# LHC Beam Operation Committee

## Notes from the meeting held on 6th November 2012

## Participants

### 1. Follow Up: Fill-to-fill Luminosity Comparison (Michi Hostettler)

M. Hostettler presented a follow up from his presentation at the previous LBOC meeting. He gave an overview of peak luminosities and luminosity lifetimes for physics fills in 2012. **In general, the current peak luminosities are slightly higher w.r.t. the fills before TS#2, but the luminosity lifetime is significantly worse.**

M. Hostettler explained the TEVATRON luminosity-evolution approximation function with three free parameters, which is used in the analysis for determination and extrapolation of the luminosity evolution.

He showed that for some recent fills, **the integrated luminosity in the first three hours of stable beams is higher compared to the fills before TS#2. For fills which are longer than about 10h, this is no longer the case and the integrated luminosity is lower compared to the fills before TS#2** (due to the worse luminosity lifetime). Corresponding plots with stable beam durations of 3h, 6h, 10h, and 15h are shown.

E. Shaposhnikova asked for which part of the analysis the luminosity model is needed. M. Hostettler replied that the luminosity model is used to extrapolate the integrated luminosity from shorter fills to increase the statistics. Only fills with a stable beams duration above 5h are considered, for which the fit quality is generally very good.

L. Evans asked if the luminosity lifetime can be explained by the intensity lifetime. G. Papotti answered that this is not the case. **The intensity lifetime is typically about 30h.** L. Evans asked if there were changes to the bunch length since TS#2. T. Mastoridis replied that the bunch length during stable beams was slightly increased by about 5%. **L. Evans concluded that the lower luminosity lifetime must be due to transverse emittance blow up.** G. Papotti added that the **horizontal emittance growth rate (3.5TeV) due to IBS is 38h.** E. Shaposhnikova elaborated on the longitudinal batch-by-batch blow-up, which was expected to be needed for operation with reduced longitudinal emittances due to Q20 optics. She pointed out that (against expectation) no significant effect of the batch-by-batch blow-up on luminosity was found. L. Evans encouraged studying the emittance growths at 4TeV with non-colliding beams. He added that an increased bunch length would decrease the transverse blow-up. E. Shaposhnikova replied that a further increase of the longitudinal blow-up would cause beam losses.

**E. Shaposhnikova motivated to analyze the beam lifetime in the same way as it was done for the luminosity lifetime.**

L. Evans asked if the transverse damper (ADT) is used during stable beams. W. Hofle replied that the ADT is active during stable beams and needed for beam stabilization due to the leveling by transverse separation in IP8.

## 2. LHC Instabilities: Needs for Tests with Octupole Older Polarity (Tatiana Pieloni)

T. Pieloni summarized that different transverse beam instabilities were observed throughout 2012. In recent fills, **a very reproducible instability occurs at the end of the squeeze, which affects the last bunches of the trains.**

T. Pieloni presented (single beam) stability diagrams, which show the required octupoles current to stabilize the beam as function of the chromaticity. Before the change of the octupoles polarity, low chromaticities were used. With these settings, the stability region is very sensitive to variations of octupoles current and chromaticity, which can explain the fill to fill variations.

With the currently used octupole polarity and high chromaticities (≈15 units) the stability region is relatively insensitive to variations, which is consistent with the good reproducibility of the instability observations. On the other hand, about two times higher octupole currents are needed to stabilize the beam (w.r.t. the initial octupoles polarity).

T. Pieloni showed an overview of octupoles current and chromaticity for all observed single beam instabilities at 4TeV. She explained that **in order to stabilize the single beam instabilities, the initial octupoles polarity (current: 100A-200A) and high chromaticity (≈15 units) is the favored operational scenario. These settings would be within the octupole circuit limitations for 7TeV operation.**

T. Pieloni elaborated on the influence of the long-range beam-beam effect (LRBB) for the beam stability and pointed out that the instabilities before/during/after the squeeze cannot be explained by the change of tune spread due to the LRBB.

**She suggested to use the favored octupole settings (with initial octupole polarity) in nominal operation** and to determine the minimal octupoles current needed. About 2 shifts would be required for machine protection validation.

***Amendment: In LMC 156, it was decided NOT to do this before LS1.***

***Discussion:***

E. Shaposhnikova asked if the current instabilities at the end of the squeeze cause beam losses. T. Pieloni confirmed that the instabilities lead to small beam losses. G. Papotti added that an emittance blow up is observed as well.

M. Lamont pointed out that the proposed test would not improve the 2012 luminosity production significantly. G. Papotti reminded that the MD schedule is already fixed and that other MDs would need to be dropped to allow for a scheduling of the proposed test.

## 3. Merging Flat-beam MD and Long-Range tests with 25ns Beams (Tatiana Pieloni)

T. Pieloni explained that **for 25ns high intensity collisions the current beam-beam separation is not expected to be sufficient.** Thus, for the corresponding 2012 MDs and physics fills, **operation with β*=1m is foreseen.**

T. Pieloni elaborated on flat-beam collision schemes. She pointed out that this would be an interesting optics option for after LS1, which would **simplify β*-luminosity-leveling** (leveling in separation plane only). She presented plans for a **flat-beam MD** and pointed out that this option would be also an **alternative for operation with 25ns high intensity collisions.** An optics with β*=1.2m in the crossing plane and β*=0.6m in the separation plane is available. Operation with flat-beam optics in 2012 would require about **2 additional shifts** for optics validation (compared to β*=1m option).

***Amendment: In LMC 156, it was decided NOT to schedule the flat-beam MD in 2012 and to use round beam optics for 25ns operation in 2012.***

*Discussion:*

L. Evans pointed out that the chromaticity correction with flat beams will be different.

R. de Maria asked which crossing angle would be used. T. Pieloni replied that this is now exactly calculated yet. J. Wenninger added that the aim is to use the same crossing angle as for 50ns operation (145mrad).

## Upcoming meetings:

**Tuesday, 20th November 2012 15:30 in 871-1-011: LBOC**

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Reported by Tobias Baer