Minutes of the 13th meeting of the SPS Upgrade Study Team on 11 March 2008

Present: S. Calatroni, F. Caspers, P. Chiggiato, R. Garoby, T. Kroyer, E. Mahner, M. Pivi, G. Rumolo, E. Shaposhnikova, M. Taborelli

Excused: G. Arduini, K. Cornelis, F. Zimmermann

• **The 2008 SPS e-cloud experiment with enamel electrode - E. Mahner et al.**

Edgar described the progress with installations in 518. All detectors are now installed and pumping should start at the end of this week.

The place between XSD1 and XSD2 detectors is occupied by two stainless steel chambers of MBN type: one hosting the antechamber with electrodes, another, the standard one, for reference measurements. Both of them are equipped with two button PUs which will be inside the C-magnet. The electrode is installed in the antechamber, slightly below the bottom level of beam pipe, providing the space for contact fingers (Au/CuBe) at the two ends without any aperture reduction. The two magnets which are able to produce about 100 Gauss maximum inside these chambers will be also installed soon. The experiment connected with the cleaning electrode in the SPS will be controlled locally, from BA5. The 2008 program for measurements and data analysis will be presented by Edgar at the next SPSU meeting.

The outgasing of the enamel was not measured yet but should not be a problem due to its production process (baking at high temperature). This issue nevertheless will be controlled by Mauro from the sample which should be provided by Fritz.

• **Progress on coatings - M. Taborelli et al.**

The liners for the SPS tests have been produced. TiZrV (NEG) and TiN are ready and C will be ready at the end of this week. Mauro also presented results of recent measurements of yields for different materials. The calibration tests were performed with Cu and other materials for measurements done at CERN with AES and in Madrid with the true SEY measurement system. This was done for coatings with 10 days exposure to air (traveling time to Madrid). The maximum SEY of 1.36 was measured in Madrid for C. In general measurements with pulsed electron beam give higher SEY values than with continuous beam (charging). The comparison of SEY for the three different materials placed them in the following order: TiN > CN > C. For the C coating no problems of charging and adhesion were observed so far, on SEM images it looks very compact with an amorphous structure.

The measurement system at CERN which includes e-gun, vacuum chamber and collector will be ready in two weeks. The next steps will be the following. For TiN coating - continue to look for optimum composition. There are more things to study for CN before using them for liners in the final geometry. The coatings based on C with ion implantation are considered also to be promising. There are other materials, with low atomic weight, which are under consideration (e.g. B4C).

• **Electron cloud studies at SLAC - M. Pivi (SLAC).**

The first part of presentation was devoted to the electron cloud installation studies at SLAC

for the ILC damping ring. Significant reduction of SEY for TiN coating (factor 2) was observed in PEP-II after beam conditioning in e^+ beam line (synchrotron radiation plus electron and ion impact). Under these conditions the Carbon content in the coating was also reduced.

In the second part of the talk the first results of the experiment with a cleaning electrode at KEKB (stripline, sputtered on aluminum) were presented. The reduction by a factor 10-20 was demonstrated by applying a clearing voltage of $\pm$500 V. Main problems at the moment are heating of feedthroughs, heating and discharge at connecting parts and decrease of insulation resistivity.

The last part of the presentation concerned the grooves. According to the simulations done at SLAC at magnetic field of 2 T, the SEY can be reduced from 1.3 for flat chamber to 0.7 or 0.9 for grooves with 2 mm and 1 mm heights correspondingly. The e-cloud build up depends critically on the sharpness of grooves (both tips and valleys) and the effect of the grooves becomes negligible for radii more than 50 μm. Two options for their manufacturing exist: grooves could be produced in-situ on the existing vacuum chamber or as an insertion. In the last case they can be fabricated by different methods which include extrusion, machining, EDM, isostatic pressing, brazing-up and metal folding. The last two are considered at the moment as the most promising. Most of these methods have a problem of dealing with small curvature radii for grooves of small depth. The grooves produced so far (by extrusion) have a height of 1.9 mm, a tip radius of 0.095 mm and a valley radius of 0.14 mm. Simulations show that for B field increase from 0.2 T to 2 T the maximum SEY value increases from 0.7 to 0.8 for a radius of 0.09 mm and from 0.8 to 1 for a radius of 0.14 mm. The flat chamber had a maximum SEY of 1.7. The height of 2 mm is too big for the SPS aperture, but probably they still can be used for proof of principle for the proton machine. If needed they can be installed in antechamber (as cleaning electrode) and results can be compared with a smooth chamber (with TiN coating or without).

The possible scheme of the test installation in the SPS should be discussed in detail (where, one or two plates, holes for collector, coating...). The impedance of grooves also need to be evaluated at different frequencies.

- **The SPS e-cloud MDs in 2008 - G. Rumolo**

The MDs planned in the SPS for this year will concentrate on studies of frequency dependence of the e-cloud instability as a function of different parameters (as beam energy). This information is necessary for a feasibility study of the transverse feedback system for damping of this instability. This work will be done in collaboration with W. Hofle (AB/RF) and LARP.

- **Updated summary of the SPS e-cloud test installations**

514: 3 pairs of antennas

517: Two C-magnets: one for exchangeable samples with different coatings and one spare

518:

1. Detector XSD1 with stainless steel screen and collector as a reference
2. Cleaning enamel electrode in antechamber with 2 button PUs and C-magnet (20 cm long)
3. Reference vacuum chamber (MBN) with 2 button PUs and C-magnet (20 cm long)
4. Detector XSD2 with C coated screen and collector

5. Detector EcEx with electrode and collector

6. Detector SDneg with NEG coated screen and collector, surrounded on both sides by two other NEG coated chambers with two baffles.

• The next meeting will be on **15 April 2008** at 15:30 in the JBA room (bld. 864).
Tentative agenda:
1. Programme of measurements for the 2008 tests in the SPS
- E. Mahner, F. Caspers, M. Taborelli
2. The SPSU subjects and budget for 2008 - E. Shaposhnikova

Elena Shaposhnikova, 19.03.2008