

Recap 4th Lecture

Periodic structures / circular accelerators: periodic boundary conditions $\alpha = \alpha_0$, $\beta = \beta_0$, $\gamma = \gamma_0$

Periodic FODO structure: stable necktie, if $f_+ = -f_- = f \rightarrow 4f > L_{\text{FODO}}$, $\langle \beta \rangle = \min \leftrightarrow \mu = 90^\circ$

Optical functions are determined by the lattice only (periodicity)!

$\beta(s)$ is always maximal in focusing quads and minimal in defocusing quads of plane considered!

Betatron Tune: indicates the number of transverse oscillations per turn $Q = \frac{1}{2\pi} \oint \frac{ds}{\beta(s)}$

Filamentation: beam ellipse will rotate (and enlarge) in case of a non-matched beam

Closed Orbit: Equilibrium path influenced by field errors, is closed!

Real circular accelerators with field errors:

Dipole Errors: closed orbit deviations $x_{co}(s) \sim \frac{\sqrt{\beta(s)\beta(s_0)}}{\sin(\pi Q)} \delta(Bl) \leftrightarrow \boxed{Q \neq n}$

Quadrupole Errors: effect on beta function (beam size) and tune $\Delta Q = \frac{1}{4\pi} \oint \beta(s) \delta K(s) ds \leftrightarrow \boxed{Q \neq n/2}$