Verena Kain, 2004-29-07

40th Meeting of the LHC Collimation Working Group, July 23, 2004

Present: Ralph Assmann (chairman), Brennan Goddard, Verena Kain (scientific secretary), Matteo Magistris, Vasilis Vlachoudis, Rüdiger Schmidt, Stefano Redaelli, Guillaume Robert-Demolaize, Gianluca Guaglio

1 Basic Parameters for different Collimators (round-table)

The aim of the meeting was to agree on the settings of the different movable absorbers and collimators and to define the maximum and minimum gaps of the collimators in the experimental insertions such as TCLIs, TCLPs and TCTs. The table below summarizes the settings of all movable absorbers and collimators as well as the available ring aperture at injection energy.

Settings at Injection (σ_β, $\delta = 0$)	
Secondary collimators in IR3	9.3σ
Primary collimators in IR3	8.0σ
LHC cold-bore aperture	7.5σ
TDI, TCLI, TCDQ	6.8σ
Secondary collimators in IR7	6.3σ
Primary collimators in IR7	5.3σ
Transfer-line collimators	5.0σ

The vertical TCLI collimators are auxiliary collimators in IR2 and IR8 (2 collimators per insertion) to protect the LHC against injection errors, mainly MKI failures, together with the TDI. Thus they are only needed at injection energy. The horizontal TCLPs are collimators with high-Z jaws (copper is foreseen so far) catching the physics debris from the high luminosity experiments in IP1 and IP5. Each insertion has 4 TCLPs. There are TCLPS on each side of the insertion close to D2 to protect the magnet from quenching. The others are close to Q5. They will be moved close to the beam at collision energy with squeezed optics only (setting: 10σ). The TCTs, the tertiary collimators, are foreseen for all experimental insertion for triplet protection and local cleaning (but will only be active in insertions with low-beta runs). The preliminary setting is $\sim 9\sigma$. They will be used at 7TeV during the squeeze and with squeezed optics.

V. Kain produced a seqedit-file to be used with MAD for installing all the additional collimators at their allocated locations and lengths in the LHC sequence. The locations of the TCS in IR6, the TCLions as well as the TCLAs in IR3 are still missing. After its completion it will be available on the collimation homepage. The TWISS-data produced with the preliminary seqedit file was used to define the required gap sizes for the collimators in the experimental insertions.

1.1 Gap Sizes

The maximum gap size for all elements was decided to be **60mm**, corresponding to $\sim 30\sigma$ at the TCTs. The minimum setting is defined as 50% of the nominal setting value.

device	minimum gap
	[mm]
TCLI at Q6	3
TCLI at D1	4
TCT at D2	4 (before squeeze)
TCT at D2	6 (squeezed)
TCT at D1	4 (before (squeeze)
TCT at D1	6 (squeezed)
TCLP at D2	2.3

1.2 Angular Control

The question of angular control must be decided for each element on an individual basis comparing the local beam-size plus tolerances with the alignment tolerance from the survey people (150μrad for a jaw).

The shorter primary ring collimators (20cm active jaw) will also be equipped with angular control and will use the same tank as the TCS collimators (50cm tapering on each side of the 1.2m jaw).

1.3 Material for the TCTs – Cu or W?

Tungsten becomes brittle with radiation, is more expensive, is heavier (more difficult for engineering), but absorbs better than copper and does not explode with heavy beam load like copper; it breaks down in a controlled way. V. Vlachoudis points out that tungsten could give a factor of 3 to 4 more absorption than copper. The working group preliminarily agreed on tungsten as material for the TCTs due to its better absorption resulting in more safety factor.

1.3.1 Additional Considerations:

The horizontal tertiary collimators (TCTh) will have to go in locations where the TCS design might not fit due to smaller inter-beam distance (TCS was designed for 194mm inter-beam distance, TCTh will go close to D2: inter-beam distance between 165 and 188mm). However, a modified TCS design could also be used for the TCLP, as half of the TCLPs will also be in the region between the TAN and the D2 like the TCTs. The required jaw depth for a TCT is 25mm.

1.4 TCDI – Transfer-line Collimators

See slides at http://www.cern.ch/lhc-collimation/files/BGoddard_23Jul04.pdf.

B. Goddard (BG) summarized the requirements of the TCDI.

The TCDI will not have any tapering, impedance is not an issue. The maximum gap will be 60mm as for the ring collimators. One of the horizontal TCDIs has a full nominal gap of only 3mm, thus the preliminary minimum gap for the TCDI is 1.5mm. This seems to be very small and might change as the positions of the horizontal collimators in TI8 must be redefined for better phase-advance conditions.

Angular control of the TCDI: Although the TCDIs can have nominal gap sizes of less than 5mm, it is not clear whether the TCDI should be equipped with two motors per jaw to allow for angular control. If the trajectory jitter for different shots at the collimator locations is already larger than any alignment tolerances, then the collinearity cannot be adjusted during operation. Additionally there is no procedure yet for using angular control in the transfer-line situation with no circulating beam.

1.5 Other issues

The collimators in IR7 do not provide full phase-space coverage. For injection energy with around 8σ aperture in the LHC, it cannot be guaranteed that the collimators are the first objects to be touched by the beam in a failure case. Additional scatterers every $45°$ could be installed in IR7 to cover the phase-space.

The set-up of the collimator for the test in the SPS is done with the adjacent BLMs. The current read-out frequency of the BLM-system of once per super-cycle does not allow for efficient tuning. Read-out in the 1Hz range is required.

M. Magistris mentioned simulation results for expected dose rates in electronics close to the collimator in TT40. As a first approximation, he took the case of semiconductors and silicon damage. No damage is expected below 10Gy and destruction above 100 kGy. For having electronics 1m from the upstream end of the jaw, 10Gy maximum are expected during the test and therefore the probability of serious damage is very low.

The next meeting will be announced.