BEAM STEERING AND ORBIT CONTROL AT DAFNE

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Abstract

The commissioning phase without experiments of DAFNE, the Frascati double ring F-factory, has been completed. Single bunch luminosity exceeding 10^{30} cm -2 sec -1 has been obtained. Accurate beam position control is mandatory for luminosity achievement. Each ring, 100 m long, is equipped with 45 Beam Position Monitors and 31 correctors per plane. The integer part of both betatron tunes is 5. The closed orbit of the two Main Rings of DAFNE is essentially dominated by the magnetic cross-talk between the two rings due to fringing fields of dipoles and wigglers, the cross-talk between some of the transfer line magnets and the rings, and the effect of the ion clearing electrodes in the electron ring, since the residual misalignments of the magnets are much better than the required tolerances. The horizontal reference for the closed orbit is complex because of the off-axis trajectories in the interaction regions (IR), the splitters which separate the two beams at the IR ends, the presence of wigglers, and finally the four different types of dipoles. The line along which quadrupoles and sextupoles have been aligned corresponds to the line defined by the nominal bending radius of the dipoles, and this line is taken as reference for the closed orbit. The aim of the closed orbit correction is the optimization of the coupling and the exact overlap of the two beams at the interaction points (IPs). Several closed orbit correction methods have been implemented and used: best corrector method, harmonic method, orbit decomposition by eigenvalue of the measured Response Matrix. Coupling of the order of few 10^{-3} , well below the 1% design value, has been achieved in both rings, by correcting the vertical orbit within ± 1 mm and the horizontal one within ± 2 mm with respect to the reference line. Coupling tuning over a large range is easily obtained using the skew quadrupoles. The vertical overlap of both beams at the IP, critical since the vertical dimension of the interacting bunches is 20 mm, is obtained with localized steering bumps with 5 mm accuracy.