

## LHC-Beam Commissioning Working Group

### Notes from the meeting held on 31 August 2010

Present: Carmen Alabau, Nicholas Aquilina, Gianluigi Arduini, Ralph Assmann, Tobias Baer, Chandra Bhat, Roger Bailey, Wolfgang Bartmann, Philippe Baudrenghien, Giulia Bellodi, Roderik Bruce, Florian Burkart, Helmut Burkhardt, Andy Butterworth, Marija Cauchi, Pierre Charrue, Paul Collier, Octavio Dominguez, Lene Drosdal, Stephane Fartoukh, Massimiliano Ferro-Luzzi, Kajetan Fuchsberger, Massimo Giovannozzi, Brennan Goddard, Per Hagen, Wolfgang Höfle, Eva Barbara Holzer, Lars Jensen, John Jowett, Witold Kozanecki, Mike Lamont, Valeri Lebedev, Yngue Levinsen, Ewen Maclean, Malika Meddahi, Elias Metral, Eduardo Nebot, Giulia Papotti, Mario Pereira, Mirko Pojer, Laurette Ponce, Bruno Puccio, Stefan Roesler, Elena Shaposhnikova, Rüdiger Schmidt, Ralph Steinhagen, Marek Strzelczyk, Ezio Todesco, Rogelio Tomas, Jan Uythoven, Gianluca Valentino, Daniel Valuch, Glenn Vanbavinckhove, Jörg Wenninger, Simon White, Daniel Wollmann.

Excused: Markus Albert, Reyes Alemany, Chiara Bracco, Oliver Brüning, Xavier Buffat, Rama Calaga, Ed Ciapala, Guy Crockford, Riccardo De Maria, Laurent Deniau, Bernd Dehning, Marek Gasior, Rossano Giachino, Jean-Jacques Gras, Werner Herr, Delphine Jacquet, Verena Kain, Emanuele Laface, Thibaut Lefevre, Alick Macpherson, Aurelien Marsili, Ryoichi Miyamoto, Valerie Montabonnet, Gabriel Mueller, Annika Nordt, Lasse Normann, Kazuhito Ohmo, Tatiana Pieloni, Stefano Redaelli, Adriana Rossi, Mariusz Sapinski, Andrzej Siemko, Katarina Sigerud, Frank Schmidt, Matteo Solfaroli, Walter Venturini Delsolaro, Uli Wienands, Markus Zerlauth, Frank Zimmermann.

#### 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. **Pierre Charrue**.
- Improved / corrected in the tune spectra fixed display application. **Gianluigi Arduini - Mario Pereira**

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

Monday morning summary of Week 34 - Ralph Assmann ([slides](#))

To note: Increased the number of bunches per beam from 48 to 50 to benefit from a scheme with no parasitic collision. To be added on the plots: beta functions at these parasitic encounters.

Some loss spikes were also observed in stable beams (factor ~30 in BLM at TCP) and not visible in the lifetime level (~50h). These are also very useful events to be analysed by the BLM team.

RF trips were experienced and heavy cleaning was observed in the momentum cleaning area. Also the abort gap monitor measured an increased population.

A beam dump was triggered during chromaticity measurements: reminder: This will be fixed by increasing the concerned BLM thresholds by a factor 10.

It happened twice that the tune peak disappeared in the noise in the tune viewer: the first time, in the beginning of the ramp, and it recovered by itself after a few minutes.

The second time, at the flat bottom, and was recovered by Ralph Steinhagen by changing the integration times.

Loss maps: cleaning in point 7 still good, to be analysed in more details. IR3 anomaly probably also seen for beam 2. This will be fixed with bunch train setup.

Tails measurements were performed and are indeed another important ingredient to the analysis of the sudden beam losses.

To follow-up: why all logging concerning the collimation system was lost for 1.5 days?

Need a mean to detect these problems. **Pierre Charrue.**

### **News on BLM events – Jörg Wenninger ([slides](#))**

A lot of activities on the analysis of the 7 events are ongoing.

The most interesting event was the one which came with the movement of the Roman Pots [RP]. The loss peak location is exactly at the BLM behind the RP location. It happened when the RP were at 20 sigma setting. The RP positions have been validated previously and the effect of the RP position was rechecked on a subsequent end of fill, without any BLM beam dump event. Since then, the RP have been inserted a few time without problems. It seems that the event was triggered by something that came with the RP. This is the event that seems to point most clearly in the direction of 'dust' particles.

An overall event characterisation was done by Jörg Wenninger. Rise time: defined as time from 10% of the max signal to max signal for Running Sum [RS] of 40 us. The BLM peak signal is always around 0.1 G/s. In some cases the maximum loss as recorded by the RS 40 us had already passed when the beam was dumped on the integrated loss over 0.6 or 2.4 ms. Some events may not have been noticed (as dumps) with BLM thresholds a factor 1.5 or 2 higher. Some clustering around point 5 is noted. Events are distributed evenly amongst the beams. The situation is not worse as the intensity increases.

What's next? Raising the threshold by a factor 2 could potentially avoid dumps without quenching. But for the moment proposal is to keep the thresholds as they are in order to collect more events and get experience with bunch trains. Benchmarking with wire-scanner will be pursued.

### **3- 2010 ion commissioning and operation – John Jowett ([slides](#))**

John Jowett reminded the LHC ion beam parameters. The machine setup choices are based on making the absolute minimum changes to the working p-p configuration.

To note: crossing angle values to be clarified for all IPs (zero crossing angle in ALICE, as is in CMS and ATLAS?, LHCb separated, un-squeezed). Could it be zero crossing angle in all IPs? To be checked.

Beam instrumentation: i) BPM: visible thresholds from initial experience at LHC – ii) Emittance: Rely on wire-scanner, BGI –iii) BCTs: Known limits, accuracy to be clarified for experiments

Filling scheme: 62 bunches

Collimation set-up: very different from protons. A single stage collimation system will have to be setup.

Machine protection: BLM thresholds to avoid quenches: shown that they should be the same as of protons. Beam dump: need to revalidate the XPOC checks of the dump quality for the BI, also define new references, etc... Safe beam intensity can be defined as same beam charge as protons for most purposes (exception: surface damage).

A first draft of the LHC ion beam commissioning schedule was presented. A total of 5 (+1) days were estimated for the machine preparation before the first physics collisions and physics.

Remarks: i) protons will be first injected after the technical stop to check the machine (+ 1 day). ii) Loss maps and asynchronous beam dump need to be added to the schedule at both 450 GeV and 3.5 TeV (+1 day).

To discuss: Investigate the possibility of a single bunch ion run in the middle of October. Seems extremely difficult on the RF side (at the same time the SPS is to be set-up and much time will be also devoted to bunch train operation). Also very difficult to add even more beam checks within the already very challenging bunch train program imposed to approach a peak luminosity of  $1e32$ .

To discuss: squeezing further beta\*? For the moment 3.5 m is to be assumed.

#### **4- LHC beam commissioning plan for week 35+36** – Mike Lamont ([slides](#))

List of commissioning work:

PSB: transverse emittance of 2.8  $\mu\text{m}$  (no transverse blow up in the SPS)

SPS:

- orbit tidied up after magnet changes
- Set-up of up to 48 bunches with 150 ns spacing
- $\sim 1.1 \times 10^{11}$  p/bunch
- Scraping on
- Long. blow up on

LHC: feed forward Q' measurements into 10 A/s ramp

Recovery from TS:

- Low intensity 2 A/s ramp and squeeze
- Low intensity 10 A/s ramp and squeeze
- Repeat

450 GeV:

- Crossing angle on
- Establish reference orbit
- ADT commissioning
- Tune PLL
- RF

Injection protection:

- Full program covering 7 shifts (1<sup>st</sup> stage: commission 4/8/12 bunches per train and injected into the LHC, TDI, TCDIs, TCLIs, un-captured beam)

Collimation: - 2 shifts

- Setup at 450 GeV with crossing angle
- Loss maps
- Asynchronous beam dump
- Prepare ramp settings (off line, without beam, 2-3 days)

Ramp-squeeze collide (low intensity)

Ramp-squeeze collide (high intensity)

High intensity bunch train

- Push through 4, 12, 24 bunches per beam
- Monitor & adjust (ADT, Longitudinal blow-up, RF, Feedbacks)
- First stable beams: 3x4

**Total: 28 shifts.**

To note: As soon as possible on Thursday evening: perform the transfer line steering onto the bottom TEDs.

Rüdiger Schmidt: Quench test: ready to be done.

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

Next meeting: 7 September 2010, 15:30, 874-1-01.

Malika Meddahi