QUANTUM MECHANICS II (524)
PROBLEM SET 2 (hand in January 30)

4) (10 pts) Demonstrate that the spin-correlation function $C_{QM}(\hat{\boldsymbol{n}}^{(1)}, \hat{\boldsymbol{n}}^{(2)})$ is indeed given by $-\cos\Phi$ as indicated in the Phys. Rev. Letter discussed in class. The angle Φ is illustrated in Fig. 3 of that paper.

5) (20 pts) Construct all the nonzero matrix elements of the operator $\boldsymbol{J}^2$ where $\boldsymbol{J} = \boldsymbol{j}_1 + \boldsymbol{j}_2$ for the case $j_1 = 1 = j_2$ in the uncoupled basis. Diagonalize this 9x9 matrix on the computer and compare the eigenvalues and eigenvectors with the corresponding Clebsch-Gordan coefficients that you obtained in Problem Set 1.

6) (10 pts) Let $\mathcal{T}_{\boldsymbol{d}}$ denote the translation operator with displacement vector $\boldsymbol{d}$; $\mathcal{D}(\hat{\boldsymbol{n}};\phi)$ the rotation operator about the axis characterized by $\hat{\boldsymbol{n}}$ and by an angle ϕ; and Π the parity operator. Which, if any, of the following pairs commute and why?

   a) $\mathcal{T}_{\boldsymbol{d}}$ and $\mathcal{T}_{\boldsymbol{d}'}$ ($\boldsymbol{d}$ and $\boldsymbol{d}'$ are in different directions).

   b) $\mathcal{D}(\hat{\boldsymbol{n}};\phi)$ and $\mathcal{D}(\hat{\boldsymbol{n}}';\phi')$ ($\hat{\boldsymbol{n}}$ and $\hat{\boldsymbol{n}}'$ are in different directions).

   c) $\mathcal{T}_{\boldsymbol{d}}$ and Π.

   d) $\mathcal{D}(\hat{\boldsymbol{n}};\phi)$ and Π.