SPS Studies Working Group

First Meeting – 04 May 1999

Present: G. Arduini, R. Assmann, R. Cappi, E. Chapochnikova, P. Collier, K. Cornelis (chairman), B. Goddard, K. Hanke, W. Höfle, S. Myers, G. Roy (secretary), F. Ruggiero, J. Uythoven, L. Vos, F. Zimmermann

Excused: K. Hübner, R. Jung, K.H. Kissler, T. Linnecar, H. Schmickler

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1 Introduction

K. Cornelis introduced the meeting with the motivation for this working group. There is a need for a forum to discuss accelerator physics and technical issues relevant to the operation of the SPS. The recommendations and decisions taken at the Chamonix Workshop and the SPS Days will be followed by the SPS Studies Working Group. A report will be given to the SL Performance Committee. Meetings of the SPS Studies Working group will be held on every other Tuesday, alternating with the LSWG.

2 SPS Startup Progress

G. Arduini gave a detailed report of the SPS startup progress.

Protons:

- MOPOS setting-up was fast; the system works well.
- protons accelerated to 450 GeV by Thursday 15th April.
- realignment of 13 quadrupoles (7 in V plane, 6 in H) resulting in RMS orbits of 2.6 mm in H and 1.2 mm in V (similar to last year's values).
- Extraction and transfer to targets roughly setup for tests. The possibility is kept for a Fast-Slow 2 as a backup in case of problem with the Beam Dump, LHC and high-intensity MDs.
- The auxiliary compensator in BB3 exploded on Friday 22 April, *as usual!* Repaired and restarted on 28 April.

To be done for protons:

- TT2/TT10 measurements of dispersion and mismatch; references for TT10 steering. Measurement of injected beam parameters.
- Orbit cleaning, CT spill adjustments, RF adjustments for higher intensity, spill ripple measurement and adjustment.
- Test of steering matrices for the extraction lines and precise phase advance measurements 6-2 with nominal extraction conditions.

Physics with protons should start on Friday 7 May, 3 days ahead of schedule.

Leptons:

- Leptons were started in SPS on Tuesday 22 April; positrons easily injected and accelerated to 22 GeV/c. More problems with electrons. Intensity is good: we can accelerate 1.6×10^{11} leptons per pulse. Can we go higher? The Robinson wiggler is off for the moment. TMCI is seen and cured by introducing betatron coupling after 200 ms.
- Available RF power limited because of an amplifier on SC cavity 3. It has been changed since.
- Steering matrices available for both injection and extraction.
- ZS tank 1 in North showed high sparking rates (aging effect) and was exchanged (Monday 26 April). No problem since. A possibility to dump the positrons at 16 GeV to avoid synchrotron radiation on ZS will be explored. Also a weakness on the interlock system preventing lepton injection in case of shutter problems has been discovered. The shutters of the new design type seem to behave very well.

To be done for leptons:

- positrons on electron cycle; incompatible with LEP filling and beam on MD cycle.
- clean-up of orbit on positron cycle.
- rematching of TI12 and TI18 to injection conditions of LEP.

Pending Problems:

- MOPOS does not allow acquisition of first turn trajectory and closed orbit on the same cycle. General lack of diagnostics in case of problems and first turn acquisition requires some gymnastics.
- Some programs work less reliably than in the past (new HP-UX compiler version).
- North Extraction was blocked three times and experts have no clue.
- Timeouts on SEM readings in North Area and and some resets needed on servo-spill.
- Beam Dump vacuum situation under control but requires monitoring.

3 Status of LHC Beams in CPS

R. Cappi presented the present situation of the "LHC Beams" in CPS. The nominal parameters of the LHC Beam were recalled with the list of hardware changes required in the PS complex. Some problems faced by CPS to provide this beams were also listed:

- Transverse emittance minimisation for LHC luminosity reasons.
- Longitudinal emittance maximisation – within some boundaries obviously: $\tau_b < 5$ ns and $\delta p/p < 6.\ 10^{-3}$ – for SPS stability reasons. CPS has difficulties keeping the correct longitudinal parameters because of a microwave instability during the debunching-rebunching process. Triple splitting will be prepared for next year.

Among the different beams in the PS complex, three are of interest for LHC studies in the SPS:

- "Single Bunch": one bunch of 2 to 20. 10^{10} protons with $h_{\rm psb} = 2$ and $h_{\rm ps} = 16,\ 84.$ $\epsilon_l = 0.2 - 0.5$ eV.s and $\tau_b < 5$ ns. This beam is synchronised to the SPS and will be available around mid-May.
- "Bunch Train": 8 bunches of 2 to 5. 10^{10} protons per bunch with $h_{\rm psb} = 2$ and $h_{\rm ps} = 16.$ $\epsilon_l = 0.1$ eV.s and $\tau_b < 5$ ns ($\delta p/p \approx 10^{-3}$). This beam is not synchronised to the SPS and will be available in June.
- "Longitudinal Nominal": "84" bunches of 2 to 10. 10^{10} protons per bunch with $h_{\rm psb} = 2$ and $h_{\rm ps} = 8,\ 16,\ 84.$ $\epsilon_l = 0.5$ eV.s and $\tau_b \approx 4$ ns ($\delta p/p \approx 6.\ 10^{-3}$). This beam will be available at the end of May.

4 How to get 7×10^{13} protons per pulse in the SPS

K. Cornelis presented some ideas to test the possibility of reaching very high intensities in the SPS.

For the NGS project, 5×10^{13} protons per SPS pulse seems to be the minimum intensity that is required and we should aim at 7×10^{13}. The present intensity record of the SPS, established in 1998, is 4.8×10^{13} but in 1999 the physics requirements call for low intensities with only a slow extraction. Clearly this is not the intensity limit and we should look into finding what is the maximum intensity that can be accelerated in the SPS and what are the limiting phenomena.

Some of these phenomena might be related to the local beam density. Therefore there is an interest in trying to accelerate 7×10^{12} particles in a 2 μs batch that gives the same local intensity as required by the NGS project. This should be done at 14 GeV/c with $\epsilon_x = 2.5 \times 10^{-6}$ m.rad and $\epsilon_x = 1.5 \times 10^{-6}$ m.rad. This should be equivalent to the CT beam provided by CPS for physics but reduced to a single turn. R. Cappi noticed that the present 14 GeV/c limit is linked to the CT beam. In a 1.2 s slot and single turn batch, CPS can otherwise go up to 20 GeV if this can be of interest for these studies.

Another possibility is to fill the whole ring with moderate intensity in order to study the coupled bunch modes instabilities and the effect of the kicker hole.

It has also been noticed that a pencil beam shows no losses at transition and it is proposed to profit from the rapid startup and the available time this week to study the evolution of $\delta p/p$ through transition.

K. Cornelis noted that for these studies we will very likely need to use some beam instrumentation in less standard ways. Some facilities are needed like a variable Q-kicker... and a 1000-turn application.

5 Next Meeting

The next meeting is scheduled for Tuesday 18th May 1999, at 09:15, Room 865 1-D17. The agenda will be announced on the web page which is being setup now.

G. Roy
5 May 1999