

## 08.33.40 Hlutjónað rafgas

### Dæmablað 4

Skilafrestur 2. október 2007 kl. 14:00

#### 1. A Partice-in-Cell Simulation with one Electron Sheet

(15) Dæmi 4.4 í Lieberman og Lichtenberg

#### 2. rf Discharge

(15) A one-dimensional slab model of an rf discharge between two parallel perfectly conducting electrodes of area  $A$  consist of a uniform plasma slab ( $n_e = n_i = n_0$ ) of thickness  $d$  with two sheaths, each of thickness  $s$ , one near each electrode. An rf voltage source is connected across the electrodes, such that an rf current  $I(t) = I_0 \cos \omega t$  flows across the plates. You may neglect ion motions and assume that  $\omega_p \gg \omega, \nu_m$ , where  $\omega_p$  is the plasma frequency and  $\nu_m$  is the electron-neutral momentum transfer frequency. Writing the voltage across the plates in the form  $V(t) = \text{Re}[V_0 \exp(j\omega t)]$ , then we can introduce

$$V_0 = I_0 Z = I_0 (R + jX)$$

where  $Z$ ,  $R$ , and  $X$  are impedance, resistance, and reactance of the discharge, respectively. ( $V_0$  and  $Z$  are complex numbers;  $I_0$ ,  $R$ , and  $X$  are real numbers.)

(a) Find  $R$  and  $X$  for this discharge model. Sketch  $R$  and  $X$  versus  $\omega$  for  $0 \leq \omega \leq \omega_p$ .

(b) Find the real power

$$P = \frac{1}{2} \text{Re}(V_0^* I_0)$$

flowing into the discharge, and find the frequency  $\omega_{\text{res}}$  for which  $X = 0$  (the series resonance frequency).