SPS Studies Working Group
Fifth Meeting - 13th July 1999

Presents: G. Arduini (secretary), R. Assmann, T. Bohl, K. Cornelis (chairman), K. Hanke, W. Höfle, D. Manglunki, F. Ruggiero, E. Shaposhnikova, L. Vos, F. Zimmermann, M-P. Zorzano

Excused: R. Cappi

Follow-up of the previous meeting

- Since a few days it has been observed that frequent re-sharing of the north extraction is required. This is very sensitive to the vertical orbit position or angle in the extraction region. Last week measurements performed by C. Arimatea did not reveal any quadrupole movement yet.

Results of recent MDs

- Th. Bohl reported on the capture of a 14 GeV/c - 2 μs long batch. He mentioned that the capture was not good because of the poor RF structure coming from the PS. D. Manglunki suggested to inform the operation crew whenever the problem reappears.

- W. Höfle presented a status report on the present understanding of the origin of the base-line jump on the signal provided by the pick-ups used by the damper (see the minutes of the 4th SSWG meeting) for the LHC beam. No improvement has been observed after the disconnection of the MOPOS electronics. The bas-line jump appears for the LHC beam at intensities higher than 0.3 x 10^{11} p/bunch. A DC bias voltage has been applied on two electrostatic pick-ups. Tiny negative bias voltages (-2 V on one plate and –8 V) seem to eliminate the base-line drift. For any other pair of voltages the phenomenon reappears. W. Höfle mentioned that a possible explanation could be multipacting generated by the electromagnetic fields induced by the beam. For that reason the frequency spectrum induced by the beam on the two plates of the pick-ups has been measured for the fixed-target and the LHC proton beams and for the positron beam. The pick-up transfer function will be measured in the laboratory to verify if the pick-up is resonating at any of the measured LHC beam frequencies which are not present for the other beams. An additional access (1 hour) is required for additional investigations to connect the cables from the monitor 210 in such a way that the signals on the two pick-plates individually can be observed. It will be provided during next Wednesday MD (14/7/99). K. Cornelis noticed that if multipacting occurs a threshold voltage should exist above which the phenomenon disappears and this is not the case. W. Höfle concluded that from the measurements performed during the last long MD (30/6/99-1/7/99) the damping time provided by the dampers is consistent with that expected at the intensity of 0.3 x 10^{11} p/bunch.

- G. Arduini reported on the measurement (taken in collaboration with X. Altuna and K. Cornelis) of the radial and vertical octupole moment of the machine at 26 GeV/c for different values of the corresponding control parameters. The measurements were performed during the last long MD with the LHC beam (0.3 x 10^{11} p/bunch). The detuning as a function of amplitude was measured for different values of the control parameters and the values corresponding to zero detuning were determined. Slightly negative values of the radial and vertical strength control variables (-0.8 m^{-3}) provide zero detuning with amplitude, that is a cancellation of the natural octupole component of the machine, in both planes. The measurement in the vertical plane is less neat (larger tune spread) than the horizontal one and it should be repeated at lower intensities.

- F. Zimmermann reported on several measurements conducted in collaboration with G. Arduini, H. Burkhardt, K. Cornelis, M.-P. Zorzano.
  A preliminary measurement of the *octupole moment of the machine at 14 GeV/c* has been performed. Minimum detuning with amplitude seems to be achieved for values of the control variables roughly equal to -1.5 m^{-3} in both radial and vertical plane. The precision of the measurement is poor and it should be repeated at lower intensity.
  The *coherent tune shift as a function of the intensity* was measured in the range 2 to 10 x 10^{12} proton/batch *for the fixed-target 10 μsec long batch (14 GeV/c)*. The measured coherent tune shift is 0.0017 ± 0.0002 (H) and -0.0018 ± 0.0003 (V) per 10^{12} proton/batch. This in good agreement with the expected Laslett tune-shift (assuming no contribution from the direct space charge) if a correction factor $<\beta>Q/R=1.3$ is applied to take into account the discrepancy with respect to the smooth accelerator model for which the Laslett formula is calculated.
  The *evolution of the coherent tune shift along the batch for different batch intensities* has also been measured *for the fixed target proton beam* but no significant dependence has been observed. This is consistent with a zero mode instability and is confirmed by the behaviour of the delta signals provided by the damper pick-ups. Tune data seem to concentrate around two values. This could be the result of the poor resolution provided by the simple FFT method used to determine the peak position. Another possible explanation is that the tune changes are related to the noise in the current of the main power converters. D. Manglunki suggested that, if this is the case, synchronising the measurement of the tune with the phase of the mains could eliminate this error.
  The *coherent tune shift as a function of the intensity* was measured in the range 0.2 to 2 x 10^{10} electron/bunch *for the electron beam at 3.5 GeV/c for 1 and 4 bunches*. The measured tune values are clustered around some discrete values for the horizontal plane while the measurement is relatively cleaner in the vertical plane and it provides -0.023 ± 0.001 per 10^{10} electron/bunch for the single bunch and -0.0118 ± 0.0015 per 10^{10} electron/bunch for a bunch train of 4 bunches. A tune precision of about 0.002

has been assumed in order to get a reasonable linear fit. The measured values do not agree with those measured for the 26 GeV/c single bunch.
F. Zimmermann also presented also an estimate of the coherent tune shift for a 26 GeV/c single bunch. He considered the contributions given by the single bunch resistive wall, by the Laslett formula and by a broad-band resonator model with a resonant frequency of 1.35 GHz and an impedance of 5.2 (H) and 12.5 (V) MΩ/m measured by L. Vos during the ppbar period. The dominant contribution is given by the broadband resonator model, which provides the following, tune shifts: -0.0046 (H) and -0.011 (V) per 10^{11} protons. These must be compared with the measured values 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 (see the minutes of the 4th SSWG meeting). The agreement is good in the vertical plane but not in the horizontal.
E. Shaposhnikova mentioned that some other measurements of the transverse mode coupling instability threshold are consistent with an impedance of 23 MΩ/m. The values of the transverse impedance are strongly dependent on the model that has been used for the interpretation of the measured data. It is very important to provide a collection of the measured impedances with a clear specification of the measured quantities and of the model used to calculate the impedance. **Action: F. Zimmermann.**

- K. Cornelis reported on some observations he performed on the 14 GeV/c 10 μsec long batch. The horizontal tune spectrum shows two peaks at 0.62 and 0.75. The first one does not move if the horizontal tune is changed. The further the tune is from 0.62 the more stable is the beam. A measurement of the growth rate of the resistive wall instabilities as a function of the tune evidenced indeed a maximum at 0.62.

Next meeting

The next meeting will take place on Tuesday 27th July 1999, at 09:15, room 865-1-D17. 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
16th July 1999