Minutes of the meeting of the SPS Upgrade Study Group on 26 August 2010

Present: C. Bhat, S. Calatroni, P. Costa Pinto, S. Federmann, V. Lebedev, H. Neupert, G. Rumolo, E. Shaposhnikova, C. Yin Vallgren

Excused: G. Arduini, F. Caspers, R. Garoby, V. Mertens, E. Metral, B. Salvant, M. Taborelli, U. Wienands

• Coatings and coating systems - P. Costa Pinto

Two main options of carbon coating - with and without opening magnets were compared. Magnetron sputtering was used so far in both cases, applying an external solenoid field in the first case and a dipole field in the second.

Very good results were obtained for coatings in the chambers outside the dipoles: an uniform thickness, SEY around 1.0, no ageing after 70 days of storage in N_2 followed by MBB assembling. The possibility of using the high temperature (230 deg C) is one of the most important advantages of this method. The only issue is the fragility of the carbon cathode with dimensions 6 cm x 740 cm. Three MBB chambers have been fully coated in this way and inserted inside the magnets (for installation in w35, see below). Due to the large coated surface this is the worst case scenario for outgassing, which could be reduced in future since only coating of the central part (4-5 cm wide) on the top and bottom of the chamber is required for the e-cloud suppression. No magnetic measurements have been done on these magnets, we will rely on measurements done with the FT beam after the technical stop. This is still possible for three newly installed magnets, but other methods have to be found in future.

A new method of magnetron sputtering based on permanent magnets was applied for coating the chamber inside a dipole. It looks promising due to a slow ageing of the sample kept in the Al foil during 3.5 months (SEY=0.98 $\rightarrow$ 1.05), which can be considered as an indication of a good quality of the coating (film density). The main problem observed is a formation of some structures (like fractals) of the size of hundreds of microns, most probably due to ion bombardment; this could probably be avoided in future tests by magnet displacement during the coating process. The next steps will be a 1 m and then a 6.4 m long prototype.

$\rightarrow$ More measurements are required for ageing studies. At the next meeting Christina will give a summary of our present understanding; to be also presented at the workshop ECLOUD'10 in Cornell in October 2010.

• RF measurements of the SPS pumping ports without shielding inserts - S. Federmann

In the RF transmission measurements the coupling had to be increased so that amplifiers suffering from radiation could be removed from the tunnel to the surface. Careful comparison between theoretical estimations and measured attenuation suggests that removal of the pumping port shielding might significantly improve signal transmission. In this case a single loop is sufficient to couple to the TE_{20} mode (at 2.5 GHz) and its orientation seems to be not very important. Nevertheless it would be better to have a definitive loop orientation.

• Multipactor measurements on a stand alone MBB magnet - F. Caspers, P. Costa Pinto, S. Federmann, M. Taborelli

The first results obtained from multipactor (MP) measurements on the StSt chamber inside the MBB magnet have demonstrated proof of principle for this experimental set-up. Multipactoring (together with a conditioning effect) was observed for the expected power level, with lower threshold in the presence of magnetic field. RF power sweep with 1 min repetition rate was performed at 225 MHz. Required power (10 Watt) was estimated using the ESA MP code. Tests were made both with pulsed and constant power. In future the RF transmission can be used as a multipactoring diagnostic together with the existing measurements of reflected power and vacuum.

→ Next step is measurements on the a-C coated magnet in a more "professional" set-up. Holger has proposed to use a similar set-up for liner calibration.

• Strategy for TS week 35 - J. Bauche

A detailed programme of magnet insertion and transfer was developed. It should be completed in less than 48 hours including time required for pumping down. Old coated magnets in positions 51470, 51530 and 51550 will be removed (temporarily) to the storage area in BA3 (268) and BA6 (096, 285). The newly coated magnets will be installed in positions 51470, 51490 and 51530. The first two (015, 188) will be used from now for pressure monitoring, while the last one (289), together with displaced uncoated magnet 177 (now in position 51550), in addition to pressure measurements, will have the modified RF transmission set-up (see above).

• Single bunch MD on 5-6th August: short preliminary summary - E. Shaposhnikova/B. Salvant

Single bunches with nominal transverse and longitudinal emittances and ultimate intensity (up to 2×10^{11}) were injected into the SPS on August 5. Beam was not accelerated. With octupoles on, these bunches were transversely stable with vertical chromaticities ξ_v in the range (0 - 0.3). With octupoles off, fast losses at injection were observed for ξ_v below 0.05. Horizontal chromaticity was kept constant at 0.15. Slow longitudinal instability was observed for intensities above 1.9×10^{11}.

During the second day of the MD, on August 6, measurements were made for very high intensity bunches (up to 3.5×10^{11}) with nominal longitudinal emittance and nominal and small transverse emittances. Scanning of vertical chromaticity allowed the threshold chromaticities to be determined for both parameter sets. A higher threshold, expected from theory and simulations for smaller transverse emittances (due to a space charge effect) was not observed. Data is in the process of analysis.

Maximum bunch intensity measured in the SPS after fast injection losses was strongly dependent on the vertical chromaticity for both nominal and small transverse emittances. For $\xi_v = 0$ only 2.2×10^{11} could be kept on the flat bottom after fast initial losses occurring during the first few ms, while for $\xi_v = 0.3$ up to 3.4×10^{11} were obtained.

• Planning of the SPS MD week 35 - G. Rumolo

During the next SPS MD in w35 time foreseen for the SPSU studies is from 9:00, Friday, 3.09 till 7:00, Saturday, 4.09. A 50 ns spaced beam with ultimate (1.9×10^{11}) bunch intensity has been prepared in the PSB and PS (with practically nominal emittances) and will be used in the SPS

for measurements of the e-cloud build-up as a function of bunch intensity. At 21:00 a 25 ns spaced nominal LHC beam will be taken for reference pressure and e-cloud measurements both in the magnets and liners.

- The next meeting will be on **23 September 2010** at 15:30.

Preliminary agenda:

1. Heavy-ion desorption yields of amorphous carbon films bombarded with 4.2 MeV/u lead ions at LINAC3 - E. Mahner

2. Results of the SPS MD w35:

- E-cloud with a 50 ns spaced beam - G. Rumolo
- RF transmission measurements of e-cloud - S. Federmann/F. Caspers
- Pressure measurements for different beams - tbd

3. Summary of a-C ageing - C. Yin Vallgren

4. News on coatings and coating systems - M. Taborelli/ P. Costa Pinto

Elena Shaposhnikova, 7.09.2010