E&M II - Project 2 outline

For the project we plan to calculate the hyperfine structure (Zeeman effect) for Hydrogen and another atom. Since these calculations become exponentially more involved with the difficulty of the atomic nuclei structure, we will perhaps try to look at simple atoms such as deuterium. We will then find how different magnetic fields affect the structure and determine if any anomalies occur for different magnetic fields. It will be up to both of us together to complete these calculation (since they are involved).

The largest part of the project will be creating methods of calculating the Hamiltoniann. This will probably take the most time, which we could hopefully expect to have completed in a couple weeks (since ¡Eric¿ may be gone multiple times to visit grad schools). Once that is complete we should take another week to compute the effect that different magnetic fields have on the structure. We will numerically or graphically represent the results for a range of cases with different magnetic field strengths. We will start with the simple hydrogen atom calculations and determine the correction terms due to a magnetic field. From this, we can determine the Hamiltonian and use perturbation theory to solve for energy and wave function corrections. This may prove different for higher energy states of Hydrogen due to degeneracies which is where a computer system will be applied to help solve for the corrections. We may only be able to achieve results for a couple low level n states but we will see.

If we have time at the end, we can look at how a linearly changing magnetic field can induce an electric field. Since a time dependent magnetic field will cause an induced changing electric field, this will cause the stark effect to play a role in the corrections to the Hamiltonian. This would be very complicated on its own so we can perhaps look at a specific case for the hydrogen atom, such as the ground state and choose a simple magnetic field changing in time to explore how this affects the perturbations. This is where we can involve much more E&M into our project, but I suspect it will be far too much work to try and generalize the effects of a changing magnetic field any.