# Minutes of $5^{\text{th}}$ Collimation Upgrade Specification Meeting

**Participants:** C. Adorisio (CA), A. Bertarelli (AB), H. Burkhardt (HB), B. Dehning (BD), A. Marsili (AM), S. Redaelli (SR) (Chairman), M. Schaumann (MS), R. Schicker (RS), D. Smekens (DS).

## 1 Positioning of new IR2 collimator (J. Jowett)

Slides are available at this link.

### 1.1 Summary of the presentation

JJ presented observations on the optimal position for a new collimator which would be installed downstream of IR2 (Alice) for both beams, in order to intercept secondary beams coming from the interaction point. The basic idea is that during lead–lead collisions, different processes take place, leading to ions with charges and masses different from the standard $^{208}Pb^{82+}$ (slide #2). These processes also have cross-sections in the scale of barns (and not millibarns). The ions consequently have a different magnetic rigidity and behave as independent beams in the lattice, and create losses in different places. The goal of the new collimator would be to intercept these beams before they are lost in the cold dispersion suppressor magnets (relying on shorter 11 T dipoles to make required space).

Simulations were done using an energy of 6.5 Z!TeV, and $\beta^* = 0.5$ m. The orbits of the secondary beams (and a $1\sigma$ envelope) were shown together with the magnet aperture and the $8\sigma$ envelop of the nominal beam. The secondary beam carrying the largest power corresponds to the process BFPP1 (red). In order to intercept this secondary beam without affecting the primary beam, the closest collimator location would be about 320 m from the IP.

JJ showed a closer view of cells 9 and 10, with a suggested position for the collimator: just after the main quadrupole of cell 9 (black line). This position would allow to intercept possibly all secondary beams while staying more than 8 $\sigma$ away from the nominal beam. Cell 8 is too early (no separation possible), and cell 10 would be too late (BFPP2 and possibly BFPP1 would have already reached the beam pipe and been lost).

Following a question from the audience, the power carried by the secondary beams was discussed. For the nominal luminosity, the most critical one (BFPP1) carries 25 W; the next in order of criticality (EMD1, green) would carry between 10 and 20 W. These values could be increased by a factor 5 after the luminosity upgrade, leading to a power in the range of 50 to 120 W.

### 1.2 Discussion

During the discussion, SR pointed out that the ideal position (w.r.t. the optics) for a collimator would be in the middle of the present main dipole, with one short 11 T dipole on each side of the collimator. The orbit bump induced in the cell affected by the change can then be closed.

# 2 Multiple pair production (R. Schicker)

Slides are available at this link.

## 2.1 Summary of the presentation

RS presented the different Pb-Pb processes which lead to electron production and the associated Feynman diagrams, to motivate the need for a Roman pot-like detector in the dispersion suppressor. The idea location would be the same as for the cryogenic collimator. RS gave examples of the production of a pair of free electrons, and an example where one electron is captured (bound) back to an ion, changing its charge. The cross-sections were given. They are strong field QED processes.

Examples of processes involving more pairs were given. They correspond to higher orders in the perturbation series of QED, and can even include virtual electrons (quantum effect). The main problem seemed to be that these uncorrelated productions need corrections which can change the cross-section (up to 15% for 3 pairs).

## 2.2 Discussion

Many questions were raised about the nature of the detector. Various aspects should be addressed before considering possible integration in the cold collimator design: size (transversal), length (longitudinal), volume, working temperature, cryogenic (100–150 K) or not, its integration to a collimator, the effect of the back-scattering of particles from the collimator (also called "albedo"). The example of the Roman Pots was brought. It is clear that there is yet no detailed thoughts about further implementation. AB pointed out that a cryogenic detector could probably not be gas-based, and also have no water as a heat-carrying liquid.

The conclusion was that more specifications on the nature of the detector should be given as soon as they are known. I t was agreed that no detailed study will start from our side until these basic aspects are addressed by the ALICE collaboration **(Action: RS)**.

# 3 A.O.B.

During the discussion following the presentations, other points related to the integration issues of a 11 T dipole were mentioned: if there will be one or two magnets replaced, the financial consequences, how the magnet would be changed. It could be replaced by two smaller magnets ($^2/_3$ of the original magnet length), which would free some space either at the front or in the middle. The question of which secondary beam must be caught was raised, allowing more freedom of position if not all are stopped.

JJ commented that one could consider installing some kind of detector on the front face of the cryo collimator.

SR commented that for the collimator settings one should consider carefully the local beam size at the collimator to ensure that the required momentum cut can be achieved with reasonable betatron cuts.

DS observed that 11 T magnets will require stronger quadrupoles and specific power supplies. This means that the new magnets might have to be next to the quadrupole.

CA (radio-protection) raised issues of the materials used, their activation, and possible replacing. The global agreement was that this shouldn't be an issue, from previous experience.

# 4 Next meeting

The next meeting will be held on
**20$^{th}$ April 2012, 16:00–17:30. Room: 874-1-011 (above CCC).**

**Tentative agenda:**

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| S.Redaelli | Collimator upgrade scenarios for impedance calculations |
| A. Bertarelli | Choice of materials for phase II collimator tests at HiRadMat |
| R. De Maria | IR optics for Hi-Lumi |