Minutes of 29th Collimation Upgrade Specification Meeting Joint WP2/WP5 meeting

Participants: C. Adorisio (CA), R. Alemany (RAl), G. Arduini (GA), A. Bertarelli (AB), H. Burkhardt (HB), R. Bruce (RB), F. Cerutti (FC), R. de Maria (RdM), L. Esposito (LE), P. Fessia (PF), M. Giovannozzi (MG), L. Lari (LL), A. Lechner (AL), N. Mariani (NMa), S. Montesano (SM), T. Pieloni (TP), S. Redaelli (SR) (chairman), G. Steel (GS), E. Todesco (ET), S. Weiss (SW).

Remote: A. Wolski (AW), T. Markiewicz (TM), N. Mokhov (NM).

Indico event here.

1 Update on TAN design and matching section losses (L. Esposito)

Slides are available here (pdf).

1.1 Short summary of presented results

LE presented an update on the energy deposition studies in the TAN region and in the matching sections of IR1/5. The IR5 case is considered for the simulations as this is worst than IR1. LE recalled the basic layout assumptions and the element design as provided by the concerned WP's (WP2, WP4 and WP5). Different design options were considered for the TAN (different apertures and positions) to assess the effect of different layout parameters. Different optics configurations, including round and flat beam options, were also considered. The latest baseline for the Q5, which is based on the MQY magnet type, was implemented. The possibility to add W shimming inside the magnet aperture, similarly to what is done for the triplet, was also studied.

The conclusion of LE's study is that the present HL-LHC layout is very challenging in terms of energy deposition effects. At present, there is not yet a satisfactory solution that ensures doses to MS magnets below quench limits and/or radiation damage with sufficient safety margins, in particular for the Q6 that is not affected by possible improvements in the region between TAN and Q5.

1.2 Discussion

LE showed which criterion was adopted to choose the TAN aperture/separation, which are set to have about $1\,\sigma$ more than the ones of the Inner Triplet. In this procedure only betatronic amplitude, crossing angle and trajectory separation are considered (for the round, flat, and flatHV optics settings). A further check by RAl using n_1 method showed that the TAN aperture is not that different.

MG commented that these calculations must be reviewed because they did not follow the n_1 parameter definition that the proposed by the LCU aperture team. MG suggested that RdM should be contacted for updated figures.

LE pointed out a potential integration issue with the TCL-4. SR commented that he is aware that a detailed integration study is required in this region. For the moment, we should focus on finding a solution that works in principle and then we will address in detail the design issues.

SR asked what is the benefit of a movable collimator and proposed to consider also the option of a fixed mask of appropriate length in front of the critical magnets. In the discussion that followed, it turned out that the neutron product of collisions actually by-pass the TCL4 W jaw and pass behind the cooling jaw. SR suggested to correct this by opening further the TCL4. GA proposed to consider a bulk W jaw instead that the real design, in order to address the principal effectiveness of this collimator.

MG pointed out that one could also consider the option to enlarge the beam-beam separation with additional 'D' magnets. This is not considered as a baseline for the moment: we should first focus on finding a solution with the standard layout [**action: GA**].

ET commented on the shimming in the D2 magnet: how comes that we have space for shimming in this element for which the aperture is very critical? RdM commented that the beam screen aperture was set conservatively to allow some space for potential shielding and for providing adequate tolerance in the beam screen installation. ET replied that we should review this aperture because every mm is important for this critical hardware and we should not keep hidden margins!

AB pointed out that the collimators are not made of pure W but of Inermet, which is an alloy with smaller density. FC commented that he was not aware of this aspect, which can have an impact on the simulation results. The W jaws considered in the model (TCL4) are actually constituted by inerm180; TCL5-6-7 have standard copper jaws.

1.3 Actions triggered

- Updated TCL-4 settings to catch the IP product that now by-pass the W insert. Alternatively, consider bulk W jaw to address the principle effectiveness of TCL-4 in front of the D2.
- Add fixed masks in front of the critical elements, in particular between the TCL-4 and the D2.
- Provide the transverse distributions of IP product at the critical elements, in particular at the D2.
- Contact Riccardo de Maria to verify the correct aperture. GA repeated that RdM is the contact person for any aperture estimations in WP2.

2 IR1/5 layout baseline for HiLumi-WP5 studies (R. Bruce)

Slides are available here (pdf).

RB presented the IR1/5 baseline layout to be used for the HiLumi-WP5 studies. It is necessary to freeze a layout, though clearly not final (see previous section), in order to

perform various studies that will be presented at the annual Meeting at Daresbury. In particular, a WP5 deliverable on background studies is due by the end of October.

The main features of the presented IR layouts are (1) new TCT in front of Q5 for the incoming beam, (2) TCL-4, 5 and 6 (not relevant for background from incoming beam halo) and (3) old TCTs in front of the triplet. As a pessimistic study for the halo-induced background, the standard TCT's will be closed to protect the triplet (halo source closer to the IP).

For these layouts, thin optics for tracking studies are available and include the new collimators. Updated aperture files for beam loss maps are also provided. The FLUKA geometry presented by LE will be used (AL).

3 Sixtrack studies for TCLD collimators in IR7 (R. Bruce)

Slides are available here (pdf).

3.1 Short summary of the presentation

RB presented the results of SixTrack studies of cleaning efficiency in IR7 with different layouts for local dispersion suppressor (DS) collimation. These studies are aimed at providing the inputs for energy deposition studies and at verifying if the lengths of the TCLD collimators might be reduced below 1 m in order to ease the integration, without compromising the cleaning performance. The standard LHC optics is used. ATS studies with TCLD's are ongoing (A. Marsili).

Three main layouts are considered: (1) Present layout, (2) one additional TCLD collimator in the DS and (3) two additional TCLD's. TCLD collimators are added by replacing a 15 m-long lattice dipole with a cryo unit consisting of two 5.5 m-long 11 T dipoles. The TCLD is installed between the two shorted dipoles. The dipoles MB.B8R7.B1 and MB.B10R7.B1 (and the symmetric ones for B2) are replaced in the new layouts.

The simulations indicate that the proposed layouts for local DS collimation are very effective in reducing the losses in the cold magnets. The global inefficiency is improved by up to a factor 20. This is consisted with similar simulations performed for the ATS optics as well as for previous simulations in which the space for additional TCLD's was made available by moving the DS magnets. The improvement of cleaning is substantial only if 2 TCLD's are added, by this should be confirmed by energy deposition studies. Decreasing the length from 1 m to 0.8 m seem to have no important impact on the cleaning.

3.2 Discussion

SR commented that, based on these results, the integration team and the TCLD design team can work on the assumption of 80 cm length, but this has to be confirmed by the final energy deposition studies to be reported at the next ColUSM. AL reported that the team should indeed be able to report on these studies at the next meeting.

Answering a question by PF and AB, SR commented that the option to have one TCLD unit per side of IR7 is considered as a possible staging of the installation. From RB's studies, it seems very unlikely that one unit only might be useful. On the other hand, from the beam

measurement the cell-8 is more charged than the cell-10 so it is worth checking if one TCLD only might be useful. This question will be addressed by the energy deposition studies.

4 Update on collimator material irradiation at BNL (N. Simos)

Status report available here (pdf).

N. Simos reported on the status of BNL irradiation tests. It will be possible to get 3 additional weeks of irradiation in Jan. 2014, which should be sufficient to complete the high-energy irradiation program of CERN samples. SR recalled that it is crucial for us to have data on the MoGr that is now considered as a strong candidate for the secondary collimators. SR asked if there are issues to re-start the irradiation after a stop of several months. Should we not start with fresh samples? NS commented that the should be no impact on the results. We will have not enough time during the next RHIC run to perform the full irradiation on new samples. In addition, we would have to go through the safety committee again, whereas continuing the irradiation that was started poses no issues.

On the other hand, there is probably the possibility to insert a new capsule that will replace the one that was damaged in July. NS will verify this option and let us know. NM will follow this up from the CERN side.

NS asked when he can get the non-irradiated samples for the reference characterization. NM commented that they are already available since summer. NS will try to organize a visit to CERN to get them.