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LHC Beam Test Program – MD Class C & D

CROSSING ANGLE SCAN IN ATLAS AND CMS

Abstract

This document summarises the parameters for a crossing angle scan in ATLAS and CMS to understand luminosity calibrations.

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History of Changes

Rev. No.	***Date***	***Pages***	***Description of Changes***
0.1	03-08-2016	All	First draft

***Table of Contents** (not compulsory, can be removed)*

***Table of Figures** (not compulsory, can be removed)*

No table of figures entries found.

INTRODUCTION

The aim of this test is to study the luminosity calibrations in ATLAS and CMS by varying the half crossing angles between 140 urad and 0 urad.

IMPLEMENTATION OF CROSSING ANGLE LEVELING

The details of the implementation of the crossing angle changes follow the procedure of MD1669 [1]. Technical details on the execution can be found in that document.

MACHINE AND BEAM CONDITIONS

The test will be executed with 4 bunches per beam colliding in IR1 and IR5 only. The total intensity will be < 3E11 to be able to use the **SETUP SBF** as some interlocks (orbit, PC currents, TCT collimators) must be inactive (SIS part) or masked (collimators). The emittance will be standard (as it comes from the injectors) or slightly blown up.

The test will use the standard operational hypercycle.

The test will begin in Stable Beams with the standard crossing angle. Luminosity and vdm scans will be performed. The machine will then move to Adjust to perform the crossing angle changes.

Beams required [1, 2, 1&2]	1&2
Beam energy	6.5 TeV
Bunch intensity [#p, #ions]	~0.7E11 ppb
Number of bunches	4 colliding in IR1 and IR5
Transv. emittance [m rad]	Standard
Bunch length [ns @ 4s]	Standard
Optics change [yes/no]	No
Orbit change [yes/no]	Yes
Interlocks [yes/no]	Yes
Collimation change [yes/no]	Inner TCT positions changed in IR1 and IR5
RF system change [yes/no]	No
Feedback changes [yes/no]	Yes (orbit FB configuration and reference)

DETAILED STEPS TO BE TAKEN DURING THE TEST

Once the machine mode is switched to Adjust, the first step is the switch the SBF to SETUP mode and to mask the BLM interlocks in IR1 and IR5. The SIS orbit and PC current interlocks will be masked out automatically by the mode change and the fact that the SBF will switch to TRUE.

The inner jaw of the horizontal (IR5) and vertical (IR1) TCTs will be moved to a position compatible with no crossing angle. To this end the inner jaw will be symmetrised with respect to the outer jaw. The position interlock will be adapted to the new position. It must however be noted that the energy limit interlock will be active. The settings are prepared in BP **PHYSICS-6.5TeV-40cm-110s-2016_V1@110_[END]_TCT_AntiLeveling_ZeroCrossing**.
The inner jaw positions are (outer jaws have identical absolute position values but with opposite sign):

- TCTPV.4L1.B1: -8.047 mm
- TCTPV.4R1.B2: -7.092 mm
- TCTPH.4L5.B1: -11.300 mm
- TCTPH.4R5.B1:-12.260 mm

The crossing angle will then be reduced in 3 steps to 100, 50 and 0 urad. The number of steps may possibly be increased if needed. At each step luminosity and vdm scans will be performed. It is expected that no more than 30 minutes will be spent on each step.

The reduction will follow the procedure for MD1669 [1]. The beam process length will be 1 minute for each step. The orbit feedback gain factor will be set to 2 and the number of eigenvalues increased to 200 during execution of the steps [2]. This configuration was determined to provide good performance during the MD.

REFERENCES

1. J. Wenninger et al., MD 1669: LUMINOSITY ANTI-LEVELING WITH CROSSING ANGLE.

2. J. Wenninger et al., Luminosity Anti-leveling with Crossing Angle (MD 1669), CERN-ACC-NOTE-2016-0058.