Home Work PHY 554 #7. **Due October 3, 2018**

HW 1 (3 point): A multi-cell accelerating RF linac operating at 500 MHz in a standing wave π-mode (e.g. each cell has opposite sign of the accelerating voltage from the neighboring cell) is used to accelerate non-relativistic heavy ion (Z=2, A=79) moving with velocity v=c/3 (β=1/3).

(a) find the length of the cell required for resonant acceleration in such a linac – 1 point
(b) at what velocity (ies) (and energy(eis) of the ion), the energy gain in 5-cell cavity would vanish (became zero) – 2 point

HW 2 (2 points): A n-cell standing wave cavity operates in π-mode with field on the axis describes as

$$E_z = E_o(z)\cdot\sin(\kappa z)\cdot\sin(\omega t+\varphi);\ \kappa=\omega/2c;$$

$$E_o(z)=\begin{pmatrix} E_o;\ 0\le z\le \dfrac{n\pi}{\kappa} \\ 0;\ z<0 \\ 0;\ z>\dfrac{n\pi}{\kappa} \end{pmatrix}$$

Find the energy gain and transit time factor in such a linac for particle moving with the speed of light.

Extra points: what will be modification if v= βc; β ≠1.

HW 3 (5 points): A 0.3 m long 500 MHz pillbox cavity operates in fundamental accelerating TM_{010} mode with peak accelerating electric field of 20 MV/m.

(a) Find the energy stored in electric and magnetic fields as function of time;
(b) What is the total energy of EM field in the cavity? Does it changes with time?
(c) What will be losses of the energy for Q-factor of 30,000?