Problem Set 3

Consider the *magnetic* scattering of a single neutron by a single spin, and then the scattering of neutrons by a macroscopic concentration of spins in a sample.

The interaction between the neutron and the spin is of the form -μ_n B were μ_n is the moment of the neutron $\mu_n = S_n\delta(r-r')$ and B is the magnetic field created by the spins in the sample.

Write an expression for the scattering cross section for scattering from an initial state $|\uparrow>$ to a final state $|\uparrow>$ or $|\downarrow>$ in the Born Approximation. This is just a review of undergraduate quantum mechanics.

Now consider a regular array of spins occupying a lattice with positions R_n

Express the measured scattering cross section in terms of the spin spin auto correlation function.

a) If the incoming neutrons are all polarized in the Z interaction (with spin up) and the detectors only count neurtons with spin down in the Z direction.

b) What if the initial beam is unpolarized and the the detector does not care about polarization.

c) Assume the spins are ordered,when do you expect a large scattering cross section for elastic scattering?