LHC Beam Operation Committee

Notes from the meeting held on 6th September 2011

List of Participants

1. Status of 1m beta* commissioning (Jan Uythoven)

J. Uythoven presented the progress with the 1m beta* commissioning. He pointed out that by keeping the crossing angle of 120µrad, the beam-beam separation will be reduced to about 7 sigma (equivalent to design value). The collimators in IR3, 6 and 7 remain at standard settings, the TCTs in IR1, 5 and 8 will be set to 11.8 sigma, identical to the settings before the technical stop.

The commissioning is grouped in four different blocks:
Block A: Aperture checks at 1m beta* and beam-beam effects: Almost finished. The loss maps showed an unconventional loss spike at Q10.R1; after the preliminary analysis, the spike is expected to be due to noise.
Block B: ALICE polarity reversal: ALICE polarity was successfully reversed and settings functions for the whole operational cycle are operational.
Block C: Loss maps and asynchronous dump tests: These will presumably be finished on Wednesday, 07.09.2011.
Block D: intensity ramp up in steps: fills are foreseen with 264, 480, 912, 1380 bunches. 1380bunch operation will presumably be reached on Friday, 09.09.2011. The expected luminosity increase for CMS and ATLAS with 1m beta* is 50% ($\approx 3 \cdot 10^{33} cm^{-2} s^{-1}$). ***Amendment: a peak luminosity of $2.99 \cdot 10^{33} cm^{-2} s^{-1}$ (new world record) was reached by the end of week 36.***

From tests with an aperture bump for different TCT positions, the triplet aperture was determined to be between 14.8 and 15.3 sigma. This is sufficient for 1m beta* operation and 120µrad crossing angle with the required 2 sigma margin.

Discussion:
J. Wenninger states that there are problems with increased losses at the injection, which may require additional studies.

B. Holzer asked if the roman pots will be moved in for the complete set of loss maps at collision. J. Wenninger answered that this is the case. Also for trigger integration between ALFA and ATLAS, which requires low luminosity, ALFA will be about 7mm from the beam for a few hours during the commissioning phase.

B. Holzer asked if 1 sigma refers to the design transverse beam size or to the measured beam size. For collimation purposes, the beam size refers to a

normalized emittance of 3.5μm throughout the whole cycle (S. Radealli). The beam-beam separation refers to the values closer to the actual beam size and assume a normalized emittance of 2.5 μm.
J. Wenninger reported that the rMPP does not see any objections to continue with 1m beta* operation. Only the long range beam-beam test is outstanding.

L. Evans asked about the presently used single bunch intensity. J. Wenninger answers that at 1m beta* it is about 1.25e11 protons/bunch. The chromaticity is about 1-2 units, for beta-beating the corrections from 1.5m were scaled and used, further corrections were not needed.

R. Calaga confirmed that instabilities due to long range beam-beam might drastically increase for separations below 7 sigma.

2. Status of the Longitudinal Density Monitor (Enrico Bravin)

E. Bravin explained the principles of the Longitudinal Density Monitor (LDM). Of crucial importance are corrections of the detector deadtime (about 75ns) and afterpulse. E. Bravin showed the good quality of the applied correction algorithm. The measurements agree well with BQM for bunch length and a bit less well with FBCT for intensity. E. Bravin stressed that the LDM cannot measure absolute intensities directly, a cross calibration with the DCBCT is required. Only about 7% of the synchrotron light intensity is used for the LDM, the rest is used by the BSRT. Because the active part of the detector (50μm x 50μm) is small compared to the beam spot size, the LDM is sensitive to beam size and beam position variations. Mitigations (e.g. modifications of the optics) are foreseen.
The current expert software is capable of displaying and logging (sdds) the data. An automatic control of the position of the detector is not implemented, yet. For operational use, E. Bravin advises a manual set-up by experts. A FESA class and an application for operational use are in preparation. E. Bravin suggests to organize a software introduction for interested users.

Discussion:

L. Evans asked why the emitted synchrotron light per proton has a local minimum at about 1TeV (cf. Slide 5). E. Bravin answered that this is because the source changes from the superconducting undulator to the D3 dipole during the energy ramp.

E. Metral asked how good the tails of the longitudinal density can be measured. E. Bravin replied that the system has a large dynamic range and can easily resolve signals which are 3 orders of magnitude below the peak signal, although the correction algorithm and other effects should be investigated in details before trusting the data.

M. Ferro-Luzzi asked if there is a problem with the dark count of background. E. Bravin answered that the background without beam can be precisely measured

and subtracted. The main background is expected to be due to the long decay time of afterpulses.

J. Wenninger states that there is an interest to use the LDM as diagnostics tool in course of the foreseen satellite-main collisions in ALICE. M. Ferro-Luzzi asked about the inter-fill reproducibility of the measurement. E. Bravin underlines that the sensitivity to beam position and beam size variations are a significant limitation for the inter-fill reproducibility.

M. Ferro-Luzzi asked about the duration of a measurement. E. Bravin answered that a typical measurement takes 5-10min and provides a resolution $\sim 10^{-4}$ of the peak signal.

P. Charrue asked for the expected amount of stored data. E. Bravin answered that the application will store 1.7million values every 5minutes. P. Charrue suggests a beam mode dependent logging. The data will be published by a proxy to avoid acquisition problems when several instances request data. R. Steinhagen points out that the BBQ system reached the limitations of proxy and CMW already.

Lyn Evans asked if a photo diode could be used as detector. E. Bravin states that the LDM relies on a single photon detection. A photo diode is not capable of this. For the LDM a photo multiplier tube is used.

3. AOB

J. Wenninger asked if the two RF loops can be decoupled for tests/MDs. It is replied that the RF systems for both rings are independent by design and a decoupling is possible. Once decoupled, the systems can only be coupled again without circulating beam.

4. Upcoming meetings:

Tuesday, 13th September: LSWG meeting (15:30 in 874-1-011).
Tuesday, 20th September: **next LBOC meeting (15:30 in 874-1-011)**.

Reported by Tobias Baer