University of Chicago
Physics 575
Accelerator Physics and Technology of Linear Colliders

Chapter 7
Superconducting RF
Lutz Lilje

Homework

1. Take the London equations

$$\frac{\partial j_s}{\partial t} = \frac{n_s e^2}{m} E \tag{1}$$

and

$$\nabla \times j_s + \frac{n_s e^2}{m} B = 0 \tag{2}$$

together with Maxwell's equations for the static case to show that

$$\nabla^2 H = \frac{1}{\lambda_L^2} H = 0 \tag{3}$$

$$\nabla^2 j_s = \frac{1}{\lambda_L^2} j_s = 0 \tag{4}$$

$$\text{with} \quad \lambda_L^2 = \frac{1}{n_s e^2 \mu_0}. \tag{5}$$

2. What quality factor Q_0 would be needed to operate TESLA in cw mode? Assume the the cryogenic cooling power is not increased. Is this realistic for operation at 2 K ?

3. Discuss the fundamental difference between superconducting magnets and superconducting cavities in terms of :

   - stored energy
   - power dissipation during operation
   - power dissipation in case of failure modes
   - properties of the superconductors