Minutes of the SPS Studies Working Group (SSWG)

9th meeting 15th October 2002

Present: G. Arduini, V. Baglin, T. Bohl, H. Burkhardt, P. Collier, K. Cornelis (chairman), B. Dehning, W. Höfle, N. Iida, L. Jensen, T. Linnecar, D. Manglunki, F. Roncarolo, F. Schmidt, E. Shaposhnikova, R. Tomas, J. Tückmantel, J. Wenninger, F. Zimmermann (secretary)

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1 Future SSWG Meetings during the Shutdown (K. Cornelis)

K. Cornelis announced that the SSWG meetings will be continued throughout the downtime, in the form of topical meetings, each centered around a special theme. He already identified six possible themes:

- transverse emittance preservation, tune diagram, damper, energy oscillations;
- longitudinal emittance preservation, longitudinal instabilties, controlled blow up;
- scrubbing results (SEY, heat load, etc.);
- high intensity, beam loading, kicker heating, kicker outgassing, damage (wire scanner)
- knowing SPS, impedance, SPS model, aperture
- electron-cloud instabilities

K. Cornelis also mentioned that there will be a Chamonix next year, focused on LHC, but the exact date has not yet been determined.

2 Priorities for the Last MDs (K. Cornelis, G. Arduini, et al.)

The last two MDs in 2002 will take place this weekend, through Monday. They are dedicated to

- energy calibration with protons at 450 GeV;
- LHC cycle and LHC-like beam.

During the second MD, B. Dehning and F. Roncarolo plan to perform tests with the wire scanners at different beam intensities, for example, measuring the resistance of the wire during a scan. This study aims at understanding the reason for the loss of all 6 wire scanners in the last MD with 3 batches of LHC beam. This wire damage seems to be in contradiction to the predicted threshold.

The fastest speed of the wire scanner is 6 m/s and it cannot be increased. B. Dehning recalled movies from the damage of LEP scanners, where the wire first broke at the top and the bottom, but not at the location of beam impact. The suspected source is a sudden high flow of current into the wire. K. Cornelis remarked that the wire scanner experience at LEP may not be a good reference, as the bunches were much shorter. The data of wire damage accumulated so far in the SPS suggest that the density of the beam plays an important role. Some of the wire scanner studies could be parasitic. While the wire scans will start at low intensity, it is planned to raise the beam current towards the end of the MD so much as to observe the threshold at which the wire is burnt. This will be done after all other LHC-beam studies are completed.

In the first MD, data are taken to calibrate the beam energy on the SPS flat top at 450 GeV, by comparing revolution frequencies of protons and not fully stripped Pb ions (Pb53+). In principle, the beam should have been available from the PS only on Sunday, but D. Manglunki commented that he would not start this study on the weekend, but rather check beforehand that the PS-SPS synchronization works.

After the meeting G. Arduini informed us that he had received the agreement from the physics coordinator for a test of the 26 GeV Pb53+ beam on Thursday 17/10 between 08:00 and 16:00. As a compensation, the end of the run has been delayed by 4 hours (Sat. 19/10 at 12:00), and the energy calibration MD will start on Saturday 19/10 at 12:00 instead of 08:00.

G. Arduini mentioned that, in the second MD, he intends to spend 6 hours for studying the acceleration of a single bunch. Timing of the (linear) wire scans for the single bunch was a concern. The single-bunch emittance can be 2 times smaller than the nominal LHC value.

COLDEX will be installed in the night from Sunday to Monday (or Monday morning). This intervention requires an access of 1 hour. The injection of various gases is foreseen, and for that reason (in order not to interfere with the incompletely stripped ions), the COLDEX installation was scheduled at the end of the calibration run.

W. Hofle asked for the emittances that were recently obtained with the LHC beam. G. Arduini replied that in the last MD he could get a single measurement for the first 3 batches, before all the wires were damaged. The result was an emittance of 3.2 μm horizontally and 4.0 μm vertically. The energy oscillations still need to be fixed, which might affect the emittance numbers.

E. Shaposhnikova reminded us that there is an option to raise the rf voltage at the end of the cycle, so as to shorten the bunches; this is the nominal scenario for the extraction to LHC. During the MD the number of bunches may be increased from 12 to 72 (in steps of 12) and then from 1 batch to several batches.

G. Arduini will prepare a detailed MD draft program until Wednesday afternoon.

3 Coupling Resonance vs. Radial Steering (R. Tomas)

In the framework of the SPS nonlinear optics study, R. Tomas reported on the analysis of multi-turn BPM data recorded during the nonlinear chromaticity measurements on August 23. He processed 1000-turn data from 240 pick ups. Averaging over 3 shots and all pick ups, he obtained the betatron tunes for different settings of the radial steering. The result looks smoother and the error smaller than for the single-shot single-pick-up data from the Q-meter taken at the same time. K. Cornelis commented that the curves are more symmetric than those in 2000 or 2001.

R. Tomas then showed the average amplitude of the resonance driving term h_{1001} as a function of radial position. There is a clear linear increase by up to factor of 10 for negative values of the radial steering. For positive settings, the horizontal and vertical tunes intersect, which could compromise the analysis. Nevertheless, for this sign of radial steering the coupling appears rather constant.

Next R. Tomas presented the strength of the coupling resonance as a function of position around the SPS ring, as inferred from the individual BPM readings and for different radial steerings. The coupling is flat, without any significant step. This could indicate either that the source of coupling is uniformly distributed around the ring, or that there is a single source only.

One possibility to explain the linear increase of the coupling for negative radial positions is by skew sextupole fields, which motivated this analysis. G. Arduini suggested an alternative explanation, namely that the simultaneous decrease in the vertical tune, approaching the integer resonance, and the associated change of the closed orbit might be at the origin of the increased coupling, via a shift of the vertical orbit in the normal sextupoles.

Fortunately, the orbit information is contained in the multi-turn BPM data, and after the meeting R. Tomas quickly computed the closed orbit at each BPM for all radial steerings. His analysis reveals a residual vertical dispersion whose magnitude is about 4% of the horizontal dispersion, indicating a maximum change in the vertical orbit by about 1 mm. (This result is included among the accompanying ps files.)

4 Next Meeting

The next meeting of the SPS SWG is tentatively scheduled for Tuesday, 29th October, 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, 15th October 2002