Minutes of the 1st meeting of the SPS Upgrade Working Group on Wednesday 21 March at 16:30 in room 6-2-002

Present: G. Arduini, F. Caspers, K. Cornelis, P. Costa Pinto, S. Calatroni, P. Chiggiato, R. Garoby, T. Kroyer, G. Rumolo, M. Taborelli, E. Shaposhnikova, F. Zimmermann

The meeting was devoted to the discussion of the possible SPS vacuum chamber upgrade as a measure against the e-cloud problem

Agenda

• Electron cloud in the SPS and present limitations for the LHC beam - G. Arduini

Electron cloud is at the moment the main intensity limitation even for the nominal LHC beam parameters in the SPS. It can be observed as a pressure rise (mainly in the arcs - 70% of the ring) and causes transverse emittance increase and beam losses. Main cures include transverse feedback (in H-plane), increased chromaticity in both planes and scrubbing run (1 week) at the beginning of operation. The scrubbing run has limited effect due to dependence of scrubbed region (the distance between two stripes of 2-3 mm width) on intensity. After the scrubbing the multipacting threshold increases from 2×10^{10} to 8×10^{10}, leading to the conclusion (after comparison with simulations) that the SEY decreased from 2.2 to (1.3-1.6). The low value obtained probably comes back to the initial one after the shutdown work in the ring. There are also some observations that a few weeks without beam and no ventilation also lead to an increase in SEY (no quantitative data available).

With the vertical emittance being already marginal (3.6 +/- 0.3) μm any future intensity increase (as to ultimate) would lead to larger emittances and requires a more drastic upgrade programme.

• Motivation for the future SPS with PS2 - G. Rumolo

Intensive HEADTAIL simulations have been performed to address the question about scaling of e-cloud single bunch vertical instability with beam energy. Contrary to the classical TMCI (transverse mode coupling instability) due to the conventional impedances the simulations indicate that for constant transverse (normalised) and longitudinal beam parameters the scaling with energy E is 1/E, which can be explained by reduction of the transverse beam size with energy. With the self-consistent e-cloud production in the code, the instability threshold in the SPS decreases in the energy range from 26 GeV/c to 100 GeV/c, and then it levels off at the build-up threshold. A few days ago the scaling from 40 GeV to 270 GeV was confirmed by simulations using different code (Ohmi's PENTS in KEK).

One of the suggested cures is the increased longitudinal emittance at injection. Giovanni will evaluate the scaling of threshold with emittance (for constant bunch length) and intensity at 50 GeV/c.

Measurements performed in the SPS in 2006 did not show a decrease in e-cloud threshold at 450 GeV in agreement with simulations due to the increase in beam size during acceleration. Nevertheless experimental confirmation seems to be very important for future injector upgrades.

Karel will look at the possibility of using the special magnetic cycle based on the LHC cycle with a 5 s long flat portion at 50 GeV to have more clear measurements. The main problem is the time (manpower) required for its setting-up. A better comparison probably could be obtained with flat portions at different energies (to avoid influence of injection into mismatched bucket). Frank is interested in these cycles for other MDs.

• **Possible solutions for the e-cloud problem - F. Zimmermann**

As a summary of the recent (March 2007) Workshop ECL2 organized by Frank, Fritz (and others) various solutions for the e-cloud problem were presented. They are different for new and old vacuum chambers. For the old chamber of the SPS, apart from the suppression efficiency, impedance and vacuum issues, their implication and cost are also very important considerations. In addition no significant (>0.5 mm?) reduction in the physical aperture of the SPS is allowed as well. For the SPS they could be: TiN or other coating, in-situ grooves and electrete inserts. They all have their pros and cons. None of them, except coating with reactivation, have been really proved to work in real machine and detailed studies and information are required to decide about their applicability for the SPS.

Grooves, electretes and sliding-in electrodes (the latest idea of Fritz) will be discussed at a separate future meeting.

• **Possible surface modifications to reduce SEY - P. Chiggiato**

Solutions without in-situ heating could be: coating (TiN, Cr2O3, ...); glow discharge Ar/O2 and chemical cleaning. NEG requires a reactivation and therefore is excluded. The solution for in-situ coating by sputtering already exists. Up to 6 chambers per day can be treated in the tunnel by 3-4 people. TiN with SEY of 0.9 was produced (somewhere). The main problem is its long term behavior with periodic venting and conditioning by beam. The best composition can be studied in the lab followed by measurements with beam in the ring in a special set-up. The first samples can be produced and tested in the lab during this year.

Roland strongly supported these plans and he will consider their possible financing through PAF.

Elena Shaposhnikova, 26.03.2007