

# Accelerator Physics - Homework 9

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### Exercise (Coupling)

Write the Hamilton function for a midplane symmetric accelerator with tunes  $\nu_x$  and  $\nu_y$  that has the following perturbations from midplane symmetry. What resonances can occur? Which of these resonances can lead to very large oscillation amplitudes and therefore have to be avoided?

- (a) Weak skew quadrupole perturbations with strength  $k_{1s}(s) = \frac{q}{p} \partial_x B_x(s)$ .
- (b) Weak skew sextupoles perturbations with strength  $k_{2s}(s) = \frac{q}{p} \frac{1}{2} \partial_x^2 B_x(s)$ .

### Exercise (Amplitude dependent tune shift)

Write the Hamilton function for a midplane symmetric accelerator with tunes  $\nu_x$  and  $\nu_y$  that has small midplane symmetric oktupoles with strength  $k_3$ .

- (a) Derive the horizontal and vertical amplitude dependent tune shifts as functions of  $J_x$  and  $J_y$ .
- (b) Show that  $\partial_{J_x} \nu_y = \partial_{J_y} \nu_x$  for your result from (a).

### Exercise(Review)

Go through the steps of finding the resonance frequencies of a rectangular pillbox cavity.