

SMOOTH B-TRAIN

T. Bohl, A. Pashnin, CERN, Geneva, Switzerland

Abstract

The transmission of the $^{208}\text{Pb}^{82+}$ Early Beam between the time of Start Ramp up to transition of the LHCION cycles in the SPS has been improved in 2016 by optimising the transfer function of the Frequency Program Data used for the generation of the Master DDS output.

MOTIVATION

The transmission of the $^{208}\text{Pb}^{82+}$ between the time of Start Ramp up to transition had been unsatisfactory for any of the LHCION cycles in the SPS used in 2016. At the same time it had been observed that there was a large transient on the phase loop phase discriminator signal, $\Delta\Phi_{\text{PL}}$, shortly after a B^+/B^- pulse from the reference magnet arrived at the DSP Frequency Program of the beam control used for Fixed Frequency Acceleration. The signal $\Delta\Phi_{\text{PL}}$ and the B^+/B^- pulses are shown in Fig. 1.

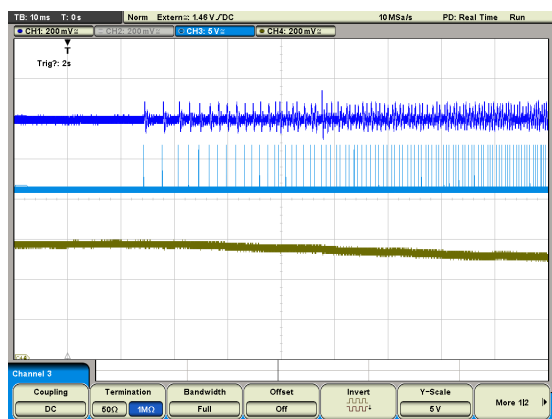


Figure 1: CH1 (top, blue): $\Delta\Phi_{\text{PL}}$, CH3 (centre, blue): B^+/B^- pulses, CH4 (bottom, green): AEW_{pk} (bunch peak amplitude), trigger: Start Ramp.

MECHANISM

The B^+/B^- pulses are treated in the DSP Frequency Program, where they lead to the calculation of new Frequency Program Data, see Fig. 2. These are then transmitted to the Master DDS. The Master DDS generates a frequency which is used to finally produce f_{LO} . The f_{LO} is up-converted to f_{RF} by mixing with a 10.7 MHz XTAL oscillator. This f_{RF} is then amplified by the RF power amplifiers and it is the RF seen by the beam in the travelling wave cavities.

REMEDY

To reduce the deleterious effect of the B^+/B^- pulses, the transfer function of the Frequency Program Data to the Master DDS was improved. The result can be seen in Fig. 3 by comparing the beam transmission for the two cycles without

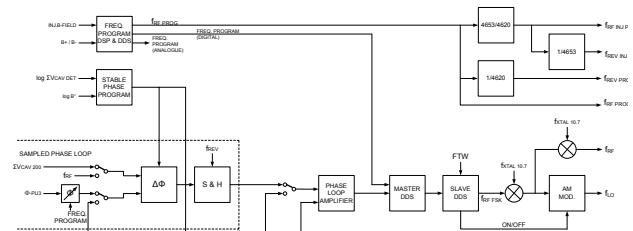


Figure 2: Part of the simplified block diagram of the low level used for FFA relevant for the discussion of the smooth B-train.

(blue trace) and with the improvement (black trace) in the case of the Early Beam. The capture loss at the beginning of the acceleration ramp starting at $t = 620$ ms is the same in both cases. However, the following losses up to transition at $t = 1465$ ms are completely removed (black trace).

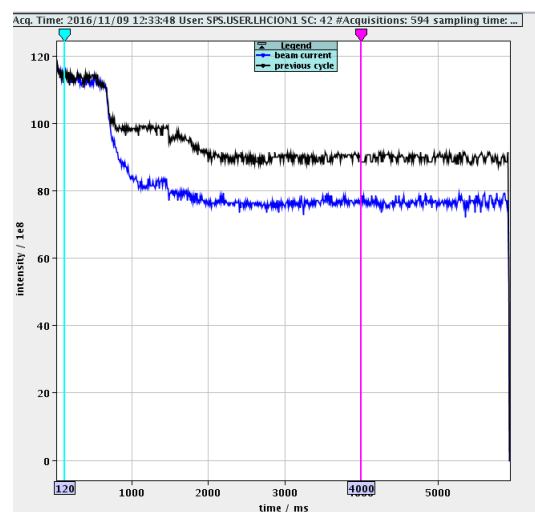


Figure 3: BCT screenshot. low level used for FFA relevant for the discussion of the smooth B-train.

OUTLOOK

The next step would be to apply this improvement and optimise it for the case of the Nominal Beam.

On a longer time scale, for the new beam control after Long Shutdown 2 (LIU SPS Upgrade), a better control of the effect of the B-train on the f_{RF} generation will be available as well as an improved control of the phase loop transfer function.