Damping Rings - Homework III

1. A DR design with arcs consisting of simple FODO cells, includes two families of sextupoles with the following parameters

	SF sextupoles	SD sextupoles
Number of magnets	196	196
Integrated strength, k_2L	0.351 m^{-2}	-0.654 m^{-2}
Horizontal beta function, β_x	34.0 m	9.38 m
Vertical beta function, β_y	9.79 m	35.2 m
Horizontal dispersion, η_x	0.553 m	0.286 m

The horizontal and vertical tunes are 61.121 and 60.410, respectively; the natural emittance is 0.64 nm, and the natural energy spread is 0.13%. The dipoles have no quadrupole gradient

a. Estimate the vertical emittance that would result from vertical sextupole alignment errors with 100 μm rms, in a lattice otherwise free of alignment and tuning errors.

b. What level of sextupole alignment would be required to achieve (under the same conditions as in part (a)) an expected vertical emittance of 2 pm?

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2. If the ring circumference is doubled, discuss the impact on space-charge tune-shift and intrabeam scattering. Do the same if the energy of the ring is halved. Assume that in both cases the bending radius remains constant but also the RF system parameters.
3. The CLIC DR consider an RF frequency of 2GHz (1 train with 0.5ns bunch spacing) and 1GHz (2 trains symmetrically spaced in the DRs with bunch spacing of 1ns). Explain which of these two options would be beneficial for collective effects.