Minutes of the Linac4 Diagnostics Working Group Meeting held on 7 July 2008

Present: U.Raich, C.Dutriat, E.Bravin, G.Tranquille, G.Bellodi, B.Goddard, K.Hanke, B.Mikulec, B.Holzer (later).

Agenda:

1. Communications

2. Follow-up of open actions

3. Status of the movable diagnostics bench

4. Beam instrumentation required for PSB injection - specifications

5. Final BLM specifications

6. AOB

1. Communications

K.Hanke explained that CO managed to attribute a budget to finance a Russian colleague for writing the LabView program required this year for the emittance meter. It has been made clear that CO will not support this program. Another program will have to be written at a later stage compatible with CO standards in order to be supported by CO.

2. Follow-up of open actions

Spectrometer design: U.Raich has contacted A.Lombardi concerning the optics simulations required for the spectrometer design. G.Bellodi will take care of this task.

Planning for wire scanner installation in the chopper line: There exists an EDMS document including this information; it will be forwarded to C.Vuitton.

3. Status of the movable test bench

G. Bellodi agreed to simulate the optics for the movable test bench.
The dipole needed for the spectrometer is not included in the Linac4 budget to date. U.Raich has contacted T.Zickler to find out whether a suitable magnet could be found in the magnet stock; he is waiting for an answer. In addition, quadrupoles might be required that would have to be added to the Linac4 magnet list.
The question came up whether one could use the magnet from the 3 MeV test stand. What will happen to the line once the 3 MeV test stand will be dismanteled? U.Raich will try to find out with Patric Ausset.

Assigned to	Start date	Description	State	Result
U.Raich	2008-07-11	Contact P.Ausset to find out what will happen to the diagnostics line of the 3 MeV test stand once the tests will be finished.		Done. G.Bellodi will take care of this edit task.

4. Beam instrumentation required for PSB injection - specifications (including BLMs)

B.Goddard gave a presentation (see PSB_injection_BI.pdf) concerning the required beam diagnostics for PSB H- injection; this presentation is intended as a starting point for further discussions.
To set up the specifications not only the production beams have to be considered, but also the commissioning beams; this means that it should be clarified first what can be achieved as minimum intensity.

BLMs: need temporal resolution for loss at injection and in subsequent turns. Post mortem buffer desired and systematic logging of first ms at high temporal resolution and full cycle at 1 ms resolution. The sensitivity range is defined by the largest loss (~4E13 160 MeV protons) and smallest loss (would like to resolve few % of losses on 1 turn <E10 protons). It seems sufficient to cut the next injection once the integrated losses are above threshold.
Number of BLMs required: BLMs at BI.DIS and BI.SMV (already foreseen); 8 additional BLMs distributed over the slow injection bump region are proposed to cover losses at aperture restrictions and from foil scattering.

Video foil monitor: intended for measurement of the beam position and it's 2D-size on the foil as well as to measure the foil temperature. There are several issues with this approach: integration issues (luminescent screen integrated with foil exchanger?); very limited space in this region (could mirrors and view ports in the infrared be used?); will there be enough light available due to the low foil temperature of ~400 deg.C; both H- and protons have to be measured; radiation hardness of the camera etc.

Beam profile monitors: to measure first the beam position and size of the injected H- beam AND at the same time the circulating proton beam; to be positioned between BS1 and BS2. Secondly, the beam position and size of the unstripped H-/H0 to the dump AND of the stripped circulating protons should be measured; to be placed between BS3 and BS4. Is there enough space? We would need 2x4 SEMgrids. This would be quite expensive, but in principle 8 SEMgrids have been budgeted. Will there be a different SEMgrid response for the stripped and unstripped beams? The dynamic range is also quite challenging (from full beam to ~2% unstripped H0). The SEMgrids would not survive several turns with the full beam; it was proposed to measure during injection and the first few turns and then kick the SEMgrids out. It still needs to be determined if 8 SEMgrids are really needed (in particular if the video foil monitor is feasible) and if they can be integrated and fulfill all the requirements.

Beam position monitors: it is assumed that the beam pickups in the BI line are kept; their suitability should be checked. The question was raised if with a 352 MHz resonant pickup in the PSB ring could be useful.

Beam current transformers/Faraday Cup: it is required to measure the injection efficiency; for this purpose one could use the transformers in the BI line and in the ring. Is an absolute calibration at nominal current to within 5% possible? As one should monitor the foil condition closely, efficiency changes of 1% (aiming for 98% stripping efficiency with maybe 2% beam missing the foil) need to be detected - is this feasible? The minimum requirement is turn-by-turn readout of the intensity during injection, but it would be better to have a 10 MHz readout. A time-history within the 100 us injection pulse at ~10 MHz would be very nice to have. It should be checked if fast pulsing devices like the distributor could deteriorate the measurement accuracy.
In addition, it would be extremely useful to monitor the intensity on the H-/H0 dump: during setting up one would measure the full intensity and during operation the stripping inefficiency could be determined. Is there a way to distinguish H- from H0 (using e.g. an electron stripper)?

Transverse emittance measurement: needed for the optimisation of injection painting and of the bump closure. An absolute measurement to within 10% and a resolution of 5% (to see painting modifications) would be required. Currently, the only transverse emittance measurement devices installed are the wire scanners. It should be checked if they can fulfill these specifications.

Diagnostics for longitudinal parameters: does longitudinal painting need special diagnostics?

It is evident that a lot of work still has to be done to finalise the diagnostics requirements for the new H- PSB injection. It was decided to follow up this issue closely and discuss in more detail with everybody involved.

Addendum: Minutes of the working meeting between C.Carli, M.Chanel, K.Hanke and B.Mikulec from 14 July

Video foil monitor: It was underlined that a **camera** to monitor the foil and also the foil temperature is

essential. It was proposed to design a sort of foil-holder ('marguerite'?) where a **monitor** could be installed in one position to measure the 2D beam distribution when needed.

SEMfil: Originally (see above) the installation of 2 SEMgrids between BS1/BS2 and BS3/BS4 was proposed; this idea has been dropped. It seems to make more sense to install 2 SEMfils (horiz. and vertical) in each ring. These devices would be used to check the **matching** and would need to have the possibility of multi-turn acquisition (for approximately 16 turns) and ppm operation. The beam would then (after 16 turns) have to be dumped and it still has to be checked if the extraction kicker can be used for this purpose in terms of timing and reliability. Obviously, adequate mechanics would be required as well. It might be sufficient to foresee only 1 or 2 electronics chains (for one ring H+V) with multiplexers to switch between rings. To evaluate the number of wires a beam size of ~1 um after injection and a beta of 5 m was used yielding a ~2 mm sized beam if perfectly matched; this means that 64 wires of 0.5 mm distance will clearly be needed.

Dump: It was proposed to segment the dump in 2 parts (one part for H0 and one for H-) and measure the dump current separately for each part via a resistance. A special inclined dump design could also be beneficial. Another suggestion was to polarise the dump up to 1 kV to limit perturbations from ejected electrons. The current measurement would not provide an absolute measurement of the dumped beam or the stripping inefficiency, but it would be sufficient to detect any foil degradation through a relative comparison. A **monitor** should be glued on each of the 2 parts of the dump for a 2D profile.

Bump closure: The wire scanners do not seem to be well suited to measure the bump closure. Instead it was proposed to modify the PSB orbit measurement system; the old normaliser modules should be replaced by different electronics providing digital data with variable integration time. This would allow to measure the beam position at each turn as well as the usual orbit measurement. A special beam with lower frequency structure can be created with the chopper to allow to measure via multi-turn acquisition the bump closure. (The 352 MHz resonant pickup in the PSB ring can be dropped from the list of required beam instrumentation.)

Collimators: At a certain point a decision needs to be taken if collimators should be installed to limit the PSB acceptance (reduce to ~100 mm in the horizontal and ~60 mm in the vertical plane to keep the current acceptance and concentrate the losses to low energy). A design with either a collimator at one specific place in the ring or distributed across the ring as it is now the case (inserts in some bendings) could be envisaged. C.Carli is following this up.

Large-band pickup: It should be considered to add a large-band pickup (up to 1.5 GHz) for transverse measurements in the Booster. A large-band pickup for longitudinal measurements is already available.

This discussion needs to be continued...

-- BettinaMikulec - 11 Jul 2008

- PSB_injection_BI.pdf: Requirements for beam diagnostics for PSB H- injection system.

This topic: SPL > Minutes07July2008
Topic revision: r9 - 2008-10-10 - BettinaMikulec