Minutes of the SPS Studies Working Group (SSWG)

3rd meeting 3rd July 2001

Present: G. Arduini, R. Bailey, R. Cappi, P. Collier, K. Cornelis (chairman), B. Goddard, M. Hayes, W. Höfle, L. Jensen, T. Linnecar, D. Manglunki, G. Rumolo, F. Schmidt, F. Zimmermann (secretary)

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1 Status of CPS (D. Manglunki)

There are 6 different proton beams which the CPS was asked to provide this year. SFTPRO and MDSPS refer to the CT beam and have been set up for intensities up to 1.6×10^{13} protons. LHC and TSTLHC beams are available including double batch injection, acceleration, and bunch splitting. This year, a new closed phase loop during the splitting process is expected to maintain a more uniform bunch population, and the extraction timing of the LHC beam will be adjusted to be the same as last year. The last two beams, MESPS and TSTSPS, contain single proton bunches. MESPS was requested for week 31, but is already available. The flat top at 3.5 GeV/c was removed. The timing is the same as for the LHC beam. The rf gymnastics looks ok, and a bunch length of 3.5 ns was achieved. Finally, TSTSPS, due in week 41 only, has also been accelerated to 20 GeV/c. An LHC beam with 50 ns spacing and a high-intensity beam with double batch injection are now being worked on.

2 PS Electron Cloud (R. Cappi)

Normally the LHC beam is extracted a few turns after bunch compression. For electron-cloud studies 72 bunches with a bunch length of 8–10 ns (4σ) were stored for about 100 ms. In this case, a fast instability was observed. The betatron oscillation amplitude increased rapidly with time. The instability saturated at an amplitude of about 1 cm, and affected mainly the trailing part of the batch. There was no beam loss, but the emittance blew up by a factor 10–20, in the presence of persistent oscillations. The oscillations were stronger in the horizontal plane, but, perhaps due to linear coupling, the instability was also observed vertically. The growth rate amounted to 3–4 ms at an intensity of 460×10^{10} protons per batch, whereas it was only 50–60

ms at 330×10^{10}. No instability was observed at 300×10^{10}. When present, the instability was also clearly seen on the pick up in TT2, where the last 2/3 of the batch was oscillating. Bunch-to-bunch motion appears completely random, which hints at a single-bunch instability. A gap of 12 missing bunches did not suppress the oscillation. It seems that the bunch-to-bunch orbit pattern in TT2 is most indicative of the instability.

Recently, studies were also performed with 50-ns spacing, nominal intensity (10^{11} protons per bunch), and about 10–12 ns bunch length. Under these circumstances, no instability could be detected. Perhaps there was some evidence of a residual BPM baseline drift in the transfer line, but this could not be verified, as the solenoid was not operational.

A beam with 75 ns spacing cannot yet be created. However, based on the experience with 50 ns spacing, it is fair to assume that such a beam should be stable in the PS. This week a test is planned with the ultimate beam (1.7×10^{10} protons per bunch) and 50 ns spacing.

R. Cappi pointed out that many years ago an instability was observed with 5 ns spacing at 10 GeV, which has never been explained. This instability might have been caused by an electron cloud. Hence, 5-ns spacing is not necessarily safe.

3 SPS Aperture and Alignment (G. Arduini)

During the last shut down many changes were made to the machine, for example, the pumping port shieldings were installed all around the ring, the LEP equipment was dismantled, and the SPS was completely realigned. Despite of all these interventions, the beam circulated almost immediately. The SPS aperture is quantified by kicking the beam and measuring the beam size on a screen or wire scanner. Prior to bump scans, the aperture was found to be about 15% smaller than in 2000. After bump scans (monitoring beam losses and DCCT) and semi-automatic centering for each bump, the aperture increased to the 2000 value. Bottlenecks are identified by taking 1000 turn data and determining BPMs at which the intensity drops on one of the first couple of turns. For some of the aperture limits discovered, the only possible remedy would be the replacement of dipole magnets.

G. Roy and C. Arimatea conducted the alignment measurements. About 25 faulty BPMs were found. The orbit was reduced to ± 4 mm after one alignment iteration. Displacements of a few magnets were of the order of 1 mm (highest value of 2.5 mm at a quadrupole whose alignment is conspicuous since 1995).

4 Need for TT2 Buncher Simulations (K. Cornelis)

Following up on the PS proposal of homogeneous extraction of the CNGS beam and installation of a 'buncher' cavity in TT2, K. Cornelis suggested the simulation of the bunching and capture process in the SPS, *e.g.*, by J .Tückmantel. The goal would be to assess the effect of the finite rf turn-on time and transient beam loading.

R. Cappi pointed out that already for nominal CNGS intensities the situation is difficult with the conventional bunching/rebunching procedure. He added that after a few hours of set

up time double-batch injection has provided an intensity 10% higher than the previous record, with less than 5% loss throughout the cycle.

5 Next Meeting

The next meeting of the SPS SWG will be devoted to reports from PAC2001. The meeting is tentatively scheduled for Tuesday 17th July, at 09:15, Room 865-1D17.

An announcement will be sent by email in due time and the agenda will be posted on the web page of the working group http://cern.ch/sl-mgt-sps-swg

F. Zimmermann, 3rd July 2001