

Terascale Accelerator School 2008

Exercises

Linear Accelerators

Exercise 1: Accelerator Construct a linear accelerator consisting of 10 consecutive FODO cells with a quadrupole strength $k = 0.05 \text{ m}^{-1}$, a length of 1 m and a free drift of 20 m between the elements. The beam source emits directly into the first quadrupole with an emittance of 10 pm. Assume a width $\sigma = 1 \text{ mm}$ for the source.

a) **Experimental width of the particle distribution using a Monte Carlo technique** Simulate $N=50$ particles from the source described above. Use a Gaussian distribution with the standard deviation indicated. Determine experimentally the width of the distribution (standard deviation) of the particle distribution at the respective pivot points. Plot the width of the distribution as a function of the trajectory.

b) **Calculated width of the distribution** Determine the width of the distribution from the β -function of the accelerator. Plot the values against the path s .

Exercise 2: Twiss Parameter Determine the Twiss parameters α, β, γ and plot the values against the path.

Exercise 3: Position accuracy Assume that the optical components of the linac can be positioned to $300 \mu\text{m}$ in the transverse direction. Ignore any angular deviations. Prolong the linac to 200 FODO cells. What is the growth of the width of the position distribution? Solve the problem by tracking individual particles and by plotting the deviation from the nominal path.