

Minutes of the Linac4 Diagnostics Working Group Meeting held on 14 December 2009

Present: C. Carli, B. Goddard, U. Raich, J. Borburgh, B. Holzer, E. Effinger, C. Zamantzas, B. Dehning, R. Versaci, T. Hermanns, K.Hanke, B.Mikulec.

Agenda:

1. FLUKA simulations of the H0/H- dump region (R.Versaci)
2. Status of the BLM design wrt. Linac4 specifications (BI)
3. Discussion

1. FLUKA simulations of the H0/H- dump region

R.Versaci presented FLUKA simulations of the region around the H0/H- dumps at PSB injection (see his slides). The geometry has been implemented with 4 rings and 4 beam pipes inside the BS4 magnet, and dumps made of graphite, boron nitride or aluminum nitride have been studied. Positions in the presentation are given in cm and deposited charge in pC cm⁻³ per primary particle (1E14 particles). The beam parameters can be found on slide 4. The energy deposition is quite similar for graphite and boron nitride, but differs a lot for aluminum nitride (particles are stopped at much reduced distance of <7 cm compared to ~11 cm, but the energy deposition per cm³ is much higher). Space restrictions for the dump integration might dictate the material choice, but this has to be further discussed.

To allow to choose an adequate position for the BLMs close to the dump, a new tool developed by M.Brugger and E.Lebbos has been used, where a 3D grid of 5 cm x 5 cm x 5 cm BLM cells is simulated. Eight different scenarios (4 dumps x 2 beams for H0 and H-) have been studied leading to 8 matrices with charge deposition values per cell.

R.Versaci will distribute the charge deposition matrix for beam losses in each ring; the values will have to be added up if injections in several rings are considered. This should allow to evaluate possible BLM locations and the required dynamic range. It should be checked if an increase of 1% of incoming flux (corresponding to a certain foil degradation) could be detected with the increasing BLM signal.

Assigned to	Start date	Description	State	Result
R.Versaci	2009-12-16	Provide the energy deposition matrix around the H0/H- dump region.		Done. Email sent with this information the 22nd of January edit 2010.

C.Carli mentioned that here the upper limit at maximum intensity has been studied; usually the injected current will be lower.

B.Mikulec asked R.Versaci if he could do another study corresponding to an accident scenario sending the full beam pulse on the dump; he will look into this.

2. Status of the BLM design wrt. Linac4 specifications

There was no presentation from BI, therefore it was agreed to discuss the feasibility of the specification list for Linac4 that had been prepared by OP and sent to BI end of August.

Time resolution: The basic time resolution should be **2 us** to allow sampling along the 400 us long beam pulse (a synchronised signal should start the acquisition). This would yield 200 values at max. twice per second. The max. throughput per VME crate is a bit less than 20 MB/s and depends on the number of monitors per crate. In the LHC there are approx. 3000 values per crate (256 channels x 1 Hz x 12). In addition, a small

number of fast BLMs with **100 ns** time resolution should be provided to be able to resolve the holes removed by the chopper. BI proposes to use ACEMs (anode coated electron multipliers) for this purpose. They are about 100-1000 times more sensitive and are commercially available at a cost of about \$1500 per piece. The exact number and location of these still has to be defined, one possible location being upstream close to the septum. The ACEMs will not be connected to the interlock system; for readout it was considered sufficient to connect them to OASIS (B.Mikulec is evaluating the feasibility with I.Kozsar).

Sensitivity: B.Holzer promised to provide a number for the min. detectable signal with the standard BLMs.

Assigned to	Start date	Description	State	Result
B.Holzer	2009-12-16	Provide a number for the min. detectable BLM signal.		See table below. edit

The min. detectable signal for LHC BLMs has been measured and results have been provided by B.Holzer in an email from 12 January 2010:

Integration window [us]	[Gy/s]
40	1.81E-04
80	9.05E-05
320	2.26E-05
640	1.13E-05
2560	4.24E-06
10240	1.06E-06
81920	3.54E-07
655360	2.04E-07
1310720	1.80E-07
5242880	1.80E-07
20971520	1.65E-07
83886080	1.68E-07

These values will have to be rescaled upwards for the Linac4 case as the measurement range will be shifted to higher signals; they should only give an idea for the lower limit.

Dynamic range: The dynamic range depends on the energy and the environment. BI asked for numbers of the max. expected energy loss. This worst case will be studied in a configuration downstream the septum by R.Versaci (beam sent towards BLM with production of secondaries in the magnet), but it will only give an indication at 160 MeV beam energy.

Beam permit: It is not yet clear if a beam permit signal is required from the BLMs for Linac4 operation, but the option should be kept open. There will be one beam permit signal per crate or at best per acquisition card (still to be decided, but for example 1 permit for 16 channels).

Beam permit response: Most probably a response time of the order of <500 ms will be sufficient. Nevertheless, if equipment should be identified that could be damaged with 1 full beam pulse, a fast interlock might become necessary. In this case a beam permit response time of **5 us** should be reached.

Additional specifications can be found in this document.

3. Discussion

FLUKA simulations are needed for the low energy part of Linac4. The request has already been made middle of September 2009, but simulations haven't started yet.

Discussions have to be finalised on the BLM specifications for the PSB. It would be very useful to have beam loss data available during the injection period with a min. time resolution of 2 us (=during the first 100 us). After that, the resolution can be decreased to ~10 ms. It should also be considered how this data will be

represented.

B.Dehning would like to have only one reference document where all BLM specifications for Linac4 will be included. K.Hanke said that the reference document will be the EDMS document he is currently finalising with A.Lombardi. In this case, interlock specifications and required numbers and positions for BLMs and ACEMs should be added.

-- BettinaMikulec - 14-Dec-2009

- 091214_linac4_H0dump.pdf: FLUKA studies on the H0/H- dump for Linac4.
- PS_BLM_specs_v6.pdf: BLM specifications for Linac4

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