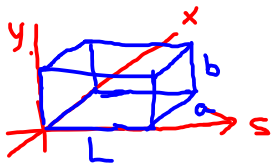
Final Exam:

(1) Consider a rectangular accelerating cavity

$0 \le x \le a$
$0 \le y \le b$
$0 \le s \le L$



Follow the logic in Sect. 2.1.3 or chapter 2, Notes 2 in Lectures.

(a) Find the lowest order accelerating mode in the cavity.

(b) If $a = b$, then what cavity dimensions will give a resonant frequency of $1\ \text{GHz} = 10^9\ \text{Hz}$?

(c) Find the transit time factor of the cavity.

(2) Based on SNS:

Use Eqns: 2.39 - 2.40

or Notes Chapter 2, Notes 5.

Parameters: $\Delta E = 1$ MeV

$E_s = 1.938$ GeV protons

$\gamma_T = 5$

$\omega_{rf} = 2\pi \times 10^6$ Hz

$\tau = 10^{-6}$ s.

Linac bunches in ring = 400

How many turns does it take for beam to debunch (linac bunches to overlap)?

③ Uniform focusing lattice

$x'' + Kx = 0$ for synchronous particle.

K = constant.

Parameters: Length L

Radius $R = L/2\pi$

Tune $= \nu$

(a) Write down 1-Turn Matrix.

(b) Find α, β (Twiss Parameters)

(c) Calculate Dispersion function for Closed orbit conditions.

(d) Find γ_T

Chapter 3.2, 3.3 / Notes 3.8, 3.9

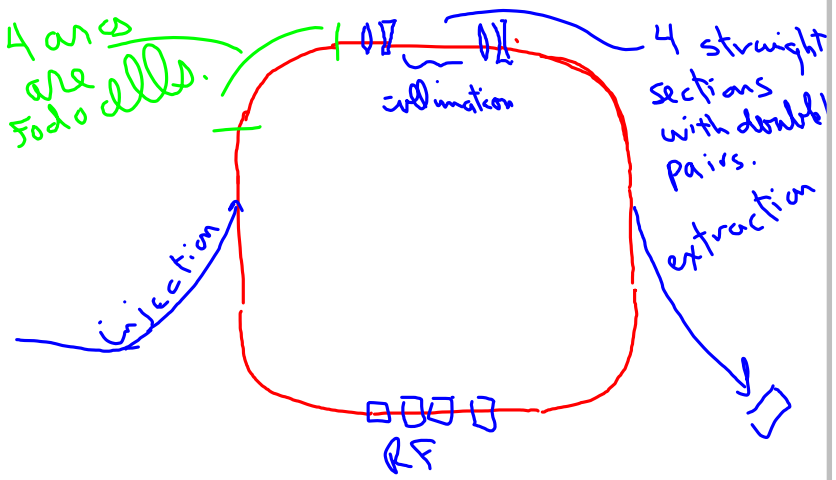
④ Doublet Lattice

ⓐ Write matrices for doublet starting at f_2 and also at f_1.

ⓑ Find the phase advance μ.

ⓒ Find α and β for the two matrices found in ⓐ. Assume $f_1 = f_2 = f$. What do you get if $L_1 = L_2 = L$?

Comment on doublets in SNS:



(5) SNS: $L = 248$ m

$B = 2.0$ (inverse of bunch factor)

$\lambda = \frac{NB}{L}$

$E_0 = 1.938$ GeV

$\nu_0 = 6.2$

$a_0 = 3$ cm

$N_0 = 1.5 \times 10^{14}$

@ Calculate Tune Shift due to space charge.

(b) What value of N would be required to give $\Delta\nu = 0.2$?

(c) What value of a would be required to give $\Delta\nu = 0.2$?

(d) What if $E_0 = 2.238$ GeV?

what is $\Delta\nu$?

what is N for $\Delta\nu = 0.2$?