

## LHC-Beam Commissioning Working Group

### Notes from the meeting held on 6 July 2010

Present: Carmen Alabau, Ralph Assmann, Roger Bailey, Chandra Bhat, Philippe Baudrenghien, Xavier Buffat, Rama Calaga, Pierre Charrue, Laurent Deniau, Lene Drosdal, Massimiliano Ferro-Luzzi, Massimo Giovannozzi, Per Hagen, Werner Herr, Wolfgang Höfle, Bernhard Holzer, Eva Barbara Holzer, Lars Jensen, Verena Kain, Mike Lamont, Yngue Levinsen, Ewen Maclean, Malika Meddahi, Gabriel Mueller, Giulia Papotti, Mario Pereira, Tatiana Pieloni, Mirko Pojer, Bruno Puccio, Stefano Redaelli, Mariusz Sapinski, Frank Schmidt, Elena Shaposhnikova, Katarina Sigerud, Ralph Steinhagen, Marek Strzelczyk, Rogelio Tomas, Walter Venturini Delsolaro, Simon White, Daniel Wollmann.

Excused: Markus Albert, Gianluigi Arduini, Reyes Alemany, Tobias Baer, Wolfgang Bartmann, Chiara Bracco, Oliver Brüning, Helmut Burkhardt, Andy Butterworth, Ed Ciapala, Guy Crockford, Bernd Dehning, Octavio Dominguez, Stephane Fartoukh, Kajetan Fuchsberger, Marek Gasior, Rossano Giachino, Brennan Goddard, Delphine Jacquet, John Jowett, Thibaut Lefevre, Alick Macpherson, Aurelien Marsili, Ryoichi Miyamoto, Lasse Normann, Laurette Ponce, Stefan Roesler, Adriana Rossi, Rüdiger Schmidt, Andrzej Siemko, Matteo Solfaroli, Ezio Todesco, Jan Uythoven, Daniel Valuch, Glenn Vanbavinckhove, Jörg Wenninger, Uli Wienands, Frank Zimmermann.

#### 1- Comments and follow-ups from last meetings

- In the BIC overview panel, left and right definitions of the P6 BPMS are not the same as defined in YASP. **Bruno Puccio:** The BIS supervision labels have been modified according to both Lars Jensen & Jan Uythoven proposal.
- Katarina Sigerud: state machine: requirements are still being discussed within OP. How to develop the frame which already exists is currently being studied by CO. **Follow-up: Verena Kain + Katarina Sigerud.**

#### 2- LHC beam commissioning: progress and issues – Ralph Assmann, Mike Lamont (slides)

Beam commissioning and operation over the last 10 days can be found at [slides](#).

To note:

- Decided to go towards nominal emittance (3.5  $\mu\text{m}$ ) to limit beam-beam effects to nominal values. Otherwise, standard emittances are very often below 2  $\mu\text{m}$  at injection.
- SPS transverse emittance blow up using the transverse damper is now set-up in order to increase the emittance values ( $\sim 3 \mu\text{m}$ ) – Wolfgang Hofle. Doing it in the LHC will require more time to set-up.
- During end of fill studies, the transverse damper system was switched on. Too high gain broadened the tune peak (probably need to work on improving signal/noise in the damper). Observed about 8 dB reduction of the vertical beam 2 tune peak; little change in the tune spectra for the other beams/planes. Will switch it on again at the end of the next Physics fills to get more experience.
- Fast losses which are observed are caught in the betatron cleaning insertion
- LHC wire scanner: are using PM, need to handle carefully the saturation effect, attenuator has been fixed.
- Emittance measurements on BSRT: in progress.

### 3- Beam observations during stable beams – Werner Herr ([slides](#))

Werner Herr has presented a follow up of the sudden beam losses observed during stable beam operation -see [slides](#). He recalled the experimental conditions and in particular the PACMAN effects of the present filling schemes  $n_x(3 \times 3)$  and the fact that we operate with full, nominal head-on beam-beam effect. He showed a few examples of the losses together with additional information from the data base. In many cases the largest loss was preceded by a small loss and/or a small emittance increase. In a few cases the bunch length was smaller after the loss. A rather clear coherent signal is observed when beams are brought into collision, although any associated beam loss is small. The large losses occurred under stable beam conditions, in most cases hours after the beginning of the fill. Operation with the 7th bunch indicates that the losses are beam-beam related since it did not suffer the same as the other bunches.

In the second part of the talk Werner went through a few possible causes of the loss and proposed further checks or modifications to the configuration. See attached slides for details. One prominent source of problems might be a too small transverse emittance.

It is most likely that the sudden loss is a consequence of the strong beam-beam effect, although it may not be the origin of the problem (remains to be investigated). Any small disturbance of the beam in the presence of this strong beam-beam force can potentially lead to the observed losses.

It is recommended to continue the study of the problem, some candidates can be tested, ideally under simplified conditions. In the meanwhile, the use of the transverse feedback should be tried and tested during stable beam operation.

To note:

- Tune feedback is off during the stable beam operation.
- Losses clearly related to beam-beam (but how, is not clear yet – cause vs. symptoms).
- Losses linked to unequal collision pattern and emittances? Being now tested with  $10b \times 10b$ , with almost nominal intensities.
- Losses linked to unequal beam emittance: very un-likely, should lead to bad lifetime, but not to a sudden beam loss.
- What if emittances are smaller than what we think? Strong coherent dipole kicks when beams are moving. To be checked!
- Any excitation of one of the beam can and will cause troubles when the beams are in collisions.
- We have basically nominal intensity i.e. head-on beam-beam: any RF noise?(e.g. phase). Not all bunches will be affected the same way when you have a crossing angle which will lead to transverse beam cross-talk.
- Loss of Landau damping? Always possible, but require collective motion and change of damping.
- Effect of crossing angles? Test without crossing angle could be done.
- For equal number of collisions per bunch and per IP, we pay a big price!
- Lyn Evans: First, get rock solid beams for physics. Octupoles should be switched off.
- Bunches which are colliding the halos, do not present un-expected behavior.
- The losses affect the bunches which have the larger number of collisions.

### 4- Crossing angle – Massimiliano Ferro-Luzzi ([slides](#))

Reconstructed crossing angle v.s. fill number (from beam-gas analysis) –see [slides](#) : Very different crossing angle when changing the LHCb magnet polarity (10% change). Not seen in the LHC orbit, no leakage of non closure. To be followed-up.

Ralph Assmann: Need to establish a reference orbit as soon as possible.

**5- RF noise during the 4th July Physics fill** – Philippe Baudrenghien ([slide](#))

Synchro and phase loop errors show bursts of noise well correlated with the bursts in VCXO control and to beam losses.

Suggests that the problem is in the Synchro Loop (or LLLoop DSp modules, including possibility for Emittance Blow-up application going weird...). All losses were caught by the momentum collimation system.

These bursts also appeared without any beams.

Since Monday 5<sup>th</sup> July, no more such observations were observed. Reason for the problem still being investigated.

To note: Since May 28<sup>th</sup>, RF voltage is at 5.5MV per beam on flat top.

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

Next meeting: **13 July 2010, 15:30, 874-1-01.**

Malika Meddahi