Homework A.2-1 : Particle source (Electron Source)

Answer the following questions. Please use $e = 1.60 \times 10^{-19}$ C as electronic charge, $\hbar = 1.05 \times 10^{-34}$ J.s for Planck constant, $m_0 = 0.511$ MeV/c^2 for electron static mass, $c = 3.00 \times 10^8$ m/s for velocity of light.

Q.A2.1 One of the role of the injector is bunching. Why is the bunching important?

Q.A2.2 To extract electrons from a material, we need some energy. What is the energy for the thermal emission, photo-electron emission, and the secondary emission?

Q.A2.3 According to Fowler equation, the photo-electron can be emitted with a photon energy less than the work function of material. Why is it possible?

Q.A2.4 Why is the polarization from the bulk GaAs crystal limited up to 50%? How is the 90% polarization obtained?

Q.A2.5 Let us design the ILC electron gun based on a DC photo-cathode gun. The cathode radius is 5 mm, HV is 320 kV, the cathode-anode distance is 10 cm. How much is the appropriate laser pulse length to extract 3.2 nC electron bunch?

Q.A2.6 If the cathode has 1 % quantum efficiency for 780 nm wave length, how much is the minimum laser pulse energy for one bunch? What do you expect by illuminating a laser pulse with an energy more than the requirement?

Q.A2.7 The bunch length from the gun is too long for RF acceleration and we need bunching. 140 kV RF cavity (eV=140 keV) with 100 MHz frequency is available for the buncher. What is the distance from the buncher to the first RF accelerator?