SL-MD Note 137

August 10, 1994

The SPS Diffusion Experiment in 1994 until the 3rd of August

Experimenters:
X. Altuna, C. Arimatea, R. Billen,
R. Blanchard, E. Brouzet, G. Buur, J. Camas,
E. Carlier, K. Cornelis, G. Crockford,
B. Deforges, C. Despas, A. Faugier, F. Ferioli,
A. Ferrari, W. Fischer, J. Gareyte, J. J. Gras,
W. Herr, H. Jakob, J. Koopman, M. Laffin,
T. Linnecar, J. Miles, I. Milstead, L. Normann,
G. Robin, F. Schmidt, A. Spinks
Reported by:
W. Fischer

Keywords: DIFFUSION

No run numbers specified.

Contents

1 Introduction

This years work at the SPS Diffusion Experiment is used to check recently obtained results from computer simulation [1]. The main tool for this purpose is the linear wire scanner in BA4 that has a thin wire of 8μm thickness. Using the wire scanner a direct measurement of the dynamic aperture is possible.

For different reasons we lost three MD sessions completely, the number of Wednesday MD's for preparational use is drastically reduced compared to last year. Therefore it was difficult to obtain useful results. Here we will report about two Wednesday MD's on 18 May and 3 August and on the only experimental MD session of 6 and 7 July consisting of two 8 hour shifts.

2 Work on Equipment

After the last shut down there were improvements on some equipment but also problems due to changes in the control system.

2.1 BOSC

The system BOSC was working. It records beam intensity, beam positions, scraper positions and the loss monitor signal, it computes lifetimes and tunes and displays phase space plots. On 3 August there has been a hardware error at the TG3 card in crate 2 detected. The new control software is still under development. It is hoped that this new software will improve the stability of the system.

2.2 Wire Scanners

There were no problems with the rotational and linear wire scanners in BA2 (wire thickness 36μm). The linear wire scanner in BA4 (wire thickness 8μm) did work on 18 May and during the experiment on 5 and 6 July. About 250 scans were made at this occasion. The thin wires in both planes broke before 3 August for an unknown reason and were replaced on 3 August. They had been in the SPS for about 9 month and it seems they are more stable than last year.

2.3 Chart Recorder

The chart recorder has still its full functionality and is used as back up for intensity, loss monitor signal and scraper positions if one of the electronic recording systems fails.

2.4 Schottky System

The local oscillator of the Schottky system is now fixed at 10.67MHz. The system worked satisfactorily and was extensively used during the MD on 6 and 7 July.

2.5 Fast Extraction Kicker

After the shut down it was no longer possible to obtain a single kick in coast. During the MD on 6 and 7 July the kicker was firing twice instead of once. The problem was overcome by the operators by disabling the kicker after the first kick. Changes have been made in the control software made but it could not yet be tested whether the "one shot" function works properly.

2.6 Extraction Sextupoles

Until now no failures of extraction sextupoles were observed, contrary to last year when Last year one of the sextupole power supplies failed at almost every MD and caused a loss of experimental time.

2.7 Aperture Limiters

The TAL119 used in the experiment worked without any problem including the signals for BOSC.

2.8 Servo Spill

The modulation source for the servo-spill can now be switched from internal to external by software, which is much more convenient than last year when a hardware intervention was required. But switching on the servo-spill power supply takes now $2\frac{1}{2}$ minutes compared to some seconds last year. This is annoying since it has to be done quite often.

2.9 Photo Multiplier

Even though the control program for the loss monitor did work on the NODAL emulator there was no signal from the PM coming back in the MD on 6 and 7 July.

2.10 Further Problems

In the MD on 6 July the crystal from the Crystal Extraction Experiment was not retracted even though the control system gave the information that it was. On 7 July there was ongoing work on octupole power supplies during the MD without notice to the experimenters. This work prevented experimental work and about 3 hours were lost.

3 Dynamic Aperture Experiments

At the MD on 6 and 7 July it was possible to set up the SPS for the Dynamic Aperture Experiment. The influence of the wire scanner in BA4 (thin wire of 8μm) could be examined and results of simulation through computer tracking checked.

3.1 SPS Machine Set Up

The closed orbit could be corrected to 0.38mm and 0.37mm rms value for the horizontal and vertical plane respectively. The chromaticity was corrected and checked and a closest tune approach of 0.0013 could be reached after coupling correction. The corrections for closed orbit, chromaticity and linear coupling were as good as last year.

At working point 1 (26.637,26.533) the detuning was measured by kicking the beam with kicks of different strength (see Fig. 1). At this working point an 8^{th} order resonance makes it difficult to determine the detuning in a certain kick range. The tune was measured by analysing the phase advance between two pick-ups. This method gives more precise values than the FFT particularly for big kicks. The measured detuning is in good agreement with the detuning deduced from the simulation model (see Fig. 1).

3.2 Influence of Wire Scanner in BA4

The influence of the thin wire (8μm) on the intensity and beam size was tested. After the beam is kicked by 9kV one scan (IN and OUT scan) causes a loss of $1.4 \cdot 10^{-4}$ of the intensity (see Fig. 2). There is no beam blow up visible in the wire scan signal (Fig. 3).

3.3 Test of Simulation Results

A modified version of the retraction method was used. After kicking the beam the vertical halo was cleaned. The beam was then scraped horizontally and the horizontal scraper was retracted by 6mm, 4mm, 2mm and 1mm in different cases. A tune ripple of 9Hz and $\Delta Q = 2.2 \cdot 10^{-3}$ was switched on and wire scans were made every minute.

In Fig. 4 the normalised intensities for these four cases are shown. If the scraper is only retracted by a small value the probability of intercepting particles that will be lost in some 10^4 turns is increased (see Fig. 4 in [1]). The scraper is probably still outside the "chaotic smear" (see [1]) in all cases since that value is small ($\approx$ 0.5mm) for the outmost amplitudes (see Fig. 5 in [1]). There is no dramatic difference in the four cases.

The observation with the wire scanner in BA4 reveals the same features for all cases. In Fig. 5 the first and in Fig. 6 the last horizontal wire scan is shown for the case of 1mm retraction. Some particles in the outer region are lost but, as a remarkable result that agrees with tracking simulations (Fig. 4 in [1]), some must have moved inwards. Otherwise the peak height of the wire scan signal would be decreased. In all cases the full width of the wire scan signal shrinks from 36.1mm to 35.3mm in the first 300s after switching on the ripple and stays then constant (see Fig. 7). The data in Fig. 7 can be directly compared with data from survival plots.

4 Conclusions

Although the experimental conditions were difficult, interesting results could be obtained. The influence of the thin wire in BA4 on the beam quality was tested and the loss mechanism was studied by a variation of the scraper position. To complete the experimental analysis that is needed for the comparison with tracking simulations working point 2 (26.605,16.538) must be examined in the same way as working point 1. We hope to get a clear answer to the question if the loss process is diffusion-like or not. A measurement of the dynamic aperture under the influence of nonlinear fields and tune modulation was done with the flying wire in BA4 and a following comparison with survival plots is possible. This comparison can give an estimate of the accuracy of dynamic aperture estimations through tracking simulation.

References

[1] W. Fischer, M. Giovannozzi and F. Schmidt, *Detailed Comparison of Experimental Observations and Computer Tracking for the SPS Dynamic Aperture Experiment*, Proceedings of the 1994 European Particle Accelerator Conference, London (1994).