as expected, no failure was observed. System latency was also analysed and found to be <90 us. Due to the observed temperature effect behavior which was observed over last summer, double fans have been added. Temperature of processing cards show wings of 10 degrees and more over 6 days and has to be ameliorated. An oscilloscope with PM triggering was connected at point 7 to read the diamond detectors. At the next technical stop a second oscilloscope with ACEMs will be added. In SR7.R crate has not shown any issues since the intervention of 25/07.

5- A.O.B – Malika Meddahi

Reminder: 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: **31 August 2010, 15:30, 874-1-01.**

Malika Meddahi