Minutes of 95rd Collimation Upgrade Specification Meeting

Participants: C. Bahamonde (CB), A. Bertarelli (AB), R. Bruce (RB), F. Carra (FC), F. Cerutti (FCe), N. Fuster (NF), R. Garcia Alia (RG), H. Garcia Morales (HG) (scientific secretary), A. Gorzawski (AG), A. Lechner (AL), A. Mereghetti (AM), D. Mirarchi (DM), J. Molson (JM), M. Patecki (MP), S. Redaelli (SR) (chairman), J. Wagner (JW)

Remote: J. Molson (JM), N. Simos (NS), S. Rowan (SRow).

Indico event [here](#).

1 Actions

Actions from this meeting:

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2 Plan for halo excitation MDs and update on simulations (J.Wagner) [slides]

2.1 Summary of the presentation

- JW presents the plan for the active halo control tests the transverse damper (ADT) to carry out in the next MD block.

- First, JW motivates the needs for actively controlling the halo. For the HL-LHC, the amount of energy stored in the tails is about 33.6 MJ, therefore, accidental tail scraping due to some errors may induce magnet quench due to high losses.

- JW explains the tail depletion technique using the ADT to generate a narrowband excitation. Relying on the detuning with amplitude provided by octupoles, we are able to excite halo particles in such a way that they are redirected to the collimators.

- JW recaps the results of previous MDs to have as a reference for future tests. In this test, the bunch profile reconstruction profile after the excitation shown that there was some tail population reduction and the core remained only slightly affected when large excitation amplitudes were used.

- JW explains the results of the simulations of the ADT excitation using Six-Track. He simulated a flat halo from $3.38\sigma$ to $5.7\sigma$ for $10^5$ turns for different ADT amplitudes. The results, in general, show a higher loss rate than the observed during the MDs.
• JW introduces a new technique to be tested in the next MD. Instead of using a single frequency excitation, he proposes to apply a coloured noise in such a way that the whole tail is excited. He shows the details of the implementation.

• Finally, JW presents the list of actions to be done during the MD. The idea is to repeat cases done in the past and introduce the coloured noise as a new type of excitation.

2.2 Discussion

• SR wonders what is the advantage of using the 3 bunch scheme over the single bunch scheme. The 3 bunch scheme does not provide any information the single bunch scheme does not. JW replies that by means of the diamond detector we could disentangle the losses from each bunch during the scraping. AG is not sure if the diamond detector is sensitive enough at injection. RB points out that is always risky to change the methodology. SR suggests to follow the single bunch scheme and test the diamond detector response when three bunches are used.

3 Update on tail scrapings (A. Gorzawski)

3.1 Summary of the presentation

• AG presents the results of the scrapings carried out at flat top during 2017 campaigns. The idea is to measure the tail population and the halo diffusion speed. In 2017 the first scans with 2550 bunches in the machine and with HL-LHC-like bunches.

• AG explains that all the results were performed as an end-of-fill exercise where both beams and planes for different intensitites have been tested.

• AG gives the details of the scrapings. First, the primary collimator is aligned and then a single jaw is moved inwards or outwards with 5 μm steps. With the extracted data once can analyze the spectra and the diffusion speed.

• AG explains the spectral analysis using FFT where many frequencies due to different vibrations are observed. The diffusion analysis using the 100 Hz data allows to perform a fit to extract the diffusion rate. AG points out that there is a clear discrepancy with respecto to 2016 results. The diffusion speed seems to be between 1 and 2 orders of magnitude higher.

• AG presents the results on the halo reconstruction. In all cases the tails seem to be overpopulated by one order of magnitude.

3.2 Discussion

• DM asks if all the scrapings were performed at collision? AG replies that all of them are performed at collision.
• SR lists the main topics to be done: evaluate the tail populations and repeat scaling for the Elens review. MJ. Also, analysis 100 Hz give same diffusion consistent. Tail population hot topic.

• AM wonders if there is any difference between planes in diffusion. AG replies that there are some differences for different cases.

4 Update on the TCAP design (C. Bahamonde) [slides]

4.1 Summary of the presentation

• CB presents the results for the passive protection of the warm magnets of IR7 after LS2. The upgrade contemplates the removal of MQWA.E5 due to a long-term radiation damage and the installation of tungsten masks in all magnets from MQWA.D5 to MQWA.A5.

• CB explains that the new normalization, where $8.5 \cdot 10^{16}$ are assumed to be lost in IR7 for the whole HL-LHC nominal operation, points out that without additional shielding the most exposed magnets still remain below the material limits. Nevertheless, the the installation of a shielding could reduce the dose to the most exposed magnet around 33%. Due to simulation uncertainties, a safety factor of 3 must be taken into account for the HL-LHC.

4.2 Discussion

• SR points out the excellent result. The scope of the study is to find an equivalent shielding as the old layout with the 6th MQW module. So, he suggests that study an absorbers design with vertical gap ”filled”, in order to cover also the volume that is now unprotected.

• AM wonders about using other materials. CB replies that indeed other materials were considered but they were discarded.

5 Collimator irradiation damage studies at BNL (N. Simos) [slides]

5.1 Summary of the presentation

• NS presents the collimator radiation damage studies performed at BNL. He first presents and overview of the different irradiation and campaigns carried out.

• NS shows some details of the simulations on the proton irradiation and spallation neutron irradiation of the MoGR and CuCD. In addition, he also shows some details of the X-ray diffraction studies at NSLS.
• NS reports the results of the studies on MoGR. He points out this is a very good investment since the properties of the material are really good. He shows the details of all the studies performed on that material.

• NS then explains in detail the results for the other materials: CFC, molybdenum and glidcop.

• NS finally shows the proposal for next tests on Mo-coated MoGr at NSLS.

• NS ends the presentation acknowledging all the people involved in the different tests carried out during the last years.

5.2 Discussion

• SR commented that the amount of results presented is impressive and, after thanking a lot NS for all the work done, encouraged the members of the working group to go through the details and contact NS off line in case of specific questions.