

1. Explain the physical origins of the perturbation Hamiltonians representing (i) the "hyperfine structure" and (ii) the "spin-orbit coupling" part of the fine structure of the H atom. Carefully distinguish which magnetic moment interacts with which field. In which states of the H atom is the hyperfine structure easiest to see and why?
 2. **McIntyre 12.14** (calculate numbers, percentage shifts *etc.* to get a feel for the sizes of terms.
 3. **Zeeman effect:**
 - (a) Explain the physical origin of the Zeeman Effect.
 - (b) Explain what constitutes a "strong" magnetic field in the context of the Zeeman effect of an external applied magnetic field for the $n = 2$ state of H. What magnetic field would have to be applied for the Zeeman effect to make the energy of the maximally-upward-shifted $2p$ state coincide with the energy of the maximally-downward-shifted $3d$ state? How big is this magnetic field on a laboratory scale?
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Coming up next homework:

1. McIntyre 13.4 (Toy problem about exchange symmetry)
2. McIntyre 13.3 (Two identical spin-1 particles)