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LHC MD Test Program

END OF FILL : TCT CLOSURE TEST FOR BACKGROUND AND B*-REACH

Abstract

This note summarises the detailed program proposed for an end-of-fill study to see whether closing the TCTs has a direct influence on background. The results are useful both in order to quantify inner limits on the TCT settings due to background, which in turn could allow a better reach in β*, but also in order for the experiments to distinguish between different sources of background and to estimate their importance.

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Distribution list :

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History of Changes

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0.1	10-Oct-2016	All	First draft

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1. INTRODUCTION AND MOTIVATION

One of the limitations on the beta*-reach in the LHC is the collimation hierarchy. With a fractional phase advance from the MKDs to the TCTs close to 0 or 180 degrees, the risk of damage during asynchronous dumps is no longer limiting the TCT setting, which instead is constrained by cleaning and background. This test aims at quantifying the increase in background in ATLAS and CMS if the TCT is moved in by 0.6 sigma. If no effect is seen, or only a negligible effect, we can conclude that a configuration with tighter TCTs and a better beta*-reach might be in reach, or at least not excluded due to increased experimental backgrounds.

Furthermore, such a test helps the experiments to quantify the impact of different background sources. If no significant difference in BCM rate and fake jets, it would indicate that the background sources depenent on the TCT setting (i.e. the beam-halo leakage from IR7 and large-angle beam-gas elastic scattering sending protons directly onto TCTs without passing IR7), would be small compared to the inelastic beam-gas scattering in front of the experiments. This in turn helps to better understand possible limitations from background and any mitigation measured that could be done if necessary.

The proposed end-of-fill test consists in large of taking over the end of a standard physics fill, and then go in adjust and move in the vertical TCTs in IR1 and IR5 from their standard setting of 9 sigma to 8.4 sigma, corresponding to the present dump limit of 400 um. Therefore, no machine protection settings or thresholds have to be changed. Finally we should go back in stable beams and continue data taking. The basic parameters are summarized in Table 1.

Time required [h]	1h
Beams required [1, 2, 1&2]	1&2
Beam energy [GeV]	6500
Optics (injection, squeezed, special)	Nominal optics squeezed to beta*=40 cm in IR1/5
Bunch intensity [#p, #ions]	nominal (1E11)
Number of bunches	2200 (take over standard physics fill)
Transv. emittance [m rad]	Not relevant
Bunch length [ns @ 4s]	Not relevant
Optics change [yes/no]	No
Orbit change [yes/no]	No
Collimation change [yes/no]	Yes –close vertical TCTs in IR1/5 by 0.6 sigma
RF system change [yes/no]	No
Feedback changes [yes/no]	No
What else will be changed?	Need to go in adjust for TCT movement, then ideally go back in stable beams
Are parallel studies possible?	No
Other info/requests	

Table 1: Machine parameters during the MD

2. DETAILED STEPS TO BE TAKEN BEFORE, DURING AND AFTER THE MD

2.1 PREAPRATION OF THE MD

A sequence has to be prepared, in which the vertical TCTs are moved in to their final setting.

Ideally, a validation fill with setup beam should be carried out, where the TCTs are driven to the final positions using the sequence, before loss maps are carried out and as asynchronous dump test. It should be noted that a preliminary validation has already been done on 8/10/2016, where the TCTs were driven to a slightly tighter setting than proposed for the measurement (8.3 sigma instead of 8.4 sigma), and in this condition loss maps were done. These loss maps did not reveal any concerns.

2.2 STEPS TO BE TAKEN DURING THE MD

The following steps will be executed by the operational crew and the collimation team.

1. Take over an existing standard physics fill 2200 bunches about 1.5 h before a planned dump and go in adjust
2. Move in vertical TCTs in IR1 and IR5 using the specially prepared sequence
3. Go back to stable beams: this is needed in order to allow ATLAS to keep the inner detector on. Without it, it is very hard or impossible to distinguish between fake jets from background and collisional jets, since even the unpaired bunches are contaminated by collisional jets which are likely to dominate. Furthermore, if we go back in stable beams, only a negligible amount of physics data will be lost.
4. Wait while experiments accumulate data in the new configuration. Ideally the time allocated in stable beams should be at least 1h before the fill is dumped.

Total time needed: 9h

2.3 RECOVERY AFTER THE MD

No special recovery needed.

3. CHANGES OF MACHINE PROTECTION SETTINGS DURING MD

The TCT movements will take place within the operational limits, so no machine protection settings have to be changed. During the tests, it is thus expected that the TCTs will show position warnings.

4. CONCLUSIONS

The presented MD aims to assess

5. REFERENCES

[1] R. Bruce, et al. “Collimator settings and performance in 2011 and 2012”. Proceedings of the Chamonix 2012 LHC Performance Workshop (2012)

[2] R. Bruce, Update on possibilities to reach beta* = 40 cm, talk in the LHC collimation working group 2015.01.19, https://indico.cern.ch/event/365220/