PHY 554. Homework 3.

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Electronic copies accepted at yichao.jing@stonybrook.edu or yjing@bnl.gov

HW 1 (4 pts). Magnet kicker (dipole)

Using the transfer matrix M to show that, when a particle is kicked at s1 by angle θ, the displacement at a downstream location s2 is

$$\Delta x_2 = \theta\sqrt{\beta_1\beta_2}sin\mu,$$

Where β_1 and β_2 are values of betatron functions at s1 and s2 respectively, and μ is the betatron phase advance between s1 and s2. The quantity $\sqrt{\beta_1\beta_2}sin\mu$ is usually called the kicking arm. In the scenario of designing a magnet kicker (which kicks the beam for injection/extraction or other orbit change), to obtain the maximum kick (or minimum kicker strength), what are the requirements for choosing the kicker location?

HW 2 (6 pts). FODO cells

An accelerator is made of 12 FODO cells with circumference of 180 m. The betatron tunes (phase advance per revolution divided by 2π) Qx/Qy are 3.5/3.4 respectively. What are the maximum/minimum betatron functions (x and y) and where are they located at?

Given the RMS beam emittance ε is 1 mm-mrad, what is the minimum vacuum chamber size to house such beam without losing particles.