

## 66<sup>th</sup> Meeting of the LHC Collimation Working Group, March 6, 2006

*Present:* Gianluigi Arduini, Ralph Assmann (chairman), Giulia Bellodi, Alessandro Bertarelli, Chiara Bracco, Hans Braun, Alessandro Dallocchio, Brennan Goddard, Verena Kain, Jacques Lettry, Roberto Losito, Matteo Magistris, Manfred Mayer, Laurette Ponce, Stefano Redaelli (scientific secretary), Guillaume Robert-Demolaize, Mario Santana-Leitner, Peter Sievers, Thomas Weiler.

### 1 Scope of the meeting / boundary conditions

This collimation working group meeting was devoted to the definition of the planning of the 2006 collimator tests with beam. Two main dedicated tests are foreseen:

- **Tests with circulating beam at the SPS** (2 MD's of 24 h each).  
Main goal: Test the the collimator control system, including motors, position sensors, middle-level electronics and high-level application software.
- **Robustness test with extracted beam at TT40** (1 MD of 16 h).  
Main goal: Repeat the robustness test in the same conditions as in 2004 to assess the robustness of the final design, which includes in the jaw assembly a Glidcop plate instead of Copper plate (the Copper was permanently deformed by  $\approx 250 \mu\text{m}$  at the 2004 test).

The dates when the above MD's will take place has not been decided yet. The overall 2006 MD plan will be discussed in a dedicated meeting this Friday, March 10th. A detailed installation planning of the collimators must be carried out when the MD dates will be known.

An updated list with the proposed measurements is available at the following URL: [http://lhc-collimation.web.cern.ch/lhc-collimation/files/RA\\_prel\\_coll\\_md\\_2006.pdf](http://lhc-collimation.web.cern.ch/lhc-collimation/files/RA_prel_coll_md_2006.pdf) Below, we present the highlight of the various discussions.

Follow-up the after meeting: The following dates have been proposed for the collimator tests (G. Arduini):

- First collimator test at the SPS: Week 39 (Sep. 30th)
- Second collimator test at the SPS: Week 42 (Oct. 18th)
- Robustness test at TT40: Week 39 (Oct. 1st)

### 2 Test with circulating beam at the SPS (2 MD's of 24 h)

#### 2.1 Access and deadlines

G. Arduini pointed out that this year new rules are foreseen for the access into the SPS. All access doors will be physically locked with a chain and keys will be located in the control room. To avoid lengthy procedures during the precious MD time, it is suggested to plan the installation campaigns in advance, by profiting of already planned access slots.

G. Arduini reminded that access to the SPS/TT40 areas can only be granted to people who have attended the new course of "Habilitation électrique". This should be done as soon as possible by the people involved in the installation.

G. Arduini also asked the people involved to provide as soon as possible an estimate of the earliest date after which the installation work can start. This will help in setting up the overall plan for the 2006 MD's. R. Losito replied that the LHC-type position sensors will be delivered to CERN starting from May and one could start the installation in June. The LHC motors will not be available but this is not an issue because for the test one could install any kind of motors. R. Assmann suggested that indicatively the installation could be foreseen for August and tests with beam could start in September, as it was done in 2004. This would leave us some time to organize at best the installation.

## 2.2 Stepping motors / position sensors

Concerning the sensor equipment, R. Losito expressed concerns about the available manpower from his team. He estimates that a work of at least 2 or 3 weeks (one person) will be required for the collimator setup. This work must come at the expenses of other activities. Roberto also stresses that the collimator has been installed before he and his team had the opportunity to work on it. Sensor calibration must then be done directly in the tunnel, which required additional time and limits the achievable accuracy of position measurements.

S. Redaelli pointed out that, since no additional position measurements have been carried out on the SPS collimator since 2004, the jaw positioning must rely on old calibrations of switch positions. We have to hope that there have not been significant changes since then. R. Assmann suggested that some MD time should be devoted to cross-calibrate the position sensors with motor steps and resolver measurements. R. Losito stated that in these conditions one cannot expect an absolute accuracy better than 100  $\mu\text{m}$ .

G. Arduini commented that, if R. Losito needs a full week to prepare the collimator for the test, then the only solution would be to do that before the start of the beam runs (middle May).

## 2.3 Collimator control (middle level and software)

To have a successful test, the collimator control system (middle-level controls and high-level application software) shall be as similar as possible to the final LHC solution. Manpower from AB/CO has been allocated to work on the middle level software (M. Jonker and M. Sobczak). No representative of AB/CO attended this meeting and hence the discussions will continue off-line among the people concerned. S. Redaelli (who joined AB/OP in January 2006) has recently started working on the high-level application software for the collimator control. There is a general agreement that for the SPS test we should try to have a full control of the collimator from the control room with a software integrated in the operation software framework.

B. Goddard asked if it is foreseen to test automatic alignment procedures. R. Assmann proposed to check if we can implement some algorithms in the top-level software. S. Redaelli pointed out that, according to the specification of the collimator control system, automatic alignment procedures must be taken care of by the middle level software. We should focus on providing from the top level the functionality that is ensured by the lower level! R. Assmann stated that, since no automatic alignment procedure will be ready in the middle level for this year's test, one can include as much as possible in the top-level software, at least to test the algorithms. S. Redaelli also commented that it should not be forgotten that BLM data will be provided at 1 Hz (see next section) and the usefulness of a feedback based on this acquisition rate is debatable. The people involved should meet with high priority and define detailed and realistic goals for the 2006 SPS run.

## 2.4 Dedicated beam loss monitoring for collimator adjustment

There was a general agreement that, in order to profit at most from the collimator test, it would be better to have an LHC-like beam loss monitoring system. L. Ponce said that, if the test is done in September, it will be possible to perform a test with the final LHC system. Laurette also pointed out that the dedicated BLM system used in 2004 for the collimator MD has recently been removed from the SPS. This is not a problem because we will use the new LHC system. There is therefore action to be taken for the moment.

S. Redaelli asked if optical fibres have to be installed for the test. L. Ponce replied that this is not the case because the cables installed for the 2004 test can be used instead.

As for the acquisition rate, it was agreed that 1 Hz should be enough (same value of 2004).

## 2.5 Loss pattern studies around the ring

Following up simulations of beam losses at the SPS (see APC meeting of February 16th, 2006) S. Redaelli and G. Arduini proposed to have fast loss pattern measurements around the SPS ring. The measurements of loss maps around the ring should not be confused with the beam loss monitoring discussed in the previous section, which refer to a dedicated system placed at a single location downstream of the collimator for the beam-based jaw alignment.

Gianluigi stated that measurement can be acquired every 20 ms but last year we only had an integrated measurement every super-cycle. The feasibility of fast measurement should be followed-up.

Follow-up the after meeting (S. Redaelli): L. Jenses confirmed that the ring BLM's acquired data at a sampling time of 20 ms. Signal integration is done via software. The AB/OP responsible, A. Ferrari, confirmed that fast acquisition will be possible with minor modifications of the existing software. A. Ferrari will leave CERN in July 2006 and the software will be taken over by F. Follin. This issue should be then followed up with him. (G. Arduini, S. Redaelli + AB/OP).

## 2.6 Impedance measurements

An open issue from the tests of 2004 is the contribution to the impedance from the inductive by-pass effect (see LHC collimation working group meeting of April 25th, 2005, presentation by E. Métral). R. Assmann informed the AB/ABP impedance team about the availability of beam time to perform impedance measurements during the collimator MD's. The team of F. Ruggiero should propose a detailed plan of measurements.

S. Redaelli reported a message from F. Caspers, who could not attend this meeting. Fritz does not plan to perform tune measurements with its 245 MHz pick-up because he is satisfied by the 2004 measurement results. However, measurements can in principle be re-done if there is a specific request. R. Assmann said that the detail plan of measurements and required instrumentation should be defined by the AB/ABP impedance team.

## 2.7 Halo studies

Six hours of beam time have been preliminary allocated for beam halo studies. G. Arduini argues that this might be an optimistic figure. A prioritized list should be worked out in detail to define what has exactly to be done.

H. Braun asked if it is possible to have halo scans at SPS injection energy. G. Arduini said that this is in principle possible but one might be limited by beam lifetime issue. R. Assmann

agrees that this could be an interesting topics and should be added to our list. Other details of halo measurements should be defined.

## 2.8 Vacuum

No representative of AT/VAC could attend the meeting. Possible vacuum tests for 2006 should be outlined because the tests carried out in 2004 were inconclusive.

Follow-up the after meeting (S. Redaelli): M. Jimenez stated that, due to lack of manpower, AT/VAC cannot commit on providing support for tests with beam in 2006. Instead, they plan to focus on detailed tests carried out on the collimator series production at CERCA. This is an highest priority for the collimation project at the moment.

## 3 Test with extracted beam at the TT40 (1 MD's of 16 h)

The TT40 robustness test should be focused on repeating the 2004 test with a collimator jaw equipped with an Glidcop plate instead then on a Copper plate. A jaw produced by the company will be tested.

J. Lettry proposed to perform laser vibrometric measurements on the bombarded jaw in order to compare the simulated time dependent jaw vibrations with simulations. This implies two main modification of the standard collimator design: (1) only one jaw should be installed in order to be able to easily access the jaw surface with the laser beam; (2) the vacuum tank must have window(s) to see the jaw surface. Within the end of this week, J. Lettry will be able to provide estimates of the required time to setup these laser measurements and deadlines by when the new vacuum tank could be available for installation.

M. Mayer commented that, due to the overload of the CERN workshop, designing and building a special tank for the TT40 could be prohibitive. This should be kept in mind.

S. Redaelli proposed to setup accelerometer measurements as a way to detect beam impacts on the collimator jaw. Since most of the required hardware is still available from 2004, with a moderate investment one could setup measurements to understand in detail the effect of radiation on the measured vibration signal (which limited the accelerometric measurements carried out in 2004). R. Assmann pointed out that detecting beam impacts on the collimator, and possibly damaged jaws, is still a critical open issue for the LHC. He believes that it is definitely worth investing the required effort to setup the proposed measurements.

S. Redaelli asked whether the access to the TT40 area could be more problematic after the CNGS operation due to activation of the componets. G. Arduini replied that this will depend on the losses during the extraction of the CNGS beam, which is not know yet.

B. Goddard asked if it could be possible to perform the test at 400 GeV instead of 450 GeV. The TSPG that protects the SPS septum can stand only 66 % of the LHC injection batch and could be damaged in case of accident (the septum would not be damaged but the CNGS operation would be compromised if the TSPG was damaged). A. Bertarelli said that for us the robustness test is only meaningful if it is done in the LHC conditions, with 450 GeV/c beams. Brennan said that in this case is should be kept in mind to keep at a minimum the number of 450 GeV/c shots to minimize risks.

## 4 Additional tests on transfer lines / sector test

In addition to the dedicated collimator tests at the SPS and TT40, various collimators will also be installed and need to be operated in the transfer lines and in the LHC sector 8-1.

Depending on the availability, 1 to 5 collimators could be installed. The commissioning of these collimators will be carried out within the collimation project.

R. Assmann commented that this is going to be a fairly challenging system to control and it would be a good achievement to show that we can do that. However, he pointed out that the available electronics might not be enough to equip all the collimators and hence one could have “movable racks” to be moved where they are needed. To be followed-up (R. Losito).

V. Kain proposed to use the TT40 collimator prototype to study in more detail the BCT transmission measurements already tested in 2004 to align the collimator jaw to the beam envelope in transfer lines. Amongst the various other collimators, the TT40 collimator is the best candidate to ensure reliable BCT measurements. The test would require the possibility of adjusting the jaw angle and a logging of the jaw positions, possibly for a fast on-line analysis. Ideally two jaws would be required to study the centring with respect to the beam but some useful tests could be carried out also with one jaw only. The details of the proposed test will be worked out off-line by the people involved.

**The next meeting will be March 20th, 2006.**