Minutes of 136th Collimation Upgrade Specification Meeting

Participants: C. Accettura (AC), N. Biancacci (NB), R. Bruce (RB), R. Cai (RC), F. Carra (FCA), F. Cerutti (FCE), M. D’Andrea (MDA) (scientific secretary), A. Fomin (AF), R. Garcia Alia (RGA), P. D. Hermes (PDH), A. Lechner (AL), G. Lerner (GL), D. Mirarchi (DM), J. Molson (JM), J. Oliveira (JO), M. Patecki (MP), S. Redaelli (SR) (chairman), M. Sabaté-Gilarte (MSG), A. Waets (AW).

Indico link

Actions from this meeting

- Discuss the effect of the new TAXN aperture with the experiments, possibly at an LBS meeting, and send a request to the vacuum team for the pressure profile.
- Finalize settings and impact parameters of TCS used as absorbers.
- Check if a skew collimator can intercept the channeled beam coming from a vertical crystal (MDA).
- Run thermomechanical studies to conclude on the possibility to safely use coated collimators to absorb channeled beams and to assess what would happen in case of direct impact on the coating (FCA).
- Inform WP2 and the impedance team of the outcome of the studies on the TCL-6 material (SR).

1 Review of recent action items (S. Redaelli)

Summary of the presentation

SR recalled the open actions identified in 2020 ColUSM meetings:

- ColUSM #127: Actions related to the crystal goniometer mechanics (finalization of crystal, holder and support model for simulations) can be considered closed, while the action on GSI measurements (evaluate resistivity at low DPA) is to be followed up in a WP2 meeting.
- ColUSM #130: Most of the crystal-related actions (finalization of the 3D model, impedance simulations and modal analysis) can be considered closed. Thermomechanical simulations are still ongoing.
- ColUSM #131: The action for INFN-Fe related to crystals characterized at H8 in 2018 (making them available to EN/SMM to allow comparison between measurements performed at CERN and by INFN-Fe) was carried out and can be closed.
- ColUSM #132: Actions related to the TAXN (review of the baseline with results from energy deposition simulations) are still open, pending further discussion with the vacuum team and experiments. Actions related to crystal collimation simulations (further checks on the Geant4 routine and comparison with FLUKA) are being followed up and will be discussed in a future ColUSM.
- **ColUSM #133**: The action related to the acceptable pressure at the solenoid level for the HL-LHC HELs is to be followed up at the TCC, while the action related to the TCL-6 (update of functional specifications with new aperture and potential new materials) is discussed in this meeting. The action regarding the effect of the new TAXN diameter on the background at the experiments was discussed at the LBS.

**Discussion**

- CA commented that the open action on measurements at GSI referred to the possibility of testing CFC at low DPA, but ultimately it was decided not to include CFC in this year’s allocated beam time. However, it may be possible to predict the behavior at low DPA using DC and RF measurements already available. This will be discussed in a [WP2 meeting](#) allowing to close the action.

- FCe confirmed that the impact of the new TAXN aperture on the background observed at detectors was discussed at the LBS. The evaluation of the pressure profile to be provided by WP12 is still pending and also impacts other studies requested by the experiments. SR proposed to discuss the validation of the latest optics version offline and then come back to the vacuum team to resume the studies. RB added that the experiments should make the request to the vacuum team for the pressure profile. FCe mentioned that this action is also being followed up by the TCC.

**2 Update on power deposition on TCSPM collimator from channeled beams (A. Waets) [slides]**

**Summary of the presentation**

AW presented energy deposition studies on secondary collimator components (MoGr bulk, Mo coating, jaw, BPM) due to the impact of channeled ions coming from the horizontal crystal on TCSPM.B4L7. This is a follow up to similar studies presented in past ColUSMs and uses the same general parameters in a conservative approach. The effect of the collimator halfgap is evaluated. The total power deposited in the jaw and in the BPM button decrease when the halfgap increases, since more particles manage to escape the jaw. The peak power density in the bulk shows little difference when changing the halfgap, with a maximum of 1200 W/cm³ located in the tapering in all cases. The peak power density in the coating on the other hand increases with the halfgap, up to 170 W/cm³ for 3.4 mm. These results show that the use of TCSPM as crystal ion absorber is less limiting than the first MoGr secondary in HL-LHC in proton regular cleaning scenario for a beam lifetime of 0.2 hours.

**Discussion**

- FCa asked clarification on the material that will be used for this collimator in Run 3. SR replied that the setup for Run 3 will use 4 collimators in MoGr. For the horizontal plane, it is possible to keep the CFC collimators in front of them for a potential double-collimator setup if needed.

- AL noted that the distance of the beam impact point with respect to the beam axis is also a parameter to be considered. SR agreed and commented that proper position interlocks should be put in place in order to avoid direct impact on the coating. This should be evaluated once the final operational settings are defined.
• RB commented that the BLM signal might not be much different if the coating is being hit compared to the jaw. AL agreed that the protection should indeed be given by the position interlock. SR clarified that the BLM thresholds should be re-evaluated in general due to the different pattern produced by crystal collimation compared to the standard system, and then additional care should be put in order to protect the coating.

• RB clarified that, since impact distribution simulations are not yet available for ion beams, these studies were carried out re-using the same distribution and spot size of proton beams, assuming that ions are channeled in a similar way. AW confirmed that this is also why this is to be considered as a conservative approach.

• RB commented that the low impedance collimator prototype can be used as absorber by exposing the uncoated surface, for the vertical case in which the additional CFC collimator is not available.

• RB asked what was the reason for having the crystals in these specific slots. SR replied that the idea was to re-use already equipped slots. However, it is possible that a skew collimator is able to catch the channeled beam coming from the vertical crystal.

• FCa proposed to run thermomechanical simulations, since the collimator model is already available, to have the final word on the possibility to safely use coated collimators to absorb channeled beams. SR mentioned that anyway in 2018 they were successfully used with up to 600 bunches. RB suggested to also run specific studies with impact on the coating to assess what would happen in this accidental case.

3 Efficiency of TCL-6 for debris cleaning with different materials (M. Sabaté-Gilarte) [slides]

Summary of the presentation

MSG presented the results of studies aimed at checking the implications of changing the TCL-6 jaw material from Inermet (as defined in the baseline) to copper. The worst case scenario (horizontal crossing on the right side of IR1) was considered. Simulations show that the peak dose in the front face of the Q6-assembly is increased by 70%, which reduces the lifetime of the MCBC by 40%. This means that the MCBC would need to be replaced during LS5, while with Inermet jaws the intervention is not required until LS6 (assuming an operational limit of 4 MGy). As for local heat loads, the power load in the TCL-6 is decreased by 5 W when using copper jaws; this quantity is redistributed in the TCLM6, in the Q6-assembly and in the surrounding walls and material. No impact is observed along the Q7-assembly. With regards to R2E, an increase of up to 70% is observed for the total ionizing dose. This has an important impact in the lifetime of some equipment, such as power converter racks. For this reason, further follow up should be planned with the involvement of the equipment group. Finally, losses in the DS are not affected by the change of material.

Discussion

• SR commented that this study seems to discourage changing the jaw material to copper, even though this means keeping the foreseen very small gaps. MSG agreed and FCe further highlighted the complications that arise from the R2E point of view when changing from Inermet to copper.