

**Home Work PHY 554 #8. Due March 9, 2020**

**HW 1 (4 points):** Superconducting RF pillbox cavity operating at 2K temperature would quench when the surface magnetic field reaches above 0.1 T (e.g. 1,000 Gs or 1,000 Oe).

- (a) For such pillbox cavity operating in fundamental  $TM_{010}$  mode find maximum attainable accelerating electric field on axis of the cavity;
- (b) For  $R_s = 5$  nanoOhm, calculate thermal losses in such cavity operating at 20 MV/m (Hint do not forget side walls!)

**HW 2 (6 points):** For SRF Nb cavity the London penetration depth is equal to 40 nanometers.

- (a) What is the density of superconducting electrons,  $n_s$ ?
- (b) For surface magnetic field of 500 Gs or 500 Oe, find the density of surface current
- (c) For frequency of 1 GHz, find value of electric field on the surface of the superconductor
- (d) Assuming conductivity on normal component (non-superconducting electron) of Nb is  $3 \times 10^8$  S/m (e.g. conductivity of  $6 \times 10^6$  S/m at room temperature multiplied by RRR of 50), find what is the value of the normal component of the surface current.

Hint: assume that the superconducting conductivity is significantly higher than normal part.