

## (r)MPP meeting: Intensity Checklist, MD block #4

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Present: S.Redalli, W.Hofle, J.Boyd, J.Jowett, M.Valette, G.Trad, C.Bracco, A.Lechner, R.Bruce, J. Uythoven, D. Wollmann, M.Zerlauth, R.Schmidt, S.Fartoukh

Excused: J.Wenninger

<https://indico.cern.ch/event/576967/>

### MD Block#5 procedures

The procedures for the MD block #5 have been reviewed and the MP comments are collected in this [spreadsheet](#). The highlighted items were discussed. Main points:

- MD1434: Head on Beam-Beam. Class B, no concern.
- MD1814: Calibration of transverse profile monitors, continuation of MD4 and for which the PM relevant aspects were presented and approved at previous rMPP.
- MD1878: Operation tighter collimators, approved previous rMPP noteworthy additional element is the insertion of the crystal on B2 in IR7 (in non-channeling mode)
- MD1826: Quench heaters effect on orbit, [presented by M.Valette](#). 10 um orbit oscillations have been measured following a training quench during beam operation. Beam stayed in the machine for 3 ms after beginning of heater discharge. The aim of the MD is to confirm that the cause is really the quench heaters. Tests with one nominal bunch per beam at injection. Triggering of QPS will be done via the nQPS test mode like during HW commissioning, but with beam. MP3 approved the list of magnets and will be present during the MD for the analysis of the heater firings. Plan to fire at least 3 (two dipoles, one triplet), at maximum up to 5 (three dipoles, two triplets) if time allows for it. Rudiger mentioned that quench recovery will be quick, will be good to check with the cryo-operators as well, if they can anticipate. Daniel mentioned that there will be somebody from MP3 present at the MD, to confirm that ~~operation~~ powering can continue. Triggering of the heater firing has been validated with Jens, using the nQPS, which should only fire one magnet.
- MD1266: Injection 80 b, all at injection, Class B.
- MD1405: Dynamic aperture, in procedure it is mentioned to mask PIC, proposed not to do so as collimators already open to coarse settings.
- MD652: Coupled bunch stability, with 1.0 ns bunch length. Keep abort gap cleaning switched on at flat top.
- MD1787: Rise time versus damper etc., Class B.
- MD1257: ATS, [presented by Stephane](#). Continuation of previous MD in block 4, plan to go to beta\* of 33 cm and half crossing angle of 140 urad. Going from 40 to 33 cm will be done by using the telescopic squeeze. Intensity will stay for whole MD below 3e11 p+. No change to collimation in IR3 and IR7 relative to nominal optics. TCTs in IR1 and IR5 will have new functions, set to 9.7 sigma for the last two matched points of the pre-squeeze. TCT in 2 and 8 will have new positions for the center, using nominal nsigma versus beta\*. Details have been agreed upon with collimation. Two fills, first fill used for optics and IT aperture measurements at 33 cm, with 10 non-colliding probes. Finish with asynchronous dump, putting collimators back to settings to be used later on. Second fill for finding collisions, using two colliding nominals and some pilots for loss maps. This time octupoles and ADT are on. IP1 and IP5 phase scans. Betatron loss maps with given delta\_f. Finish with another asynch dump with TCTs at 7.0 sigma, instead of 9.0 sigma

in the first fill.

- MD979: Beta beat corrections on colliding bunches. AC dipole only to be used on beam with pilot bunches.
- MS1900: Chronograph. Open collimator threshold, will be protected by the energy limits and set position limits to parking. Will also be protected by secondary's which are not touched and fine with limited number of bunches. Stefano mentioned he wants to use the other beam to repeat a previous halo MDs (either MD1691 if EPC has time to improve the current control compared to the previous attempt or – which is more likely MD1388 as a standard test using the ADT). To be integrated in the MD planning by MD team.
- MD1879: Crystal collimation. Ramp function of the collimators changed to see channeling during the cycle. Possible use nominal bunches, but only at injection - so far this has never been necessary as signal from pilots has been sufficient.
- MD1850: Linear coupling dependence on intensity. ADT in special excitation mode, test with up to 12 bunch train. Wolfgang mentions that it will be good to also have the second derivative of the ADT excitation to be smooth – to be checked with Daniel.

Under the precondition that all the above comments and recommendations are taken into account, all MDs for MD#5 are approved by rMPP. The agreed EDMS approval procedure has been launched for the ATS MD 1257 (EDMS link) and the quench heater effect on orbit MD1826 (EDMS link).

### Special fills:

- [High pile-up fill](#) requested by ATLAS and CMS. See the presentation by Elias in LMC of last week for the pileup reach with different bunch intensity/beam configurations. ECP decision for 2 x 48b trains, BCMS with  $1.3e11$  p+ bunches plus 3 colliding and one non-colliding INDIV up to  $1.8e11$  p+. These trains remain to be tested in the SPS, ADT to be put in low gain mode (=high intensity). Intensity limitations of beam instrumentation (BCT, BPMS) has been checked and validated from MP perspective. Planned for Friday 14/10 or later (if SPS test not yet done), plan for 3 hours of Stable Beams.
- Closer TCT settings for experimental background, [presentation by Roderiek](#). Confirmation if closing TCTs will not cause background problems and help ATLAS and CMS understand their present background. EoF test 1.5 h before dump, go into Adjust. Move in vertical TCTs in IR1 and IR5 by 400 um, from 9 to 8.4 sigma, in 4 steps of 100 um and do it manually. Aim to go back to stable beams with 1 hour of data taking. No TCT threshold to be changed to go to 8.4 sigma, will violate warning limit. No loss maps or asynch dump to be made with this setting as we remain within the standard interlock window, but only move vertical TCTs. No MP objections.
- Reduction of crossing angles for ATLAS/CMS. Aim to better understand differences in luminosity as measured by the experiments. [Procedure provided by Jorg](#). Collapsing crossing angle down to 0 urad. Fill with 4 small nominals to stay below  $3e11$  p+. Move inner TCT compatible with 0 crossing. Settings are given in the presentation. Reduction of crossing angle in 3 steps, lumi and VdM scans at each step.  
Jamie mentioned possible EXP request to go to stable beams in the end, procedural not evident, but can provide added value for CMS due to additional detectors being switched ON. Stefano mentioned that this is not critical machine protection wise, as we will not move the outer TCT (ensuring the triplet protection) and will gain in aperture by collapsing the Xing angle. Procedure and if further qualifications are required will be confirmed off-line with Jorg after the meeting.
- [RF with full detuning scheme](#), following MD249 of MD4, at the end of (during) a standard physics fill. Vital for HL-LHC. Expect a 12.5 mm displacement of the vertex at IP2 and IP8. If no

losses, no beam de-bunching etc. observed, go back to stable beams in this mode. The necessary firmware is already resident in the RF controls and the full detuning mode can be engaged or stopped at any time and it is an adiabatic procedure. Jamie: still waiting for feedback from experiments, but seems like a useful test to be done. Will confirm in the coming days.

All 4 special fills have been approved from MP perspective and can be scheduled by the machine coordinators in agreement with the physics coordinators.

### **Ion intensity ramp-up strategy:**

- Three proton - ion configurations at two beam energies are foreseen for this year's ion run. Intensity with up to 702 proton bunches with  $2 \cdot 4e10$  charges, ions 588 b of  $1.5e8$  ions (possibly up to  $1.9e8$  ions), which corresponds to  $1.15 \cdot 2e10$  charges.
- Validation fills will be made for each configuration (energy, species), including loss maps and asynchronous dumps.
- It is proposed to have one intensity ramp-up step for each configuration of  $\sim 50$  nominal bunch equivalent, with would result in about 200 proton bunches and about the same number of ion bunches. Keep in Stable Beams for at least 2 hours. In a second part of each configuration the bunch intensity can be further increased. rMPP validation will need some flexibility in the validation during this mini intensity ramp-up. Checklist strategy to be discussed in the coming weeks.
- The presented proposal is endorsed and was welcomed by J.Jowett. To be noted that if firmware of BPMs or attenuators of BPMS are modified, the verifications required will need to be agreed upon with rMPP. Validation tests with setup beam conditions ( $< 3E11$ ) can be performed.

### **BLM threshold changes for the ion run:**

- [Presentation by Anton](#). Aim is to remove the bottlenecks due to leakage of ion fragments from IR7. One needs to adjust the dumping hierarchy for Pb losses in IR7. Plan to change monitor factor at selected IR7 secondary collimator BLMs such that they dump first. One set of threshold to be used for all three ion runs foreseen independent of species.
- Losses during previous ion run quench test and present BLM threshold shows which BLMs would trigger a dump, if no changes were made. A list of selected BLMs to be changed was presented. New dedicated BLM families will be created for this.
- FT corrections at 6.5 TeV to be made, based on the most constraining monitor. Corrections follow measured signal during quench test. The Monitor Factors are kept at 0.333 (i.e. at the assumed quench limit).
- The MF at 2 skew TCSGs will be reduced from 0.4 to 0.014 – 0.020, with the aim to dump first at the TCSG instead of at the DS magnets - margin to quench limit implemented in collimators. Following detailed studies, exploring several options. The thresholds will be compared with qualification loss maps during the ion commissioning. MFs could then still be adjusted if necessary.
- The presented strategy is endorsed by rMPP.

Reported by J.Uythoven and M. Zerlauth