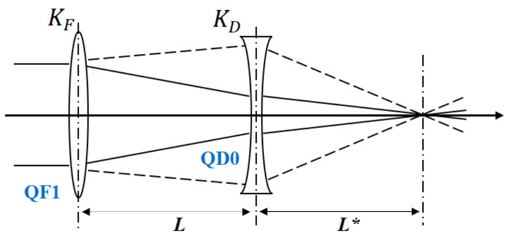
Homework at 12/16

Homework #4

We can express the Transfer Matrix by thin lens approximation as



$$M_x = \begin{pmatrix} 1 & L^* \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ +K_D & 1 \end{pmatrix} \begin{pmatrix} 1 & L \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ -K_F & 1 \end{pmatrix}$$

$$M_y = \begin{pmatrix} 1 & L^* \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ -K_D & 1 \end{pmatrix} \begin{pmatrix} 1 & L \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ +K_F & 1 \end{pmatrix}$$

$$K_F = \frac{1}{\sqrt{L(L+L^*)}}\ ,\ K_D = \frac{1}{L^*}\sqrt{\frac{L+L^*}{L}}$$

(1) Derive the vertical Transfer Matrix from QF1/QD0 to IP for $L^* = L = 5\ \mathrm{m}$.

(2) Derive the horizontal beta beam sizes at QF1 and QD0 for $\beta_x^* = 0.01\ \mathrm{m}$, $\varepsilon_x = 20\ \mathrm{pm}$.

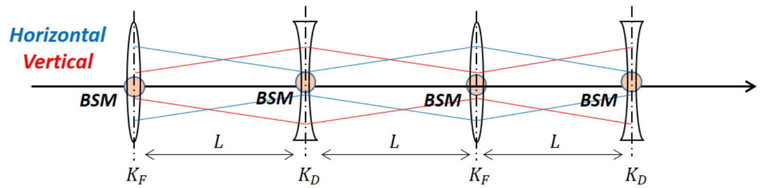
(3) The IP beam size growth by T_{322} *is expressed as* $\Delta\sigma_{322} = M_{34}\beta_x\varepsilon_x K_1 \frac{b_{2S}}{r_0}$.
When the multipole errors of quadrupole is $b_{2S} = 0.005$ *at* $r_0 = 0.01\mathrm{m}$,
calculate the $\Delta\sigma_{322}$ *both for QF1 and QD0.*

Homework #5

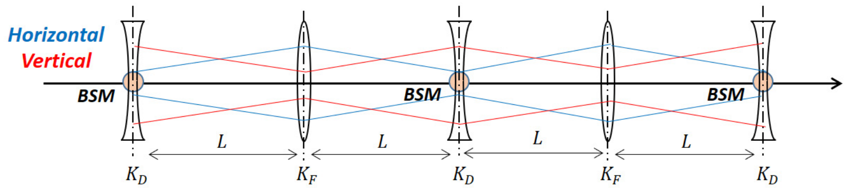
Assume the beam with the vertical physical emittance of 0.1 pm.

Beam emittance should be measured with periodic FODO diagnostic section.
Four beam size monitors, which can measure the beam size more than 2 micron, are used.

(1) Calculate the total length of the diagnostic section (3L) for the following scheme.
The phase advances in between monitors are set by 45degrees both for horizontal and vertical.



(2) Calculate the total length of the diagnostic section (6L) for the following scheme.
The phase advances in between monitors are set by 45degrees both for horizontal and vertical.



(3) Which is shorter ?

#4 is the aberration at final doublet.

#5 is the optics design for beam diagnostic section.