Physics 125b – Problem Set 12 – Due Feb 19, 2008

Version 1 – Feb 13, 2008

This problem set focuses on spin and on addition of angular momentum, Shankar Chapters 14 and 15 and Lecture Notes 13 and 14.

Many basic problems in QM can be found in textbooks – there are only so many solvable elementary problems out there. Please refrain from using solutions from other textbooks. Obviously, you will learn more and develop better intuition for QM by solving the problems yourself. We are happy to provide hints to get you through the tricky parts of a problem, but you *must* learn to set up and solve these problems from scratch by yourself.

1. Shankar 12.4.4 (Vector operators)
2. Shankar 14.4.3 (Quantum mechanical version of paramagnetic resonance)
3. Shankar 14.5.3 (Multiple Stern-Gerlach apparatuses)
4. **Derive** the Clebsch-Gordan coefficients for the following:

   (a) $1 \otimes 1 = 2 \oplus 1 \oplus 0$

   (b) $\frac{1}{2} \otimes \frac{1}{2} \otimes \frac{1}{2} = \frac{3}{2} \oplus \frac{1}{2} \oplus \frac{1}{2}$

   That is, use the techniques we developed in class to find all the CG coefficients from scratch. Yes, it's painful, but it's good to do this once in your life. You may look up the results in the PDG table of Clebsch-Gordan coefficients to check your results, but you must fully justify your derivation of the coefficients.

5. Shankar 15.2.5. For your own amusement, can you think of a generic formula for such a projection operator for an arbitrary $V^{(j)}$? Does it reduce to the result in this problem?