LHC Beam Operation Committee

Notes from the meeting held on 30th August 2011

Participants

1. BE_CO Work for the TS– P. Charrue (slides)

P. Charrue presented the list of activities performed and to be performed by BE/CO group during 29/08-02/09 technical stop.
In particular, interventions on the logging services, for attribution of new storage, and change of routers, to avoid future problems in case of power cut, were completed. A detailed list of the ongoing activities (japc-monitoring, LSA release, OASIS server, Sequence manager timing, RBAC upgrades, etc.) can be found in the attached slides.

Discussion:

P. Charrue explained that all CO changes have been tested in the CO testbed for making sure evident bugs and incompatibilities for the installed base is caught.

B. Holzer pointed out that, as usual, the machine restart after TS will happen during the weekend. He asked if experts will be available in case of problems.
P. Charrue confirmed this.

G. Arduini asked if it is possible to start testing update of proxies, LSA etc. before the end of technical stop in order to immediately find out and solve eventual problems.
P. Charrue said he will ask the main responsible to organize this test.

J. Wenninger commented that few changes were applied to telegrams logic. Some were suppressed and some new were added and are already working.

2. Operation 3e33 – J. Wenninger (slides)

J. Wenninger presented the first outcomes of 1 m β* MD. He underlined that the main changes concerned collimators, which were closed to tight settings (see slides for details), and IP1/IP5 crossing angles which were reduced to 100 urad.
Previous MD with tight collimator settings, 8 σ long range separation and 1.5 m β* were successful. Moreover, an aperture larger than assumptions by 4-5 σ was measured at the triplet.
A dedicated hypercycle was created for 1 m β* operation (3.5TeV_10Aps_1m); new collimator settings, squeeze functions and crossing angles were implemented and the system is ready and almost operational.

Loss maps and asynchronous dump were performed and validated the new collimator setting.
No significant change was observed in orbit (150-200 peak change during squeeze) and beta-beating; no correction had to be applied for the new optics.

Signs of instabilities, in particular for beam 2, appeared during the squeeze before putting the beams into collision. The chromaticity had been increased by1-2 units already in a previous fill.
Correlation between losses at the primary collimators and squeeze is under investigation.
J. Wenninger showed beam lifetime during the different steps towards 1 m β* underlining the big drops observed when closing the collimators (R. Assmann commented that this is normal) and during the squeeze. Losses interested mainly bunches in the middle of the first batch; this corresponds to bunches undergoing long-range interactions in IP1 and IP5.
He presented a possible plan for operation after the technical stop saying that further investigations on beam instabilities and possible causes are sill needed. Few fills, before ALICE polarity reversal, will be dedicated to these studies in order to estimate if we are ready for physics with 1 m β*.

Discussion:

B. Holzer asked if chromaticity was correctly scaled with the new squeeze.
S. Redaelli answered that this was the case and that chromaticity was measured.

R. Assmann pointed out that long range depends on emittance; a larger emittance could explain the different behavior with respect to previous MDs.
M. Pojer said that he checked emittance behavior during squeeze and a blowup is clearly visible, especially in the vertical plane (plot1, plot2).
M. Ferro-Luzzi suggested to use the BSRT during the next run to measure beam blow up.
J. Wenninger replied that there could be a synchronization problem

S. Fartoukh asked if any correlation was observed between beam instability and bunch length.
R. Assmann answered that no change was observed on the online display.
G. Arduini explained that the displays show an average measurement and a more accurate analysis is needed.

S. Fartoukh suggested that one should profit of the bigger aperture measured at the triplet and increase the crossing angle.
G. Arduini confirmed and added that, for the same reason, collimators could be kept at their nominal setting.
J. Wenninger pointed out that this depends on aperture measurements that should be rechecked offline.
O. Bruning commented that measurements should allow to reconstruct the real aperture (in mm).

M. Lamont asked when octupoles were switched on.
J. Wenninger answered that they were probably switched on too late when the beam was already blown up and stable.
R. Assmann asked why long range beam-beam should depend on octupoles.
E. Metral answered that the beam-beam long range could shift the stability diagram.
E. Metral asked what were the differences w.r.t. to past MD when tight collimator settings were tested.
S. Redaelli explained that, at that time, only CFC collimators in IR7 and IR6 were moved after 8 hours of colliding beams with 1.5 m b∗.
G. Arduini commented that the main difference was observed when going into collision (crossing angle)
R. Assmann underlined that tune spread from several hours of collision could have contributed to stabilize the beam.

S. Redaelli mentioned that unusually high losses were recorded during the energy ramp
R. Assmann commented that this is not a problem since these are losses coming from the beam tails which do not contribute to luminosity.
G. Arduini replayed that it should be checked if this could be a problem when operating with high intensity (nominal number of bunches).
R. Assmann suggested to increase BLM thresholds, as for collimation quench test MD, during next fills to avoid dumps during the ramp.

3. Recent Observations of Beam Instabilities in the LHC –

E. Metral (slides)

E. Metral explained that the first case of instability was observed when injecting 48 bunches separated by 25ns. The beam was dumped after ~1000 turns with the transverse damper on, and after ~500 turns with the damper off. BLM data showed a fast increase in the signal, at the primary vertical collimator in IR7, after 150 turns. No vacuum activity was observed. This seems to be compatible, according to predictions (E. Benedetto's PhD thesis and F. Zimmermann calculations), with fast e-cloud instability.
The cure would be injection with a high chromaticity (> 15) plus octupoles to control head-tail instabilities induced by the high Q'.
S. Fartoukh commented that octupoles could be used also for damping e-cloud instability. E. Metral answered that a much stronger octupole current should be needed compared to usual head-tail instabilities as it is believed to be a TMCI-like instability and a spread of the order of the synchrotron tune might be needed. It will be followed up.
E. Metral moved then to the description of instabilities observed during the 1 m β* MD. He confirmed that a coherent activity, especially in the vertical plane, could be observed at the BBQ. Octupoles were used to stabilize the beam but, looking

carefully at the data, it can be seen that beams were already stabilizing before increasing the octupole current.
These instabilities were not observed during the previous MD with tight collimator settings. E. Metral explained that, indeed, a real tune shift is expected when moving the collimators closer to the beam. He added that, during the last MD, chromaticity was higher by a factor of two and this could explain the rising up of instabilities due to the loss of Landau damping (depending on the tails of the transverse distributions which could have been modified by the beam-beam long range). TCBI of mode 1 could explain the observed behavior as well as the `` Christmas tree" tune shape.
He concluded suggesting either to use a lower chromaticity (1-2 units) or increase the octupoles current to better stabilize the beam.

Discussion:

J. Wenninger asked why instabilities raised up only when changing the crossing angle.
E. Metral answered that, due to the high chromaticity, the TCBI was more excited and the beam-beam long range could have modified the stability diagram leading to a loss of Landau damping of the TCBI m=1.
S. Fartoukh commented that not much margin is left for octupoles current in view of operation at 7 TeV.
J. Wenninger commented that, at first, chromaticity should be correctly setup and only afterwards one should play with octupoles.
E. Metral agrees with this, first we should have the smallest chromaticity (~ 1-2 units), then decrease the beam-beam long range (which, according to the measurements played an important role) by increasing the crossing angle and then increase the octupole current if needed.

4. Re-setup of Injection Protection after ALICE Polarity Flip –

W. Bartmann (slides)

W. Bartmann presented the activities to be carried out to re-setup injection protection in case of ALICE polarity flip. He explained that the external angle is also changed and this affects the injection system. TDI and TCLI collimators will have to be realigned around the new orbit; TDI angle will have to be re-checked and machine protection validation tests performed. This will require one full shift.
In case of significant orbit change in the injection point, the transfer line will have to be re-set up as well: steering of trajectory, alignment of TCDI collimators and phase coverage validation. Additional 1.5 shifts have to be considered.

Discussion:

M. Ferro-Luzzi asked if the time presented is either beam time or machine time

W. Bartmann answered that some margin for downtime was considered, based on past experience.

J. Wenninger commented that it should be possible to steer the orbit in the injection point in order to avoid the TL setup.

5. AOB

M. Ferro-Luzzi commented about the BPM intensity issue for 90 m β* optics. He suggested either to mask low intensity bunches or to adapt BPM sensitivity for mixed intensities.
He also asked if AC dipoles could be used not only with pilot but also with nominal bunch.
J. Uythoven commented that during TS the aperture kicker MKA had been upgraded to a larger strength. The MKI is now `consigne', and requires access in the tunnel to be activated. This means that while the MKA is `consigne', there is no risk of accidentally using it while using the AC dipole with a nominal bunch (and relaxed SBF).

M. Ferro-Luzzi asked for some dedicated time for Roman pot detector setup with 90 m β*. If this is not possible, it would be good at least to move the roman pots to physics settings and perform loss map studies.
R. Assmann commented that loss maps do not ensure machine safety and he added that official roman pot settings should be prepared and circulated around.

6. Next meeting

Tuesday, 6th September: **LBOC meeting (15:30 in 874-1-011)**.