LHC-Beam Commissioning Working Group

Notes from the meeting held on
12 October 2010

Present: Carmen Alabau, Nicholas Aquilina, Gianluigi Arduini, Roger Bailey, Tobias Baer, Wolfgang Bartmann, Giulia Bellodi, Chandra Bhat, Philippe Baudrenghien, Andrea Boccardi, A. Bogacz, Chiara Bracco, Oliver Brüning, Xavier Buffat, Andy Butterworth, Rama Calaga, Christian Carli, Pierre Charrue, Guy Crockford, Bernd Dehning, Lene Drosdal, Massimilano Ferro-Luzzi, Brennan Goddard, Rossano Giachino, Per Hagen, Eva Barbara Holzer, Delphine Jacquet, Lars Jensen, John Jowett, Verena Kain, Mike Lamont, Yngve Levinsen, Ewen Maclean, Django Manglunki, Aurelien Marsili, Malika Meddahi, Tom Mertens, Ryoichi Miyamoto, Gabriel Mueller, Eduardo Nebot, Annika Nordt, Lasse Normann, Mario Pereira, Tatiana Pieloni, Mirko Pojer, Laurette Ponce, Bruno Puccio, Stefano Redaelli, Federico Roncarolo, Mariusz Sapinski, Frank Schmidt, Elena Shaposhnikova, Katarina Sigerud, Matteo Solfaroli, Ralph Steinhagen, Marek Strzelczyk, Ezio Todesco, Rogelio Tomas, Jan Uythoven, Daniel Valuch, Glenn Vanbavinckhove, Walter Venturini Delsolaro, Simon White,Daniel Wollmann, Frank Zimmermann.

Excused: Markus Albert, Reyes Alemany, Ralph Assmann, Florian Burkart, Helmut Burkhardt, Roderik Bruce, Marija Cauchi, Octavio Dominguez, Stephane Fartoukh, Ed Ciapala, Riccardo De Maria, Laurent Deniau, Kajetan Fuchsberger, Marek Gasior, Massimo Giovannozzi, Jean-Jacques Gras, Werner Herr, Wolfgang Höfle, Witold Kozanecki, Emanuele Laface, Thibaut Lefevre, Alick Macpherson, Valerie Montabonnet, Kazuhito Ohmo, Giulia Papotti, Stefan Roesler, Adriana Rossi, Rüdiger Schmidt, Andrzej Siemko, Benjamin Todd, Gianluca Valentino, Jörg Wenninger, Uli Wienands, Marco Zanetti, Markus Zerlauth.

1- Comments and Follow-up from the last minutes

John Jowett and Christian Carli: (slides): an optimum configuration was presented for the 128 bunches/ring which meet all the requirements:
a) Abort gap keeper- b) Bunch 1 collides with Bunch 1 at a point near ALICE (arranged by RF dephasing) – c) No change to beam dump kicker timing set-up – d) Provides non-colliding bunches to all 3 experiments – e) 124 bunch encounters for ALICE and 112 for CMS and ATLAS – f) Still need to verify acceptability to experiments.
Mike Lamont clarified that it will take about 7 mn to fill the ring, in dedicated filling.

Mike Lamont on behalf of Ralph Steinhagen, Marek Gasior: BBQ: Marek Gasior built a high-voltage version of the detectors. This was installed in the tunnel and the system is working very well. Q-feedback stays on during the full ramp.

Daniel Valuch: Switching on the AG cleaning at injection: dedicated time is provided this afternoon to finish the preparatory work (fine setting up of the timing). The aim is to have it running permanently during the injection process. The kick delay and the mode of operation are critical settings, so should provide cleaning at right time/position. For the injection region cleaning, prior to each injection, work is in-going to guarantee safe operation.

Bernd Dehning: (slides) Understanding of the beam loss seen on BLMQI.02R1.B1 in fill 1389. A plot of the post mortem data was shown; such data are only accessible offline. A clear signal 660 ms before the dump event is seen, which indeed is not seen from the on-

line data display. Losses vs loss duration were presented. The 600 ms signal was over the threshold. The observations were summarised: a HV current is measured - negative channels indicating change of HV and therefore current flow - all monitors are belonging to the same card. - the sanity check is positive - ATLAS BCM did not record loss signal (buffer not long enough) - no loss signal at IP3, 7 and 6 (more checks to be done)
Bernd Dehning concluding by saying that it is a real event, very fast, and below threshold for the fast losses. For the protection point of view, this is an issue. The beam was dumped on the long signal, as a result of the short signal.

Mike Lamont: Decision on early and short ion run in week 32? NO early ion run.

Mike Lamont: Operation at 50 - 75 ns bunch spacing this year? – Operation with 150 ns is continuing with as well pushing towards lower emittance. 50 ns operation will be done (tentative schedule: week 43), single batch, 2.5μm – 1.6e11/bunch. NO 75 ns operation.

2- LHC beam commissioning: progress and issues – Jan Uythoven

Monday morning summary of Week 40 - slides from Roger Bailey, Joerg Wenninger and Jan Uythoven. Updated summary (slides) – Jan Uythoven
To note:

- No more UFO since BLM threshold increase done.
- Quench tests: will be discussed during the next MPP meeting and reported here next week. To be done at 3.5 TeV as well!
- Vacuum activity: depends on the bunch current, preliminary observation from the coils installed around the vacuum tubes, both side of ATLAS seems to indicate e-cloud effects.
- Injection losses with beam 1. Injection was well tuned until last Friday morning, and then losses were 100 times larger then what have been observed up to now. Brennan Goddard is coordinating the work done to identify the possible causes. In the meantime, a trajectory bump was applied to displace the beam at the location between MSIAs and MSIBs, which was pointed out to be the location of the problem. Alignment checks and radiography of vacuum modules were done. RF finger is a possible culprit, but data analysis is on-going.
- Injection kicker pulse inhibit: understood and preventive measures taken. Katarina Sigerud: GPS system: a component has been replaced today. Medium term: monitoring of the signal. Longer term: Prevent the SPS extraction if this de-synchronisation is detected.

3- Ion readiness in the LHC injectors– Django Manglunki (slides)
Django Manglunki reminded that only 4 weeks are left before injecting ions in the LHC. Review of the LHC injectors was done:

- ECR source and Linac3: intensity is low but sufficient. Reminder: oven needs 36h refill every 2 weeks. This does not depend on the intensity delivered. Currently Monday morning till Tuesday noon as SPS takes Wednesday-Friday. It can be done on weekend but probably not desirable for LHC as it is usually a very smooth operational time! John Jowett – Mike Lamont: With luck, we might also be able to keep a fill for maybe about 26h, also it would be a good opportunity to fit accesses.
- LEIR: beam ready and on specs.
- PS: ready and on specs. Smaller longitudinal and transverse emittances than anticipated. Emittances in TT2 are about H=0.8μm and V=0.5 μm (wrt 1μm in the design report)
- SPS: done on parallel cycle, implemented on filling cycle: energy matching, capture, acceleration on fixed frequency, transition crossing, switching from radial to synchro loop, rephasing.

Remaining: RF noise on flat bottom to be solved, transverse settings throughout cycle, longitudinal blow-up (worked in 2009, measured bunch length 0.8-1.1 instead of 1.5ns, transverse blow-up (John Jowett: probably not necessary, tbc), extraction (worked in 2009).
Plan B: produce a nominal beam on short cycle – 100 ns bunch spacing - Needs to be done for NA61 anyway. John Jowett: we may not want such a short spacing in the LHC for the moment.

4- Ions readiness in the LHC – Walter Venturini Delsolaro – Matteo Solfaroli (slides)

Matteo Solfaroli reminded the beam characteristics –e.g. 7e7 ions - 5.4e9 changes /bunch. First setup will be done with 2 bunches/beam (still safe beam @3.5TeV) and collisions in all IPs. The nominal filling scheme (128b) for luminosity production is being finalized (John Jowett). The Energy of the nominal beam (128b) is about ~400kJ and the possibility of quench in the DSs negligible with this intensity. The SBF reduction factor still to be decided. Proposal for 2 or 2.5 as it's the maximum we can do while keeping safe beam measurable (2b beam still safe @3.5TeV).
An overview of the beam instrumentation was presented. See slides for all details. To note: safe beam flag for wire scanner damage is between 2.2e13p and 9.4e9 ions. BPM system will operate always on high sensitivity
Settings managements: a dedicated hyper cycle is already available –most settings are identical to the protons at the exception of the RF, the crossing angles in collisions, and the collimation system. The settings of the crossing angles were given; they have been chosen to minimise the changes wrt protons. Concerning the collimation system, if possible, no changes will be done to IP7 and IP3 to the settings all over the cycle. A cross calibration of orbit reading with protons will be required (Low/high BPM sensitivity). Test ramps will be done and loss maps performed. The remaining problem is the shadowing of ZDC, being investigated by MPP.
Planning and shift breakdown were shown. Stable beams with 2 bunches could be established in 5+1 days. Then more bunches operation could be done (straight to 128b? tbc, pending injection issues).
Open questions:

- Transverse emittance - to keep low, ADT off? tbc
- Longitudinal emittance: start without blow-up
- Re-steered the transfer lines? Malika Meddahi: to be checked, and if needed to be re-steered
- LBDS: special tests? Jan Uythoven: asynchronous dump to be done, at least at injection, and probably at 3.5 TeV (orbit changes and TCTs re-aligned).
- Loss maps configuration to be decided
- Shadowing of ZDC- activity in progress there
- LHCb dipole and compensator off? Yes and to be tested during test-ramp

Mike Lamont: Particle type: telegram distributed through the timing system
Luminosity monitor: BRAN working.

5- A.O.B –
150 ns filling scheme evolution: Massimiliano Ferro-Luzzi: (slides)

- 150 ns with more and more bunches: getting tough…
- For future upgrade of the "SPS injection request manager", please discuss with Massimiliano as well
- Number of transfers from the booster? Upgrade foreseen?
- Abort Gap keeper: from now will use buckets < 31182 (information from Etienne Carlier).

HI 2010: Massimiliano Ferro-Luzzi: (slides)

Currently abort gaps meet in IP 1 and IP5. Proposal: move HI abort gap encounter to IP2 such as to allow maximum number of collisions in ALICE. What impact on the other experiments? It is not transparent: affects trigger/timing of detectors. Probably can be handled in the shadow of the first few days of HI beam commissioning, but difficult to be sure… Please, wait a week before deciding.
Another possible ion scheme was proposed with no change of the abort gap crossing point (16b in one go). Django Manglunki: This would require a new cycle commissioning, so additional preparatory time. Also, the long stay on the flat bottom will probably deteriorate the earlier bunches.

Decision taken to switch off the LHCb dipole and its compensators during the heavy ion run. Saving of about 100kCHF in total (and 4 MW on the energy budget).

LHC proton operation: only 19 days left : Mike Lamont : (slides)

On the list to be done: Periodic loss maps, orbit shift vs TCT checks, all in one ramp-squeeze-collide, push the bb tune shift limit with 150ns, 50ns pilot run, long BI list, Abort Gap Cleaning – on at injection for physics, Injection Studies 32 Bunches when required (344 bunches), Setting-up of the SPS with tighter batch spacing (225 ns), long whish list from the experiment, quench test at 3.5 TeV.

Daily 8:30 HWC meeting in the CCC conference room (09:00 at weekends).
Next meeting: **19 October 2010,** 15:30, 874-1-01.

Malika Meddahi