DAΦNE TECHNICAL NOTE

INFN - LNF, Accelerator Division

Frascati, April 2, 2004

Note: **BM-13**

REPORT ON DAFNE MD OF JAN. 28th, 2004

A. Stecchi, M. Biagini, S. Guiducci, C. Milardi, M. Preger, C. Vaccarezza

1. Introduction

The MD shift was dedicated chromaticity measurements on both beams in order to find the correct coefficients for the creation of chromaticity bumps and to determine the central frequency of the two rings. Before the MD shift about three hours of beam time have been dedicated to check the sensitivity of the infrared synchrotron radiation beam line to beam displacements.

The first task is approached by calculating the current variations in the most efficient sextupoles to reach a small given change in the chromaticity in one plane, applying to the magnets in the ring and measuring the tunes versus RF frequency in the ring. Both the amplitude and the orthogonality between the two planes are checked and iteration of the procedure yields the final chromaticity bumps.

The central frequency in the ring can in principle be directly obtained from tune scans at different sextupole settings. In fact, if the RF frequency corresponds to an orbit length equal to nominal ring length, the beam energy is equal to the nominal energy, the beam passes through the sextupole magnetic centers, and the betatron tunes do not depend on the sextupole current. Of course this is not true if the sextupoles are displaced with respect to the nominal orbit or there is a closed orbit in the machine. The effects of these errors contribute to a distribution of the crossing point of tune scans versus frequency at different sextupole settings.

2. Results

Horizontal and vertical chromaticities have been measured in the electron ring on the lattice used for FINUDA collision mode. The lattice is saved as “cromatismi”. The octupoles were off and the frequency span with stable beam was between –60 and + 35 KHz with respect to the initial frequeny of 368.278 MHz. The momentum compaction factor used to calculate the chromaticity is 0.019. The calculated variations of chromaticity are indicated in the following table as ΔC_{ic} (where index i stays for x or y) while the corresponding measured chromaticities are shown as C_{im}. Initial tunes are given as Q_X and Q_y. Second derivatives are also indicated as Q_X” and Q_y”. Filenames are indicated where the file has been saved.

Table 1 – Chromaticity bumps in the electron ring

ΔC_{xc}	ΔC_{yc}	Q_X	Q_y	C_x	C_y	Q_X”	Q_y”	Filename
0	0	.0975	.2002	1.531	-2.019	-1.12e-5	-1.34e-6	200401281200
0	+1	.0975	.1991	1.484	-0.840	-9.00e-6	-4.19e-6	200401281210
0	-1	.0977	.2020	1.664	-3.444	-1.26e-5	-3.38e-6	
-1	0	.0993	.2006	0.815	-2.439	-1.21e-5	-2.48e-6	
+1	0	.0965	.2006	2.394	-2.054	-1.30e-5	-4.61e-6	

The same measurements have been performed on the positron beam, again with all octupoles off. The stability range is between –60 and +65 KHz. Table 2 collects the results. The last measurement in the table is taken with all sextupoles off. The stability range in this case is from –35 to +5 KHz.

Table 2 – Chromaticity bumps in the positron ring

ΔC_{xc}	ΔC_{yc}	Q_x	Q_y	C_x	C_y	Q_x"	Q_y"	Filename
0	0	.1140	.1981	-0.788	1.431	-3.97e-6	-2.95e-6	200401281259
0	+1	.1136	.1973	0.050	2.369	-3.43e-6	-4.29e-6	
0	-1	.1138	.1995	0.170	0.125	-5.14e-6	-2.33e-6	
+1	0	.1124	.1987	1.235	1.299	-4.24e-6	-4.95e-6	
-1	0	.1160	.1985	-0.800	1.020	-6.67e-6	-3.05e-6	200401281330
-2	0	.1169	.1989	-1.507	0.814	-6.48e-6	-2.71e-6	
+5	0	.1048	.1993	5.583	1.754	-5.24e-7	-5.29e-6	200401281347
+5	+5	.1044	.1936	5.255	7.871	-2.82e-6	-1.04e-5	200401281356
sexoff	sexoff	.1156	.2114	0.597	-22.50	-2.61e-5	1.13-6	200401281414

The measurements reported in the tables have been put together in order to find the central frequency for the two rings. Figures 1,2,3,4 show the tunes as a function of the frequency shift. Unfortunately, in the case of the electron ring only few measurements have been saved and, moreover, they have been performed with small differences in the sextupole settings. As can be seen from the figures, the situation is much better in the case of the positron ring. From the analysis of the curves we can conclude that for the positron ring the central frequency is between 358.278 and 358.268 MHz, and that this range is compatible with the few measurements availble for the electron ring.

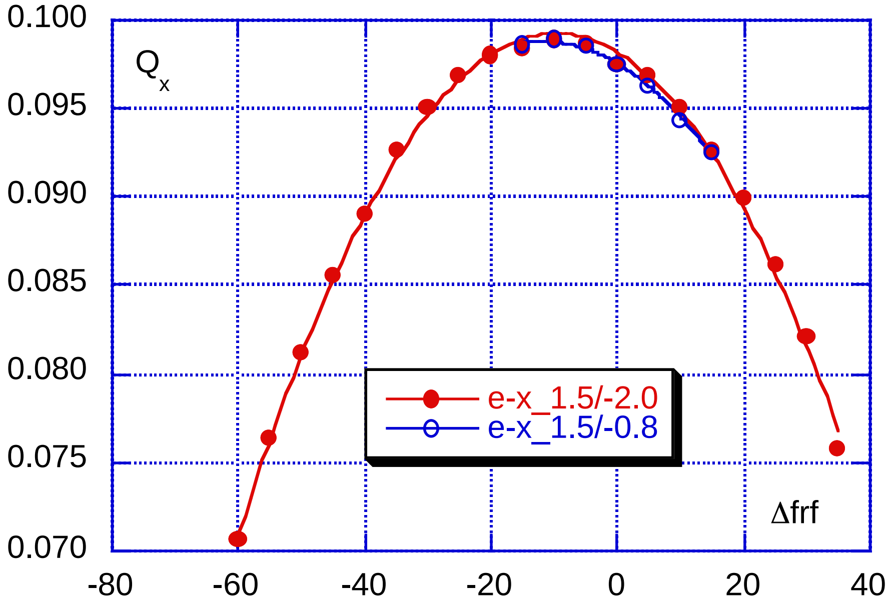

Figure 1 – Horizontal tune versus frequency shift in the electron ring

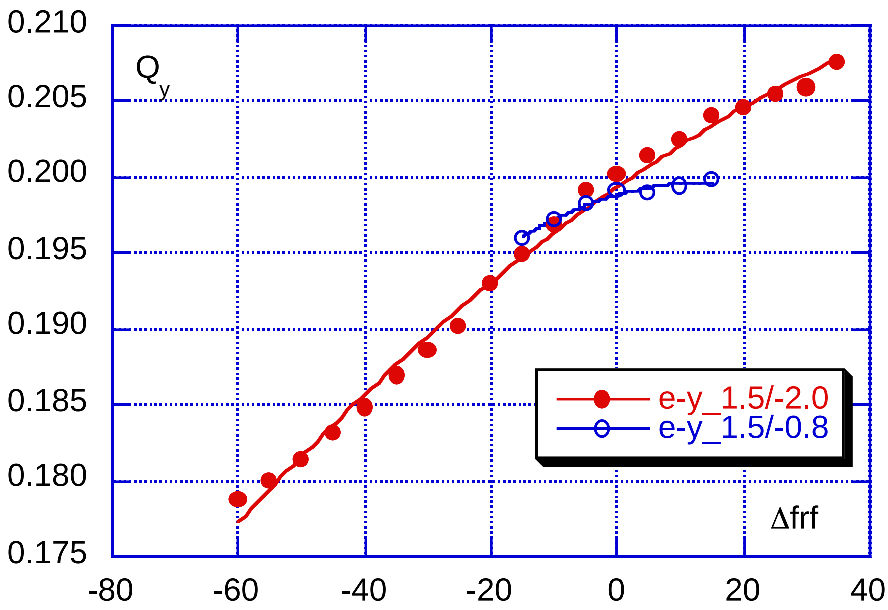

Figure 2 – Vertical tune versus frequency shift in the electron ring

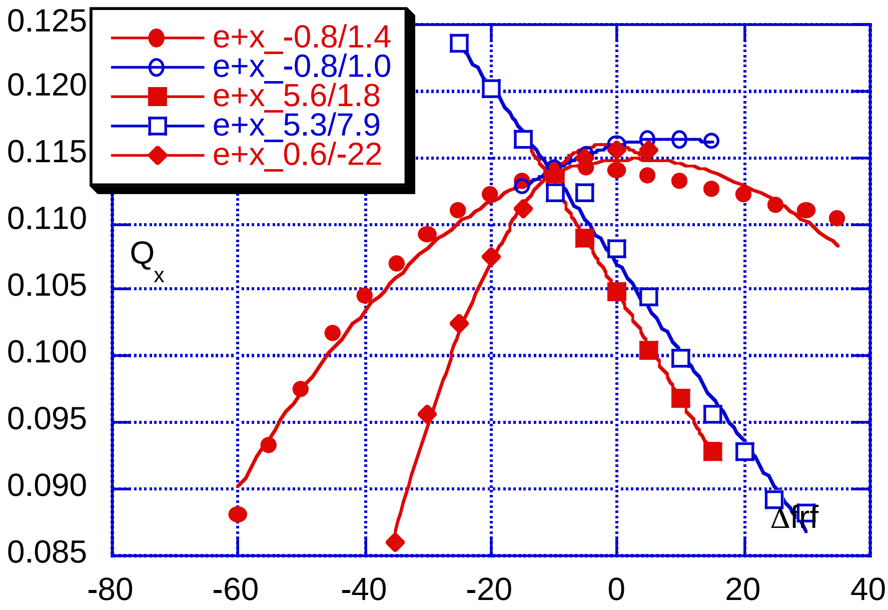

Figure 3 – Horizontal tune versus frequency shift in the positron ring

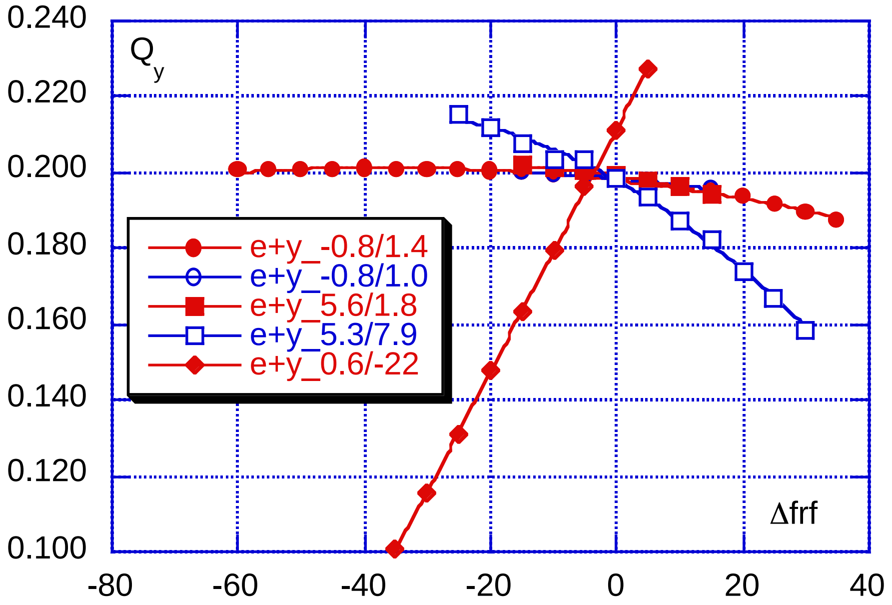

Figure 4 – Vertical tune versus frequency shift in the positron ring

Since it has been observed that the threshold of the instability which presently limits the storable current in the positron ring increases when the frequency is shifted towards lower values, the result of the measurements seems to be in agreement with he behaviour of the threshold. Just after the MD shift a test has therefore been performed together with FINUDA in order to check the beam energy by means of an energy scan obtained by simply changing the frequency. Figure 5 shows the dependence of the ratio between Kaon pairs and Bhabha events versus frequency. Although the statistical error is quite large, it seems that a shift of 5 KHz in the operating energy is still well within the Φ resonance width.

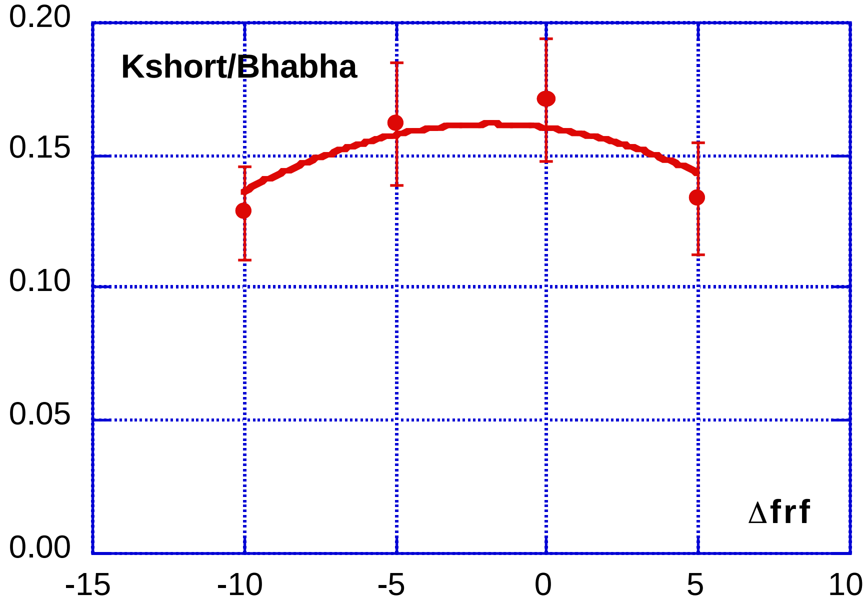

Figure 5 – FINUDA energy scan