Minutes of the SPS Studies Working Group (SSWG)

5^{th} meeting 31^{th} July 2001

Present: G. Arduini (chairman), V. Baglin, R. Bailey, T. Bohl, H. Burkhardt, R. Cappi, P. Collier, A. Faus-Golfe, J. Gareyte, O. Gröbner, M. Hayes, W. Höfle, M. Jimenez, R. Jones, J. Klem, D. Manglunki, S. Myers, G. Rumolo, E. Shaposhnikova, R. Tomas, J. Tückmantel, L. Vos, K. Weiss, J. Wenninger, F. Zimmermann (secretary)

Excused: K. Cornelis

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1 Long MD on August 20 (G. Arduini et al.)

Four LHC batches might interfere with the PS physics programme. It was decided to use only 3 batches for half of the MD time.

2 Recent MD Results I: Stripe Monitor (M. Jimenez)

A document summarizing the recent measurements using the stripe monitor with LHC beam has been prepared by M. Jimenez, and will be sent to all members of the SPS SWG.

The monitor sensitivity to the horizontal beam position varies due to the arrangement of holes. The calcualted variation is about 20%.

A measurement with a 8-mm orbit bump over 2 s confirms that the stripe follows the beam as expected. The measured current on the monitor is about 10^{-8} A/m; some ambiguity in the length normalization remains to be clarified.

The monitor allows for a clear measurement of the threshold current. This threshold corresponded to about 2×10^{10} protons per bunch. After 7 hrs of operation with LHC beam there was no discernible scrubbing effect, consistent with the expectation of the vacuum group.

Stripe intensity and width were measured for various magnetic fields. The stripe full width varies between 5 and 20 mm. The stripe is wider for lower field.

With 6×10^{10} protons per bunch two stripes were observed, in agreement with simulations. The stripes were separated by about 15 mm. Valve closure prevented further studies at this intensity.

The largest electron signal is observed at rather low magnetic fields of about 30 G. Below 15 G the stripe signal disappears. Also measurements with other monitors and the pressure gauges indicate the absence of multipacting in field-free regions, for an intensity of 2×10^{10} protons per bunch.

The two triangular detectors, which should provide an alternative measurement of the stripe locations, are more sensitive to the position of the beam. In particular, the beam should not be centered at these detectors.

G. Arduini mentioned that the plan for the parallel MD in week 35 is operation with 25 ns spacing at high intensity. At that time we will have the LHC beam for 1 week 24 hours per day.

3 Recent MD Results II: LHC Beam Transverse Behavior (G. Arduini)

Turn-by-turn bunch motion was recorded above the electron cloud threshold.

Without damper, the horizontal tune splits into two lines. The second line starts approximately at bunch no. 20, and moves towards higher values, possibly consistent with the expected focusing effect of the electron cloud. The last part of the batch is unstable.

The vertical tune consists of only one line, whose value also shifts in the positive direction as a function of bunch number. The tune resumes the original value (the value of the start of the batch) after about bunch no. 40. This tune recovery is attributed to the strong (horizontal) beam instability in this part of the batch, which might blow up the beam and decrease the electron cloud.

The activity in the horizontal plane is confined to low frequencies. In the vertical plane all multi-bunch modes are rather uniformly excited.

The transverse damper completely stabilizes the horizontal plane, whereas the vertical multi-bunch modes above 10 MHz are still undamped, presumably because these lie outside the damper bandwidth.

A hole of 12 missing bunches inside the batch is insufficient to stabilize the bunches behind the gap. This measurement confirmed similar findings from last year, now at two times lower bunch intensity.

4 Recent MD Results III: RF for LHC Beam (T. Bohl, E. Shaposhnikova)

The low level rf system was recommissioned. New hardware, feedforward and TW cavities were put into operation. Some problems were associated with noise and with loop stability. Injection phase errors were quite large, of the order ± 1.5 ns.

The beam was unstable at various times, both at injection and during acceleration. The behavior of 1 or 3 batches was similar. Up to 50% bunch-to-bunch intensity fluctuations were observed.

It has been expected that the longitudinal instability threshold increases during the first part of the ramp and later decreases again during the second part. The beam becomes unstable at an energy of about 150 GeV, which is consistent with the computed threshold evolution. It is a coupled-bunch instability.

The 800-MHz system was not available for stabilization. Instead pink noise was used to induce an amplitude modulation of the 200-MHz rf, so as to blow up the beam longitudinal emittance. By this method, the beam could be stabilized. The MD time was too short for more detailed studies.

5 Recent MD Results IV: Kicker Rise Time (W. Höfle, G. Arduini, R. Jones,)

An injection kicker 'spike' is seen by the transverse damper. Both the preceding batch and the newly injected batch are affected. About three bunches in each batch experience up to 3 times the typical injection error. The turn-by-turn orbit motion measured for individual bunches shows a similar picture.

6 Recent MD Results V: Emittance (G. Arduini)

For an LHC beam below the multipacting threshold, the vertical emittance of about 3μm was preserved during the acceleration up to 340 GeV. Unfortunately, horizontal wire scanner data are not available, and the signal of the luminiscence monitor was perturbed by beam loss.

It is desirable that the wire scanner properly functions during the next long MD. In addition, a continuous emittance measurement from the luminiscence monitor would be useful.

7 Optics Study (A. Faus-Golfe)

A. Faus-Golfe started to analyze the chromaticity measurements taken July 17–19 by P. Collier et al. The initial values of the sextupole settings in the machine were different from those in the MAD model. The model will be updated to the correct values, as inferred from the control system. A preliminary fit suggests that the b_3 components in MBB and MBA are of opposite sign, consistent with the result for last year's measurement.

8 AOB (G. Arduini)

Set up for the single short bunch on the MD cycle including optics measurements are foreseen for Thursday and Friday, August 2–3. The following Monday and Tuesday are allocated to transverse and longitudinal impedance measurements, respectively. For the longitudinal impedance measurement, the intensity should be varied by scraping in the PS.

9 Next Meeting

An announcement for the next meeting will be sent by email in due time and the agenda will be posted on the web page of the working group http://cern.ch/sl-mgt-sps-swg

F. Zimmermann, 31st July 2001