

## HOMEWORK 3

**Physics 752**  
**Many body problems in solid state physics**  
**Fall, 2002**

- 1 What is the leading small momentum dependence of the damping rate of a quasiparticle in a superfluid bose gas?
2. Describe possible phases of a  $p$ -wave superfluid state in 2 dimensions (are both A and B phases allowed?)
3. The bosonic excitation spectrum of a 3D ferromagnet is given by  $E_k = J(0)S(1 - \nu_k)$ , where  $\nu_k = (\cos k_x + \cos k_y + \cos k_z)/3$ . Using  $M = \langle S_z \rangle = S - \langle a^\dagger a \rangle$ , obtain the leading temperature dependence of  $M$ . What will be the result in dimensions  $D = 2$  and  $D = 1$ ?
4. Using the large  $S$  approximation  $S_z = S - a^\dagger a$ ,  $S^+ = \sqrt{2S}a$ ,  $S^- = \sqrt{2S}a^\dagger$ , obtain the excitation spectrum of an antiferromagnet.