

LHC Operation Committee

Notes from the meeting held on 8th February 2011

1. Organization structure of 2011 - J. Wenninger (slides)

Jorg presented the new structure of committees for the 2011 LHC commissioning. There will be 3 committees devoted to machine protection issues the rrMPP and rMPP chaired by R. Schmidt and the MPP chaired by M. Zerlauth and himself. Then the High Luminosity LHC Project chaired by L. Rossi and the LHC Injection Upgrade Committee chaired by R. Garoby. The LHC operation and performance issues will be addressed by the LBOC chaired by J. Wenninger and with not yet defined deputy chairman. Machine Development studies (MD boxes on the official planning) will be followed up by LSWG chaired by R. Assmann and F. Zimmermann.

The LBOC will meet on a bi-weekly basis on Tuesday afternoons at 3:30 pm in room 874-1-011. In case of MD weeks on the LHC meeting will be maybe shared/alternated with the LSWG. The LBOC mandate will be soon defined. Participation is on a free bases anyone interested can subscribe to the mailing list via the official webpage <http://lhc-beam-operation-committee.web.cern.ch/lhc-beam-operation-committee/>

All committees report directly to the LMC.

This year the Monday weekly reports by machine coordinators will not be repeated at the LBOC.

Next week meeting will not take place due to BE department meeting at same time.

2. LHC Cycle for Physics Operation - S. Redaelli (slides)

Stefano with J. Wenninger and M. Lamont defined a possible strategy for the 2011 run to reach the goal of luminosity based on the defined machine parameters of Chamonix 2011. In Chamonix the machine main parameters were defined Energy 3.5 TeV and β^* in all IPs (1.5/3.0/10.0 meters) nevertheless minor changes are still under discussion to face the commissioning.

The main idea is that since the machine will start with virgin settings for the ramp and squeeze, it is worth profiting of this opportunity for an optimization of the machine turn around time by reducing the time spent on these two modes and by improving the operational procedures in order to reduce possible errors. Stefano illustrated the different beam modes for the LHC to clarify the modes which have well defined time-functions for the setting and therefore which can be optimized to reduce the time spent on this modes.

Last year modes had the following characteristics:

- **RAMP:** nominal ramp rate of 10 A/s with a duration of 1400 s per ramp, optics and tunes kept constant as well as separation and

crossings at IPs. At 3.5 TeV a decay compensation was applied taking 380 s.

- **SQUEEZE:** settings were generated for 2.0 m β^* then we stopped earlier at 3.5 m in 1041 s. Tunes from injection setting (0.28, 0.31) to collision (0.31,0.32) are changed in the first 23 sec and then 2 stop points needed for feedback references and collimators movements. All available matched points from ABP have been used.
- **COLLISIONS:** the time needed to bring beams into collision was 108 s for protons and 180 s for ions. Time is mainly defined by the IPs correctors which are just collapsed to zero settings since lumi-scan feed forwarded correction showed very good convergence.
- **PRE-CYCLE:** nominal LHC pre-cycle (not clear last year timing from Stefano slides)

After a summary table of beam parameters agreed in Chamonix and proposed crossing angles to keep fixed setting from injection to collision some proposals to reduce the time at different beam modes.

This year proposals:

- **RAMP:** Introduce faster ramp-rates in the first part of the PELP ramp to speed up the parabolic and exponential increase. For this beam validation is needed and as a backup solution we can roll back to 2010 settings. With this new setting the ramp will last 680 s. To gain time after in the collision mode in parallel during the ramp the parallel separation of the beams will be collapsed linearly between the values at injection and at flat top (which should scale according to $1/\sqrt{E}$). The decay compensation time at top energy will be kept constant. The FiDeL team is working on tracking Q and Q' decay at top energy in order to apply preventive trims at injection.
- **SQUEEZE:** This year the squeeze will be performed in a single step without stop points, this will bring a factor 2 gain in time and reduce the primary sources of errors from 2010 experience. The FiDeL implementation of the hysteresis has been removed due to wrong setting of up and down branches. By skipping the two stopping points the duration will be of 704 s keeping all the matched optics points (IP1/5 $\beta^*=11$ m down to 1.5 m, and from 10 m down to 3.0 m for IP8). A further optimization of the squeeze which can lead to a duration of 474s is coming from reducing the number of matched optic points in the well explored area above 4 m. The strategy is to go for this Optimized version (with reduced matched points) with continuous beta measurements, and if problems arise roll back to all matched points from optics. For the squeeze in IP8 (LHCb case) two strategies are proposed. The present baseline is to stop at 3.0 m β^* and then perform luminosity leveling with beam separation. The fall-back solution in case of problems with leveling is to add the squeeze of IR8 from 6 m to 3 m after IR1/5 are squeezed to 1.5 m. The time function will require

an extra 250 s from 6.0 to 3.0 m β^* . To commission this scheme 2-4 shift with NO physics will be necessary.

- **COLLISIONS:** as in 2010, but the duration will be reduced by a factor 2
- **PRE-CYCLE:** two possible changes are under discussion. The first is to reduce the minimum current in the MB to 100 A to allow access with RBs and RQs ON at this current level (Venturini, Chamonix2011). The second proposal is to update the maximum dI/dt with the 2011 HWC. Two pre-cycles are shown: "COMBO" pre-cycle which allows skipping the pre injection plateaux for a duration of 2100 s compared to the standard LHC of 3100 s.

Additional optics changes were presented:

- Optics with β^* below 1.5 m under preparation by ABP.
- Squeeze for ion operation ALICE required to operate at 1-2 m. Optics under preparation by ABP and will require re-commissioning at beginning of ion run.
- TOTEM/ALFA 90 m optics. Ready for test without beam (IP5 only), then final optics update for IP1/5 together.

Comments:

Concerning the β^* at IP1/5 R. Assmann mentioned that 1.5 m is more risky for the collimation system, at Chamonix the agreed value was 1.6 m. O. Bruning pointed out that 1.5-1.6 m is the same value if we think of the 10% error we have in knowledge of the β^* . Stefano also pointed that all optics is available for 1.5 β^* we go for that and if any problem it is easy to roll back.

Concerning the crossing angles proposed by W. Herr in order to keep constant settings for collimations from injection up to top energy S. Fartoukh asked why we do not go for nominal crossing angles of 170 μ rad. Stefano answered that last year we saw that long-range allows for smaller crossing angles and like this we can get some margin for aperture and be on a safer side. Werner also mentioned that nominal crossing is meant for nominal parameters and we know that we have lower emittance for some of the beams. In this way the crossing angles could be kept constant over the whole cycle and this will be easier for operation. Gianluigi asked if this will be the case also for 25 ns beams. Werner said that this depends on the beam parameters, but changing crossing angles afterwards is easier.

Concerning the magnet ramp A. Siemko asked if we are able to correct for faster snap-back which will occur due to the faster ramp rate proposed, the parabolic-exponential slow ramp rate is meant to make snap-back slower. E. Todesco said yes they will be able to correct the faster SB effect. Ezio asked if the 380 s at 3.5 TeV for decay compensation are really necessary, the decay is very slow and rather linear. Stefano pointed out that Mike decided to keep it like this to not mix with the squeeze function. For the moment the b3 decay at 3.5 TeV is corrected using the Q' knobs based on the lattice sextupoles rather than the b3

spools, which should be changed in the future as suggested by B. Holzer. W. Venturini also mentioned that more time will be spent on the linear ramp-rate of 10 A/s this could make the effect larger this year. Ezio reminded that a correlation between decay at 450 GeV and at 3.5 TeV should be defined and a forward correction applied.

Concerning LHCb squeeze strategies, M. FerroLuzzi will discuss this point at the LPC.

3. Handshake - R. Alemany ([slides](#))

Reyes presented the changes with respect to 2010 for the handshake procedures. A table summarized the procedure of 2010 with highlights of the new features for 2011. The different handshakes are described in details for the OP crew. The main change is in case of programmed dump of the beams: the experiments that will now have 5 minutes to react and the beams are dumped if no 'problem' message is published.

Comments:

Jorg wanted to make clear that the experiment should report a problem only and only if there is a real problem situation. Massi points to the fact that the experiments are ready to take a non programmed dump at anytime and there is nothing dangerous with this procedure. Jorg proposed the possibility to implement in the SIS logic an automatic mode change, Stefano added also with automatic change of fill number to avoid errors.

4. Check out and first beam planning-J. Wenninger ([slides](#))

Jorg presented a first draft of the start-up planning from the injector chain up to the LHC. Beam will arrive to the SPS on 14th February and hopefully some fix target beam measurements could be performed at 400 GeV. On 16th Feb. the probe beam may be available but may not yet be ready for extraction since the MKE had many modifications during the shut down and should tested without beam. Beams could be sent through transfer line TI2/8 on 17th-18th. Possible PS cycles from the SPS are LHCFast for probe, LHCFast with 7.2 sec injection plateau for individual nominal bunches and LHC nominal for 50/75 ns beams with single and double batch injection modes. HWC should be finished by 18th. DSO tests start on 11th Feb and volunteers are needed. Then machine checkout starts in parallel with HWC. Requests for access can be presented at 8:30 meetings shared with HWC. The machine checkout will go through all systems and will be performed mainly by OP and friends. First beam in the LHC: probe 4-5E9 with a flat orbit (no separation no crossing angles) applying correction settings from 2010,. The spectrometers will be off, ATLAS and CMS will be ON. First turn from one IP to next stopping at collimators, followed by RF capture and closed orbit. Requests for shifts during commissioning should be sent to [Jorg](#) and [Tatiana](#) and will be posted on the LBOC.