

# Minutes of the SPS Studies Working Group (SSWG)

12<sup>th</sup> and special meeting 13<sup>th</sup> November 2001

**Present:** G. Arduini, R. Bailey, T. Bohl, H. Burkhardt, R. Cappi, P. Collier, K. Cornelis (chairman), A. Faus-Golfe, J. Gareyte, M. Jimenez, T. Linnecar, D. Manglunki, G. Rumolo, E. Shaposhnikova, J. Tückmantel, L. Vos, F. Zimmermann (secretary)

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## 1 Scrubbing Results This Year and Beam-Time Request for Electron-Cloud Scrubbing Next Year (G. Arduini, K. Cornelis, M. Jimenez, et al.)

K. Cornelis presented the three questions to be answered in this meeting:

- How many hours of scrubbing did we have this year and what was the effect?
- How many hours of scrubbing would we like to see next year and why?
- Can this be done on the parasitic MD or do we need dedicated time?

G. Arduini presented an analysis which answered the first question. In order to compute the total scrubbing time, the threshold of multipacting must be known. For the LHC beam the threshold was  $N_b \approx 2 \times 10^{10}$  in July 2001, and  $N_b \approx 3 \times 10^{10}$  in August and November. For the LHC beam with 50 ns spacing, the threshold was measured to be  $N_b \approx 6 \times 10^{10}$ . And, finally, for the fixed-target beam it was  $N_b \approx 5 \times 10^9$  in August, and  $N_b \approx 7 \times 10^9$  in October.

Taking rather pessimistic values for the *average* threshold of  $3 \times 10^{10}$  for the LHC and  $6 \times 10^9$  for the fixed-target (FT) beam, G. Arduini calculated effective scrubbing times of 140 hrs for the FT beam, 90 hrs for the LHC beam in the parallel MDs, 64 hrs for the LHC beam during the long MDs, and about 80 hrs for the LHC 25-ns beam at the end of the run. With a correction factor of 2 for the last component, he estimated a total scrubbing time of about 330 hours in the year 2001. Assuming 80% efficiency this would correspond to about 17 days of dedicated running time next year.

M. Jimenez mentioned that logging data and beam informations is a problem in the SPS. He pointed out that the interpretation of the scrubbing effect is difficult, as for different bunch intensities, different surface areas are bombarded. The main limitation encountered this year as compared with the previous year is the higher background pressure of the vacuum. At the beginning of the year the pressure was 100 times higher than in 2000 ( $10^{-7}$  torr instead of  $10^{-9}$  torr). It improved by about a factor of 10 over the year, to a value around  $10^{-8}$  torr. Since many parts of the machine will be opened again in this winter shut down the situation next spring might be similar to the start up in this year. While the background pressure improved by a factor 10, the multipacting threshold this year increased by only 50%. M. Jimenez recommended to scrub with a higher bunch intensity, and to only vary the filling pattern, so as to maintain an acceptable pressure.

K. Cornelis then asked what would be the result of doubling the scrubbing time. The main limitation is the closure of the vacuum valves. M. Jimenez mentioned that the threshold for the valve closure might be increased next year even in the regions near the kickers, *e.g.*, to  $10^{-6}$  torr. Some of the observed valve closures were not related to the pressure rise, but were possibly induced by beam loss. If we raise the threshold pressure for valve closure, we will gain in the scrubbing efficiency for both pressure and secondary emission.

K. Cornelis next posed the question whether dedicated MD time would be needed for the scrubbing. J. Gareyte pointed out that the LHC should have highest priority and that the electron cloud is also preventing the SPS from providing the nominal LHC beam for commissioning. How much scrubbing time would be needed? According to M. Jimenez a full week of scrubbing at the beginning of the run would be desirable, not including the machine set-up time. It may be possible to reduce the pressure rise by a factor of 50 during this week. T. Linnecar emphasized that, if the scrubbing is done at the beginning of the year, the subsequent MDs will be much more efficient and less limited by the electron cloud. M. Jimenez mentioned that next year also COLDEX will have been installed, and should deliver additional informations.

P. Collier asked about the recontamination after a change in intensity, whose importance was confirmed by M. Jimenez. G. Arduini stressed that improvements in the beam quality over the year may have obscured the improvements in the threshold and the scrubbing effect, since it was demonstrated that a smaller beam size results in a larger electron signal.

M. Jimenez listed two further reasons why the scrubbing should be done at the start of the run, namely (1) towards the end of the year many ion pumps are failing, and (2) there is also an increased number of vacuum leaks. Both effects reduce the maximum tolerable electron-cloud density.

It was also mentioned that the SPS physics run might be delayed next year. P. Collier explained that a dedicated MD time for the scrubbing increases the flexibility of operation and would offer the opportunity to optimize the cleaning procedure, which can then be applied at the SPS start up in the following years.

M. Jimenez mentioned that the decrease in  $\delta_{\max}$ , *i.e.*, in the maximum secondary emission yield, affects the performance of the detectors and that more informations could be gathered during the start up. In 2001, the in-situ measurement showed a reduction in  $\delta_{\max}$  from 2.3 to 1.6. M. Jimenez indicated that the final value is comparable to the value of 1.6 estimated by O. Gröbner's for the end of 2000.

K. Cornelis asked why the conditions in the end of 2001 looked worse than in 2000, although the secondary emission yield should have been similar. G. Arduini offered a possible explanation which is the improved beam quality. Smaller and shorter bunches more easily induce the electron cloud. M. Jimenez also mentioned a different time distribution of bunch intensities compared with 2000. In 2001 the fraction of the operation time at the highest intensities was significantly lower than in 2000.

R. Bailey concluded from the discussion that he and K. Cornelis will ask for two weeks dedicated scrubbing time at the start of the 2002 SPS run. The LHC beam will then be the first beam requested from the CPS next year.

## 2 Next Meeting

In view of the BI review on 20th November, the next meeting of the SPS SWG is tentatively scheduled for Tuesday, 27th November, at 09:15, in Room 865-1D17. The agenda will be posted on the web page of the working group <http://cern.ch/sl-mgt-sps-swg>, and an invitation will be sent by email.

F. Zimmermann, 13th November 2001