Minutes of the 26th meeting of the SPS Upgrade Study Team on 19 May 2009

Present: G. Arduini, M. Barnes, J. Bauche, S. Calatroni, R. H. Cavaleiro Soares, P. Chiggiato, P. Costa Pinto, R. Garoby, E. Mahner, E. Metral, N. Mounet, G. Rumolo, B. Salvant, E. Shaposhnikova, M. Taborelli, V. Vaccaro, C. Yin Vallgren

- **Update re kicker magnets impedance in the SPS - M. Barnes**

All MKE kickers have transition pieces between magnet and tank and all (3) MKE6 magnets are now serigraphed. As a result a much smaller temperature rise (factor 4 for LHC beam) is expected during operation, however an additional peak has been measured in the longitudinal impedance at 48 MHz. The nature of the unchanged high peak at 1.7 GHz is not yet clear while the low frequency spike could be related to the external circuit (termination). During the next 3 shutdowns 5 MKE4 kickers will also be serigraphed. To achieve this spare magnets (one L and one S) should be converted during operation.

In 2008 MKDV1 had fast outgassing with 50 ns spaced beam, stronger than for 25 ns spaced beam, contrary to observations of the e-cloud (strip-line monitors). Measurements in 2009 should demonstrate the effect of transition pieces installed recently together with temperature probes on a spare MKDV1 which is now in the ring. Measurements of longitudinal impedance done on MKDV1 and MKDV2 show that transition pieces suppress the spikes starting at some frequency above 200 MHz, in agreement with a half-wavelength defined by the magnet length. These peak frequencies are different for MKDV1 and MKDV2 which can explain an excessive heating of MKDV2 with 75 ns spaced beam. Transition pieces in MKDV2 should solve this problem, however only spare MKDV1 is available which has a smaller vertical aperture and is not recommended for installation at the position of MKDV2 (confirmed also later by G. Arduini and J. Uythoven).

Transition pieces are still to be installed in all MKDH. The theoretical model used for impedance calculations assumes a ferrite core and therefore diverges from the measurements of these magnets having a laminated steel core.

The high impedance measured around 1.7 GHz in all magnets (MKE, MKDV, MKDH), also with serigraphy, needs to be explained. Probably it comes from the measurement set-up (beam pipe at the ends).

Enamel flanges (with 0.1 mm ceramic rings) installed around kickers were also discussed and even demonstrated. Similar flanges in the PSB and PS (resonant frequency of 4.4 MHz) have the RF bypasses.

→ The number of insulated flanges in the SPS is probably small but nevertheless the inventory should be made. It would be also useful to determine its resonant frequency.

- **Follow up on SPS transverse impedance - B. Salvant et al.**

The main objective of the impedance team (led by E. Metral) is to obtain, from calculations, electromagnetic simulations and measurements done for all single SPS elements, a general wake which could then be used in particle simulations (HEADTAIL) for comparison with measured beam tune shifts and instability thresholds. So far 40% of the SPS transverse impedance seems to be missing in the model (which includes kickers, BPMs and beam pipe) for agreement with measured tune shifts while obtained instability thresholds are quite close to those measured. The direct space charge should increase the predicted thresholds and leave a room to accommodate more impedance in agreement with the tune shift data.

High-Q resonant impedances of BPMs may lead to coupled bunch instabilities (transverse and longitudinal).

Other beam observables studied (both by simulations and with beam) are intensity dependent phase advance (used for impedance localisation) and spectrum of long unstable bunches (search for resonant frequencies).

Search for unknown impedances is a very important issue for the SPS upgrade since the impedance reduction required by future intensities assumes first of all its identification.

• **Coating of the SPS main dipoles vacuum chambers. Resources needed for project. - J. Bauche**

The updated work hypothesis was presented where the 48 hours previously assumed for coating of one magnet are replaced by 4 days (extra time for cleaning and installations).

The capacity of the underground workshop ECX5 (plus 100 m2 floor in ECA5) without any serious modifications is for 16 dipoles and would be 24 magnets with the additional 300 m2 floor space in ECA5.

The detailed comparison of work planning for 3 and 4 years, based on consultations with all groups involved in the project, shows that a 4-year scenario has many advantages and is also $\sim 30\%$ less expensive (by 2 MCHF). It is expected that a 5 year-scenario will be again more expensive due to non-optimum use of manpower.

With 4 magnets produced per day we will need 8 coating benches working simultaneously. One of the potential problems - large quantity of contaminated water (after rinsing). Radiation level (ALARA) should be also taken into account for work planning after a beam stop.

Edgar suggested considering a replacement for the shielded vacuum ports during a coating campaign. → He will think about this possibility.

Pedro Costa Pinto reported about successful plasma cleaning of carbon coating (in lab system).

• **Progress report on coatings - M. Taborelli**

Twice higher pressure was measured between coated magnets (51540) in comparison with uncoated MBBs at the beginning of beam operation (23.04.2009). On 28.04 all absolute values were reduced, but pressure between the coated magnets was still $\sim 50\%$ higher than for uncoated with a pressure value in between these two for one coated and one uncoated magnet. This is consistent with the (4 times) higher outgassing measured in lab for fully C-coated tubes as compared to the StSt tubes.

Thermal recovery of ageing was studied for a sample with SEY of 1.35 after one month of air exposure. SEY was reduced to 1.2 after heating at 200 deg, but went up to 1.3 again after one night in air.

Measurements of recent coating produced by C-Cu co-sputtering show an increase of SEY with increasing amount of Cu.

• **The installation to degrease the SPS magnets chambers - L. Ferreira**

The main (seven) steps of the degreasing procedure will take about 5 hours. a similar procedure is applied for LHC magnets by a special cleaning machine. Floor spaces of 3x6 m2 and 1x8 m2 are required to conduct this operation for SPS dipoles. Necessary services include demineralised water (up to 4 m3/cycle), clean, dry air or nitrogen, power supply and ventilation. Safety is an important issue due to chemical risks.

• The next meeting will be on **30 June 2009** at 15:30 in the JBA room (bld. 864).

Preliminary agenda:

Future modification of the SPS vacuum system - P. Chiggiato

Results from the scrubbing run - C. Yin Vallgren, F. Caspers, M. Taborelli

Progress report on coatings - M. Taborelli

Elena Shaposhnikova, 27.05.2009