**Problem Set 1**

Due in class Feb. 15

Exercise 1 (long problem): Consider the usual Ginzburg Landau free energy density and include to it the following term:

$$\epsilon \mathbf{h} \cdot [\Psi(i\hbar\nabla - e^*\mathbf{A}/c)\Psi^* + \Psi^*(-i\hbar\nabla - e^*\mathbf{A}/c)\Psi]. \tag{1}$$

(a) Derive the resulting Ginzburg Landau equations and associated surface terms (for both $\mathbf{A}$ and $\psi$). Interpret the boundary condition found from variation with respect to $\mathbf{A}$ in terms of the usual Maxwell boundary conditions for magnetic fields.
(b) Work in the London limit ($|\psi|$ constant) and solve the boundary value problem (that we solved in class) to find the penetration depth and find the magnetic induction inside the superconductor. Note that the answer to this problem can be found in L.S. Levitov, Yu V. Nazarov, and G.M. Eliashberg, JETP letters **41**, 365 (1985). However, you find this paper difficult to follow.

Exercise 2 (not so long): Fill in the missing details for the boundary value solution of the London equation for the magnetic induction around a superconducting sphere.