Minutes of 71st Collimation Upgrade Specification Meeting

Participants: C. Adorisio (CA), A. Bertarelli (AB), C. Bahamonde Castro (CB), R. Bruce (RB) (chairman), F. Cerutti (FC), M. Fiascaris (MF) (scientific secretary), H. Garcia Morales (HG), A. Mereghetti (AM), D. Mirarchi (DM), M. Moretti (MM), E. Quaranta (EQ), D. Ramos (DR), A. Valloni (AV), A. Vande Craen (AVC).

Remote: J. Molson (JM), S. Tygier (ST).

Indico event [here](#).

1 Actions

Actions from this meeting:

- Perform energy deposition studies with a geometry that includes no shielding in the connection cryostat, but thicker beam pipe (FLUKA team). Based on the outcome discuss possible solutions if shielding is necessary.

- Specify alignment tolerances for beam line in connection cryostat (D. Ramos and A. Vande Craen to contact Massimo Giovannozzi and Riccardo De Maria).

- On composite material implementations in Merlin: more checks to understand differences between different methods for SD events at large angles and for MCS in the energy loss distribution (AV).

2 Status of design of IR2 cryo-bypass and input requests from beam losses/energy deposition (A. Vande Craen)

2.1 Summary of the presentation

As discussed at CoUSM70 [link](#), the new HL-LHC baseline now foresees in IR2 the installation of TCLDs in the connection cryostat, without 11T dipoles. AVC described the status of the connection cryostat design. He explained that the principles of existing connection cryostats are being re-used and described in some details the different components: cold mass, cryogenic circuit and beam lines. Finally, he posed some questions regarding the shielding. The shielding specification from the LHC Project Note 296 indicated two possible solutions: 15 mm of Pb or 50 mm of stainless steal. However shielding also poses some problems and adds complexity to the design. AVC therefore asked clarifications for the shielding specifications. It should be assessed if shielding is still needed, and if so what material and thickness. This is a urgent item given that the shielding is an important specification that affects the design.

2.2 Discussion

The need for shielding was discussed. FC explained that in the connection cryostat additional shielding is needed to contain radiation, while in normal magnets this role is played by the magnet yoke.
FC and CB expressed some concern about the radiation in the busbars in the shuffling mode and asked if this can be prevented with a different kind of design, for example moving them further away from the collimator. DR explained that two shuffling modes are needed (one before and one after the collimator) and unfortunately these cannot be moved.

AVC pointed out that the alignment tolerances required for the beam line should be specified. These should be the same as in the standard dipole. It was suggested to contact Massimo Giovannozzi and Riccardo de Maria.

3 Recap of previous IR2 energy deposition studies for a DS collimator in the connection cryostat (C. Bahamonde Castro) [slides]

3.1 Summary of the presentation
CB gave a brief presentation summarising the results on energy deposition studies in IR2 that were shown at last CoUSM (link). She showed the expected peak power density in IR2 with the new baseline (orbit bump plus collimator in empty cryostat) and the resulting heat load to the cold mass. In addition to what previously shown, she also described the FLUKA geometry used for the simulations and pointed out that radiation dose to the electronics in the DS area should be below 20 Gy per year. Estimates of the radiation dose in the DS area are however not yet available.

3.2 Discussion
From CB studies it was concluded that in terms of energy deposition on downstream magnets there is no concerns. However the limit radiation does of about 20 Gy (or at least some tens of Gy) per year has to be met. Several solutions were discussed: no shielding but thicker beam pipe or shielding around the cryostat (although in this case the shielding could only be on the cylindrical part but not on the interconnect). It was agreed that the design team will pass on to the FLUKA team the geometry available now (with no shielding but thicker beam pipe) for energy deposition studies. If it is found that this solution is not sufficient, a further discussion on possible solutions for shielding will follow.

4 Comparison between different composite material implementations in Merlin (A. Valloni) [slides]

4.1 Summary of the presentation
AV explained that a new composite material class has been defined in Merlin and this can be handled in two different ways. In the first method, used for direct comparison with SixTrack, composite materials are treated as single chemical elements with effective nuclear and atomic parameters used as input for scattering, while the second method performs a rigorous treatment of point-like interactions with single compound components. The latter is closer to what happens in reality. Both method were implemented to benchmark the results in SixTrack that only has the first, more approximated, implementation. AV showed how composite materials are modelled in Merlin and then showed results of simulations.
performed with the two different Merlin methods and SixTrack. AV compared polar angle and energy loss distributions for different type of interactions. Significant differences were observed between Merlin and SixTrack in the multiple coulomb scattering (MCS) energy loss distribution.

In the last part of the talk, AV reported the results of cleaning simulations with new collimator materials (MoGr or CuCD) performed with Merlin. Novel materials were used for either all TCSGs or all TCPs in IR7. Losses on individual collimators were compared to the CFC case. The resulting cleaning inefficiency in the DS was also shown and found to decrease by up to a factor of 3 when TCPs were replaces with new materials, while the no significant effect was observed when replacing TCSGs. Results were consistent with those obtained with SixTrack by EQ. This is an important result that shows that the errors made by SixTrack are moderate and within the error of this type of simulations.

4.2 Discussion

RB pointed out that the second Merlin method, with a rigorous treatment of composite materials, is also used in FLUKA and Geant4.

There was some discussion about the observed differences in the energy loss distributions for MCS. It was agreed that more checks should be done on SixTrack to understand what is happening. FC also pointed out that some differences are visible between the two Merlin methods for single diffractive events at large polar angles and suggested to check if this has any impact on the losses.

On the simulations with new materials for the TCPs, FC commented that it is important to check what is the load on the these collimators and what is the effect of the showers on the TCSGs.