Experiment 3

Dispersion

The dispersion is the dependence of orbit displacement on beam energy. We can change the beam energy, while keeping magnetic guide field fixed by varying the frequency of the RF cavities. The revolution period for the bunch is some integral number of RF periods, the so-called harmonic number. If we change the RF period, then we change the revolution period and path length. The beam energy and path lenght are related according to

$$\frac{\Delta E}{E} = \frac{\Delta L}{L}\frac{1}{\alpha_p} \tag{1}$$

where α_p is the momentum compaction factor which for CESR is about 0.01. (Use CESRV to get a more precise number. Type SHOW GLOBAL.)

1. With about 3mA in a single bunch of electrons, and electrostatic separators off, use CESRV to measure the closed orbit.

2. The CESR RF frequency is about 500MHz. We will change it by a few kHz. In order to get the best sensitivity, it is best to take an orbit difference of $\Delta E/E$ positive and $\Delta E/E$ negative.

3. To change the frequency, Type "RU [CESR.DLR.USPAS]RF_FREQUENCY" on a control system computer.

4. Keep track of orbit butns numbers and RF frequency. The orbit difference for high and low energy is the dispersion. Compare measured dispersion with theory.

Chromaticity

Along the way you may have measured the chromaticity, the dependence of tune on energy. Measure horizontal and vertical chromaticity as a function of XQUNEING 1 and 2. The XQUNEING group knobs 1 and 2 control families of sextupoles designed to change vertical and horizontal chromaticity respectively. (GROUP TUNING $\rightarrow$ XQUNEING $\rightarrow$ 1)