DISCUSSION SUMMARY OF SESSION 5: BEAM LOSSES

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Abstract

This paper summarizes the discussions that followed the presentations of the "Beam Losses" session of the the LHC Beam Operation Workshop, EVIAN2010.

INTRODUCTION

The fifth session of LHC Beam Commissioning Workshop was dedicated to the analysis of beam losses and included four talks:

1) **Multi-turn losses and cleaning**, by Daniel Wollmann (BE-ABP);

2) **Injection and extraction losses**, by Wolfgang Bartmann (TE-ABT);

3) **Losses away from collimators: statistics and extrapolation**, by Barbara Eva Holzer (BE-BI);

4) **BLM thresholds: limiting locations**, by Annika Nordt (BE-BI).

For each presentation of the session, summaries of the discussion that followed the presentations are given.

MULTI-TURN LOSSES AND CLEANING (D. WOLLMANN)

B. Goddard asked if the beam loss maps used for inefficiency calculations weight in the same way the BLM readings at the collimators and at the magnets. *D. Wollmann* reply that for the final intensity reach estimate, appropriate BLM factors are taken into account for the different element types.

F. Zimmermann asked if the ratio of loss peaks in IP7 and IP3 are correctly predicted by simulations in the case of betatron losses. *R. Assmann* replied that they agree within a factor ≈ 2.

O. Brüning asked if the hierarchy violation in IP3 was caused by a positioning error of the collimators. *D. Wollmann* replied that this is not the case: the collimators were correctly sent back to the same positions within the mechanical accuracy. He also pointed out that the machine was never at risk because the provided efficiency with hierarchy violated was still acceptable. *R. Assmann* commented that the radiation resistance of the warm magnets in IP3 could have been compromised in case of larger stored energies because only the magnets downstream of the primary collimators are protected with passive absorbers.

S. Fartoukh asked if the hierarchy violation was caused by an error at the primary or at the secondary collimator. *D. Wollmann* replied that this is not clear because the source of the problem was not identified.

As the estimated intensity reach from the collimation system is well above the goal for 2011, *M. Ferro-Luzzi* asked if there are other immediate limitations on the luminosity reach. *R. Assmann* stated that the 2011 goals should not be compromised. We have collimators dedicated to the absorption of the physics debris that have not yet been used but are fully operational and will be used if the debris from the IP will become an issue.

Having seem the excellent performance of the system, *O. Brüning* asked if we really need an upgrade of the system. *R. Assmann* replied that at 7 TeV the margins will be reviewed and also reminded that the losses for ion beams are worst.

B. Goddard suggested to review offline the issue of non reproducibility of vertical losses in IP6 because there we only have horizontal collimators. Why should we have vertical losses? *S. Redaelli* stated that for vertical losses at the primary collimators of IP7 there is also a leakage for the horizontal plane that induced losses in the collimators of IP6 as well.

R. Schmidt suggested to fold the latest updates on the quench estimates for different integration times onto the cleaning results presented by D. Wollmann. *B. Dehning* reminded that the new calculations will only affect the long running sums whereas the short one should be correct.

J. Uythoven asked if one should expect a different behaviour for smaller β^* values. *D. Wollmann* replied that the betatron cleaning from IP7 should remain unaffected so the conclusions should not change (provided that the triplet magnets are locally protected in an appropriate way by the tertiary collimators).

INJECTION AND EXTRACTION LOSSES (W. BARTMANN)

R. Assmann asked why the injection loss projections as a function of the number of bunches is not linear. *W. Bartmann* replied that the measurement with more than 24 bunches were taken without re-optimization of the injection collimator settings. *M. Sapinski* warned that the BLM thresholds were not the same for the various data taking and strongly recommended to make sure that this is properly taken into account.

P. Collier asked if it is clear why uncaptured beam at the SPS is seen in the LHC. This could only be explained

by a mis-match between SPS extraction kicker and LHC injection kicker. To be checked.

B. Dehning asked if the factor 3 improvement of TDI losses from the shielding will be enough. *W. Bartmann* replied that this will not be the case. *B. Goddard* warned that the simulations that predicted this value are preliminary and the final figures should be considered. *B. Dehning* stated that a beam-based validation of the improvement factor from shielding predicted by simulations should be addressed as soon as possible. Dedicated beam time should be foreseen for tests with beam.

G. Arduini commented that the scaling of losses versus bunch number must take into account the fact that so far we used smaller emittances than nominal. This will not be possible anymore with many more bunches per train.

G. Arduini also asked how we will make sure that the abort gap cleaner, proposed as a way to clean the space of the next injection train, will not act also on the already filled bunch slots. *W. Hofle* replied that he has established a procedure for that. This method will have to be stamped by the machine protection panel.

J. Wenninger pointed out that the "BLM sun glass" has not been discussed yet at the machine protection meeting and therefore it should be considered just as a proposal at this stage. *W. Bartmann* confirmed that this is the case.

R. Jones asked how much should one open the injection collimators in order to reduce the loss spikes. *W. Bartmann* replied that clearly opening collimators is an effective way to reduce losses: 0.5 σ reduces the losses by about a factor 3. *R. Assmann* commented that one could also increase significantly the thresholds of the TCTV collimators for the short integration times. *R. Schmidt* suggested to consider also the possibility to increase the thresholds of the superconducting magnets in the injection regions. We should not be too afraid of the quenches!

W. Hofle reminded that, as he stated in his presentation, the present mechanism to clean the injection slot has a problems that require follow-up if the area to clean is 8 μs.

LOSSES AWAY FROM COLLIMATORS: STATISTICS AND EXTRAPOLATION (B.E. HOLZER)

Bernhard Holzer asked if the degradation of the signal experienced with some of the ionization chambers was caused by radiation damage. B.E. Holzer replied that the problem was identified as a bad soldering and is therefore independent of the beam.

P. Collier pointed out that, as no UFO was observed at injection energy, one should think of a mechanism that only produces them at top energy. The theory of the dust might not be appropriate. Clearly, we do not have yet a satisfactory physics model. *O. Brüning* suggested that the dependence on the synchrotron radiation should be taken into account. *T. Camporesi* proposed to consider the possibility that single halo protons hit directly the aperture. Other ideas were proposed: looking in detail in the ramp data to see when UFOs appear (*R. Assmann*), study the correlation with primary collimator settings (*S. Fartoukh*).

BLM THRESHOLDS: LIMITING LOCATIONS (A. NORDT)

B. Goddard asked if the pressure rise seen in case of losses at the collimators is real of could come from noise in the electronics. *A. Nordt* replied that she does not have this information.

J. Jowett stated that it would be interesting to perform a similar analysis of beam losses and pressure levels also for the ions.

P. Collier asked if there is a rationale for the change of BLM thresholds. *R. Assmann* commented that the purpose of this talk was indeed to identify locations for which a safe change of thresholds makes sense. *A. Nordt* pointed out that all the changes applied in the machine are subjected to a strict EDMS approval procedure.

F. Zimmermann suggested to check if there is a correlation between critical loss locations and β^* values.

H. Burkhard stated that the interaction of proton beams with the rest gas is well known and the losses could be compared with simulations.