Collider-Accelerator Department

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Memo

Date: *May 18, 2015*

To: *RSC, M. Babzien, K. Kusche, and I. Ben-Zvi*

From: *D. Beavis* DB

Subject: *Multi-train Mode in ATF*

The ATF is expected to operate in a mode in which each macro-pulse will have one to several micro-pulses contained inside the macro-pulse. This is the first time this mode has been operated since approximately 2011. Marcus, Mikhail, and I met on May 15, 2015 to discuss potential radiation issues related to this mode of operation.

The beam will be delivered to the experiment in Beam line 1 and the spectrometer magnet will be on with the beam being dumped into the floor beam stop. The experiment will start with the typical condition with one micro-pulse inside a macro-pulse. At some point the experiment will ask for a small increase in the number of micro-pulses. It is not expected that the number of micro-pulses will exceed 20. The machine will be operated below the 1.28 W limit imposed by the LESHC. The beam pulses are expected to have 500 pC per bunch (micro-pulse) and the experimental energy is 60 MeV. It would require about 28 bunches to reach the 1.28W limit with the linac operating at 1.5 Hz (macro-pulse rate). The time between mirco-pulses is 25 nano-seconds.

The experiment requires that each mirco-pulse is essentially the same amplitude. This operating condition requires effort by the laser operator to achieve. The intensity of bunches will mimic the intensity of the laser pulses. The laser pulses are tuned and monitored with a light readout system. As more mirco-pulses are generated the laser system losses energy and it is more difficult to maintain uniform laser intensity. Eventually the laser can no longer produce bunches. It is expected that the laser could produce 100 or more bunches, although they would not be satisfactory for the experiment. The number of bunches is controlled by using a programmable gate/delay generator and only Marcus B. is authorized to adjust this mode of operation.

A principal beam loss mechanism when changing the number of bunches is that the RF needs to be re-tuned. If not properly tuned the electron mirco-pulses in the Linac will have different energies. The high-energy slit will intercept beam that is not at the proper energy. The CCD camera integrates for 30 ms and if the electron mirco-pulses are at different energies the beam spot becomes oval in the horizontal plane. This allows the Linac operator to tune the RF and achieve beam pulses with the same energy. Therefore, the beam loss is expected at a location designed for large beam losses. The beam optics after the high-energy slit is expected to deliver the beam to the experiment and into the floor beam stop.

The operator will record the delivered beam power on an hourly basis. The operators monitor the Linac current on a more frequent time scale.

When stable single pulse beam is being delivered to the experiment a baseline survey will be conducted by the RCTs. After the baseline is achieved, additional surveys will be conducted when 5 or more mirco-pulses per macro-pulse is achieved. A survey will be conducted when 15 bunches or more in a macro-pulse is reached. If the external dose rates does not scale (within reason) with the beam power then this will be brought to the attention of the RSC Chair.