SPS Studies Working Group
Fourth Meeting - 29th June 1999

Presents: G. Arduini (secretary), T. Bohl, H. Burkhardt, K. Cornelis (chairman), K. Hanke, W. Höfle, D. Manglunki, F. Zimmermann

Excused: F. Ruggiero, T. Linnecar, J. Tuckmantel

Follow-up of the previous meeting

- Tunnel movements as a consequence of the LHC civil engineering: the measurements performed by C. Arimatea last week have not revealed any quadrupole movement yet.

- TT10 matching: K. Hanke reported that a new optics has been loaded for the fixed target proton transfer. A geometrical mismatch factor < 1.1 has been measured after the re-matching (the initial value was >1.5).

Results of recent MDs

- H. Burkhardt reported on the measurement of the coherent tune shift for a single bunch at 26 GeV/c performed on the parasitic MD segment. The first part of the MD was dedicated to the adjustment of the machine parameters (capture voltage, chromaticity, machine octupoles) in order to get a clean tune measurement. The radial and vertical strength control variables for the octupoles were set to $-1.5\ m^{-3}$ (this should provide a cancellation of the natural octupolar component of the main machine magnets). The bunch intensity was varied from $1x10^{10}$ p to $1x10^{11}$ p. The bunch length could not be kept constant for the different intensities and varied from 2.3 to about 3 ns. The observed tune shifts are: 0.00152 ± 0.00014 per 10^{11} protons in the horizontal plane and -0.00894 ± 0.00047 per 10^{11} protons in the vertical plane. Tune precisions of 0.0004 (H) and 0.0015 (V) have been assumed. T. Bohl mentioned that important losses (25 %) were observed in the first 5 ms after injection. Their origin is not clear. During the MD it was observed that at lower intensity the decoherence time was longer than at higher intensity. K. Cornelis mentioned that this could be related to the space-charge tune spread that increases with the intensity. In that respect the evolution of the transverse emittance as a function of the intensity is an important parameter as it affects the space charge tune spread. Unfortunately the measurement of the transverse emittance was performed only for an intensity of about $6x10^{10}$ p but not for the other intensities. The measurement should be repeated with the damper on at injection and the transverse emittances should be recorded for the different intensities. K. Cornelis added that the same measurement should be performed also

for leptons that have a comparable bunch length. The space-charge tune spread is absent for the lepton beam as this is ultra-relativistic.

- W. Höfle reported about a problem observed on the signals provided by the damper horizontal pick-ups for the LHC beam. The base line of the sum and delta signal is not stable and some ringing is observed. No correlation has been found either with beam losses in the damper area or with the presence of leptons. The terminating (air filled adjustable) capacitors are suspected: these might breakdown as a consequence of the signal induced by the beam. New capacitors will be installed at the BPH210 during the next CPS MD (Wednesday, 30th June) and the MOPOS system will be disconnected in order to perform tests during the next long MD (Wednesday, 30th June).

- K. Cornelis reported on measurements performed with a 14 GeV/c 2 μs long batch (5 ns bunch spacing) to disentangle the effects of long range wake-fields (typically resistive wall) and short range wakes. The intensity of the batch was about 8.5 x 10^{12} protons. The evolution of the tune along the batch was measured by moving the Q-meter gate (500 ns long) along the batch when the whole batch is kicked. Due to the large error in the measurement no firm conclusion can be derived. The large errors are probably due to the strong damping provided by the damper. An analogous measurement was performed by kicking only part of the batch and measuring the tune at the same place. This measurement shows evidence of the effect of short-range wake-fields.
  It was also observed that at the above intensities a transverse horizontal instability develops in the batch from the edges to the centre of the batch. While the instability developing on the tail is expected the origin of the instability developing from the head is not clear. The frequency of the instability is about 6 MHz, just above the bandwidth of the damper. If the radial strength control parameter (octupoles) is lowered from 0.5 m^{-3} to -0.5 m^{-3} then the instability disappears. This seems to indicate that the natural octupolar component of the machine varies with the energy and should be therefore measured at 14 and 26 GeV/c.
  One of the possible schemes foreseen to inject a high intensity beam in the SPS is to inject a short batch (2 μs long) and let it debunch within two RF voltage barriers 1 μs long and equidistantly spaced in the machine. Due to the high intensity per bunch the microwave instability can arise during debunching, for that reason the momentum spread blow up with RF off was measured by using two wire scanners (one in a non-dispersive region and the other in a dispersive region). The momentum spread when the RF is off is 1.6 x 10^{-3} (2 σ) and when the RF is on is 1.3 x 10^{-3} for an intensity of about 4 x 10^{12} p/batch. The momentum spread of the extracted beam is about 10^{-3}. Some blow-up is therefore occurring as a consequence of the RF capture and some blow-up, probably due to microwave instability, is also observed when the RF is off. The measurement should be repeated at higher intensities. From these observations it also appeared that some beam is outside the RF bucket already at intensities of 4 x 10^{12} p/batch (corresponding to a total intensity of about 4 x 10^{13} p for a full machine).

- G. Arduini mentioned that during the last Wednesday MD (23/06/99) the coast at 26 GeV/c has been tested. An LHC type beam has been injected and sudden losses have been observed from time to time at different timings. This might be related to the fact that the damper is not active when going in coast.

Next meeting

The next meeting will take place on Tuesday 13th July 1999, at 09:15, **J.B. Adams conference room**. A reminder will be sent by e-mail in due time and the agenda will be announced on the web page of the working group http://wwwinfo.cern.ch/~ghislain/sswg/sswg.html.

G. Arduini
3rd July 1999