

75th Meeting of the LHC Collimation Working Group, September 18th, 2006

Present: Oliver Aberle, Ralph Assmann (chairman), Alessandro Bertarelli, Dariusz Bocian, Chiara Bracco, Markus Brugger, Barbara Eva Holzer, Jacques Lettry, Andres Gomez Alonso, John Jowett, Stefano Redaelli (scientific secretary), Herta Richter, Stefen Roesler, Federico Roncarolo, Lucia Sarchiapone, George Smirnov, Maciej Sobczak, Vasilis Vlachoudis, Thomas Weiler, Roman Willfnger.

1 Prioritized list of FLUKA studies (R. Assmann)

R. Assmann presented a prioritized list of topics for future FLUKA collimation studies based on the project requirements. This list was setup in a meeting with M. Brugger, S. Redaelli and R. Assmann that followed up what was discussed the 74th meeting of the collimation working group (July 17th, 2006).

Highest priority is assigned to the topics that have an **impact on the collimation production schedule** and on the **LHC layout**, such as for example the finalization of the beam scraper design and the cooling of the passive absorbers of IR7.

The complete list is available on our web page at the following link:
<http://lhc-collimation.web.cern.ch/lhc-collimation/files/fluka-rwa-priority-list-2006-09-18.pdf>

There was a general agreement to the proposed list of items and to the priority assigned. The final approval will be discussed again at the next meeting of the collimation working group, when Alfredo Ferrari will also be present. People were welcomed to look in more detail at the attached list and to send comments the scientific secretary.

2 Updated list from the FLUKA studies (M. Brugger)

Markus Brugger presented a list of accomplished and ongoing FLUKA studies. He commented that the studies of the **skew halo loads** (one of the pending items on Ralph's list) have been carried out by using inputs provided by C. Bracco. It has been found that the losses in the cold magnets are comparable to the ones of vertical and horizontal halos and hence loads from skew halo do not seem to be an issue for magnet quenches. On the other hand, the loads on the D3 separation dipoles are larger than for the other halos. This might require further investigations.

Markus also carried out detailed cross-checks of the simulation setup for the **450 GeV IR7 optics**, which were setup by Mario Santana-Leitner and reported at the collimation working group meeting of July 17th, 2006. Markus found a minor bug that did not affect significantly the conclusions Mario's studies.

During summer Markus has studies the **energy balance** to try and understand what leaks out from the collimation system and further downstream of IR7. He provided list of protons that escape from the collimator jaw and stay within the vacuum chamber. Particles coordinates at the end of IR7 have been given to S. Redaelli, who will plug them as an input into the **SixTrack** simulations with aperture model in order to see in which element they are lost. Results will be reported at the next meetings. (**Action: S. Redaelli**).

M. Brugger stated that **beam tests at CERF** will be used to benchmark the simulations of BLM response to beam losses. The 'dummy' geometry normally used in simulations will be compared with a detailed BLM geometry implemented by using the layout of the CERF beam tests. This will validate the simulation setup used so far or will tell whether a more detailed setup is needed.

M. Brugger also announced that, in addition to the list agreed with Ralph, the FLUKA team has been asked to investigate the quenching of superconducting magnets due to obstacles in the beam pipe. This work is ongoing.

The work for the scraper design is basically starting now. R. Assmann reminded that the beam scrapers at the LHC will be used for beam shaping in various conditions, both at injection energy and at 7 TeV. For these objects we need a robust design that should allow scraping the beams down to less than 1 sigma. Four slots per beam have been reserved in IR7 close to the primary collimators (80 cm per scraper). The FLUKA studies should be focused on determining what are the best **material** and **length** for the scraper jaw. The goal is to have the final drawings by spring 2007, which implies having a solid engineering concept ready by the end of 2006 (A. Bertarelli).

S. Redaelli asked on which case the study for the scraper design should be based on: (1) the operational case (scrapers used to cut the beam down to 1 or 2 sigmas) or (2) a failure case of full beam impacting on the scraper? R. Assmann replied that both cases should be addressed for the scraper design. However, he expects that the best scraping performance will be achieved with thin elements, for which the survival in case of full beam impacts should not be an issue.

A. Bertarelli asked whether one can combine in one reserved slot the scrapers for more than one plane. Everybody agreed that this is certainly a viable option, if a design that fulfills all the requirements can be found.

A. Bertarelli also asked clarifications about the item of thresholds for the tertiary collimator (TCT) damage, which is listed in Ralph's and Markus' tables of pending actions. Alessandro wanted to know how urgent it is to investigate the TCT robustness. R. Assmann replied that the TCT will not withstand a failure scenario at 7 TeV and they are meant to protect the triplet quadrupoles. However, the cooling pipes are close to the Tungsten jaw and hence it is important to understand if in case of accident the cooling pipes could be broken. This would cause a very serious water leak in the experimental region and likely a few months of shut down. If we convince ourselves that this event cannot occur, even in case of serious accident, the TCT's could be used operationally more often, e.g. for experimental background tuning.

3 Organization of the beam tests at SPS and TT40 (R. Assmann)

R. Assmann showed a tentative schedule of the collimator MD's with beam at the SPS and TT40. This year we will have two 24-hours MD's at the SPS with stored beams (October 31st and November 7th) and one material test with extracted beam at TT40 (November 9th). Preliminary plan were already discussed at the 66th collimation working group meeting of March 6th, 2006. R. Assmann welcomed comments on the MD plans that he drafted. We should aim to have another iteration at the next collimation meeting in two week time and the to finalize a detailed programme by the end of October, in order to be ready for the tests at the beginning of November,

R. Assmann also announced that the **COCOST meeting** has recently started again to follow up collimator control issues. M. Jonker is chairing this meeting and M. Sobczak is the scientific secretary. The acronym now stands for COLLimator COntrol STeering meeting. Maciej reported that the COCOST meeting will be held on a weekly basis until the completion of the SPS beam tests. The last meeting was focused on the parameters of the BLM data acquisition at the SPS tests with circulating beams.

R. Assmann commented that the SPS MD will be focused on the **collimator controls**. Even if the collimator hardware will not be the same as in the final LHC configuration (position sensors and stepping motors will not be of LHC type), the goal of the test is to setup the communication between high-level software and low-level devices as it will be done for the LHC. R. Assmann reported that Roberto Losito's team is trying to get a PXI system

in place for these tests. In order to see where we stand, it will be useful to arrange a dry run for the collimator controls at the beginning of October, which will leave another month to address the remaining open issues.

Concerning the **collimator impedance measurements**, which are of major relevance for the LHC, we should try to measure the so-called “inductive by-pass” effect, which is predicted by theory but has not yet been experimentally demonstrated. No impedance experts could attend this meeting and hence the discussions were postponed to the next meeting. Federico Roncarolo is now working within the FP420 project and would be interested in measuring impedance effects (possibly by moving one collimator jaw only). R. Assmann welcomed that help of Federico for these measurements.

Concerning the **material tests at TT40**, the main goal is to validate the robustness of the collimator in case LHC injection failure (one full SPS batch, i.e. 288 SPS bunches, hitting the collimator jaw). In addition, laser vibrometer tests will be performed to measure the jaw vibrations induced by high-intensity beam impacts. Following up the results of 2004, new vibration measurements with accelerometers and microphones will also be performed. Details of these tests will be reported at the next meeting.

Barbara Eva Holzer said that it will be difficult to have **BLM** for the TT40 because the BLM team did not receive the request in due time. The BI team busy with the LHC installation. R. Assmann replied that these issues were discussed in early collimation working group meetings, where BLM team representatives were present. R. Assmann will follow up this issue with Bernd Dehning to try and install some BLM for the collimator test. Indeed, BLM are essential for the beam-based alignment of the collimator jaw with respect to the beam.

A. Bertarelli asked what is the bandwidth of the laser vibrometer. Roman Willfnger replied that it depends on the total acquisition time. The longer the acquisition time, the smaller is the allowed acquisition frequency. For example, at most one can measure for 32 seconds with an acquisition frequency of 400 Hz.

R. Assmann proposed that at the next meeting Roman should present the details of the laser vibrometer measurement. The collimation working group will decide which measurement points should be considered and how many measurements will be performed.

S. Redaelli reminded that, in previous meetings, R. Willfnger stated that the laser vibrometer is limited to a maximum vibration velocity. Stefano suggested that A. Bertarelli checks in his ANSIS simulations what is the largest jaw surface velocity that we should expect. R. Willfnger confirms that the laser vibrometer is limited to velocities of 10 m/s.

The next meeting will be announced.

Action Items:

- ▷ Loss locations of the protons from collimator adronic showers that leave IR7 (S. Redaelli).