Minutes of the meeting of the SPS Upgrade Study Group on 18 November 2010

Present: T. Argyropoulos, H. Bartosik, C. Bhat, F. Caspers, S. Federmann, R. Garoby, B. Goddard, E. Mahner, H. Neupert, Y. Papaphilippou, M. Taborelli, G. Rumolo, E. Shaposhnikova

Excused: G. Arduini, C. Yin Vallgren, J. Bauche

• Pressure and e-cloud measurements. SPS MD run 19/20.10.2010 and 10.11.2010 - H. Neupert

The correlation between pressure measurements and e-cloud signals was analysed. For different beams and conditions during MDs the pressure was acquired during the acceleration cycle (with a 1 s sampling rate) between the two coated, two reference magnets, coated and uncoated magnets and in the region of the e-cloud monitors. Maximum pressure rise was observed between the coated and uncoated magnets (is it due to contaminated MBB51550?) as well as in the region of ECMs. While the e-cloud signal has an expected dependence on bunch spacing and intensity, the pressure rise in coated magnets is lower than in uncoated for 36 bunches and higher for 72 bunches both spaced at 25 ns. It looks as if the pressure rise is not just reflecting e-cloud activity.

• Beam observations during MD week 42 - E. Shaposhnikova

Beams with 50 ns and 25 ns spaced bunches were studied using the dedicated MD cycle in the SPS. This created a problem with the MKE magnets heating even with a single batch with 50 ns spacing. No transverse emittance blow-up was observed at the end of the cycle for a 50 ns beam (2.5 μm at extraction) while for a 25 ns beam with the same number of bunches per batch (36) the measured vertical emittance grew with the number of batches reaching a value of 3.7$\pm$0.9 μm for 4 batches. The horizontal emittance was around 3.5 μm.

$\rightarrow$ Bunch-by-bunch emittance measurements with higher accuracy are required to investigate the origin of the observed emittance blow-up.

The necessity of the longitudinal emittance blow-up for a 50 ns spaced beam was analysed. Stability of a 50 ns beam with the 800 MHz RF on in bunch-shortening mode seems to strongly depend on injected bunch length (emittance). For the nominal voltage program the beam was unstable on the flat top for an injected bunch length below 3.5 ns (probably also more unstable towards the batch tail). This effect could be observed even locally, when only a few bunches had a smaller bunch length at injection. In this case controlled emittance blow-up is required for stability on the flat top. On the other hand transmission in the SPS decreases from 95 % to 88 % when the injected emittance is increased from 0.33 eVs to 0.5 eVs due to the corresponding increase in bunch length.

• Preliminary MD results for a low transition energy in the SPS - H. Bartosik

For a low transition energy the expected increase in instability threshold is proportional to the slippage factor η. However for the same longitudinal parameters the voltage also scales as η which could prove to be a limitation for fast cycles and beam transfer to LHC. The decrease in

transition gamma from 22.8 to 18 is achieved by lowering the present tunes (26.13 and 26.18) by 6 units. Maximum dispersion is also increased from 4.8 m to 9 m. The new optics was confirmed by measuring the optics functions and the synchrotron frequency from the quadrupole oscillations. Chromaticity was also measured and calibrated. No signature of the TMCI was observed for injected single bunches with intensities in the range $(2.7-3.3)\times10^{11}$. Initially the voltage on the flat bottom was too low (1.8 MV) and this led to continuous particle loss ~ 10 % with a corresponding, small, reduction in the bunch length. No transverse emittance blow-up could be measured on the flat bottom for bunches with $\varepsilon_{\mathrm{H/V}} = 2.0/2.3$ μm at 2.6×10^{11} and $\varepsilon_{\mathrm{H/V}} = 2.5/2.7$ μm at 3.3×10^{11}. With limited time for optimisation single bunch was accelerated to 450 GeV/s using the LHCfast3 cycle. For an intensity of 2.6×10^{11} on the flat top emittances were $\varepsilon_{\mathrm{H/V}} = 2.4/2.9$ μm.

$\rightarrow$ Very promising results. The next important step will be to inject bunch trains to study multi-bunch effects, in particular e-cloud and longitudinal coupled-bunch instability during the ramp.

- The next meeting will be on **16 December 2010** at 16:00.

Preliminary agenda:
(1) Shutdown plans for e-cloud studies - M. Taborelli
(2) RF transmission measurements of e-cloud - S. Federmann/F. Caspers
(3) New results for low transition energy in the SPS - H. Bartosik
(4) End of year drink - everybody

Elena Shaposhnikova, 2.12.2010