SPS Studies Working Group
Eighth Meeting - 25th September 2001

Presents: G. Arduini (secretary), Ph. Baudrenghien, T. Bohl, H. Burkhardt, R. Cappi, K. Cornelis (chairman), B. Dehning, J. Gareyte, M. Hayes, W. Höfle, L. Jensen, J.M. Jimenez, T. Linnecar, G. Rumolo, J. Tuckmantel, L. Vos, J. Wenninger.

Excused: F. Zimmermann

Capture of high intensity beams for CNGS (J. Tuckmantel)

Coasting beams of a few 10^{12} protons are unstable in the SPS. For that reason debunching and recapture at 200 MHz is performed in the PS machine for the fixed target beam (SFTPRO) before extraction towards the SPS. An alternative scheme has been recently proposed in order to avoid instabilities observed in the PS during the debunching process. Long (110 ns) bunches could be created in the PS by bunch rotation before extraction and a strong 200 MHz cavity (50 MV) in the injection line could then provide sufficient bunch modulation to give a bunched beam after a few tens of turns in the SPS. Simulations of the energy modulation in the TT10 line and of the capture in the SPS were presented (see transparencies. For the simulations it has been assumed that the 200 MHz system is installed in the SPS for simplicity reasons). No impedance model for the SPS has been assumed in the simulation. The energy modulation could be obtained also by pulsing the existing SPS 200 MHz Travelling Wave Cavities to 7 MV over a few turns. This would imply a modulation of the voltage in the cavities during a revolution period in order to apply the energy modulation and capture to the second batch without perturbing the first batch circulating in the SPS. T. Linnecar commented that adiabatic capture in the SPS was performed in the early years at low intensities (few 10^{12} protons) with poor efficiencies because of the instabilities affecting the coasting beam at injection. For that reason the present bunch-to-bucket transfer (with debunching and recapture in the PS) was introduced. R. Cappi observed that the 200 MHz cavities in the PS are providing only an intensity modulation in the beam, which is not fully bunched. He also mentioned that the absence of 200 MHz modulation on the beam delivered by the PS does not seem to affect significantly the capture efficiency in the SPS (reduction of the transmission efficiency in the SPS by a few percents). Ph. Baudrenghien and T. Linnecar commented that the 200 MHz modulation is important to provide a reference for most of the RF loops in the SPS at injection. R. Cappi reminded that with the new scheme proposed above the 10 MHz structure in the PS beam will persist in the SPS and asked if this is expected to be a problem. T. Linnecar replied that experiments should be performed. G. Arduini suggested to impose the 200 MHz modulation to the 16 bunches of the SFTPRO beam before extraction without going through the debunching process, this should avoid the instabilities observed during the debunching in the PS. It was agreed that a test should be done this year (week 42). K. Cornelis asked what is the status of the high intensity in the

PS. R. Cappi replied that double batch injection in the PS (2 batches of $2x10^{13}$ proton/batch) has been achieved. The CT extraction of such a beam in pulse-to-pulse mode is being tested and it is hoped to provide a high intensity beam for the SPS MD in week 42.

Results of recent MDs (Ph. Baudrenghien, M. Hayes)

- Ph. Baudrenghien reported on the results of the Long MD performed in week 37. The hardware for the damping of the phase oscillations of each of the 4 LHC batches was successfully tested and provided the desired effect in about a synchrotron period. An issue to be addressed is the effect of such a damping system on the circulating beam as the distance between batches is smaller than the filling time of the TW cavities. Longitudinal coupled bunch instabilities are observed in the LHC beam for intensities higher than $4.6x10^{12}$ proton/batch. The rise time of such low-mode instabilities is about 1 s long. The rise time of the instability gets longer if the gain of the 1-turn feedback of the 200 MHz TWC is increased. Increasing the RF voltage has a similar effect. This instability can be cured also by increasing the synchrotron tune spread (and therefore Landau damping) by means of the fourth harmonic SPS RF system (800 MHz TWC) in bunch shortening mode. In this mode the synchrotron tune spread increases with the longitudinal emittance for a wider range of longitudinal emittances as compared to the bunch-lengthening mode. Furthermore the tune spread obtained in bunch shortening mode is less sensitive to RF phase errors than in bunch lengthening mode.
- M. Hayes reported briefly on the machine development sessions devoted to the measurement of resonant terms performed on the MD cycle at 26 GeV. Plenty of data could be collected and are being analysed. In order to get stable reading of the 1000 turn data all the orbit programs running in the control room had to be stopped. Noise was observed on all the beam position monitors of a sextant. The sextant with noisy beam position monitors varied with time. M. Hayes mentioned that no data could be taken with the wire scanner in BA5.

G. Arduini
7th October 2001