HST 584/22.561 - Problem Set 1

1. If B_o= 1.5 Tesla, and the nuclei of interest is protons, what is the ratio of parallel to anti-parallel spins at room temperature? How about for phosphorus (P-31)?

At what temperature can you get a 3-1 ratio of low to high energy spins at this field strength?

What field strength would you need to achieve this differential at room temperature?

2.

a) In typical proton NMR experiments, RF pulse lengths ($ø_{tip}$=90^o) are _100 μsec. How big is B_1? How does this compare to typical B_o's?

b) For a 4 turn solinoid of radius 1cm, what current would need to be applied to generate this field? Estimate the power needed to apply this current.

c) If B_o = 1.5 Tesla, and the RF pulse is applied 10 kHz off resonance, what is B_{eff}? Where would the magnitization vector point after a 100 μsec RF pulse?

3. For $B_1 = 0$, what is the solution to the Bloch Equations ? (This should be simple!)

If at t=0, B=B_o, M_x=M_o, M_y=0, M_z=0 (i.e., immediately after a 90 degree pulse), write out the equations of motion for **M**.

If at t=0, B=B_o, M_x=M_y=0, M_z=-M_o (i.e., immediately after a 180 degree pulse), write out the equations of motion for **M**.