Home Work PHY 554 #9. Due March 4, 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 Rs = 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 3×10^8 S/m (e.g. conductivity of 6×10^6 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.