Quantum Mechanics 2, Autumn 2011 CMI
Problem set 2
Due by beginning of class on Wednesday August 24, 2011
Anisotropic rigid body

1. Consider an anisotropic rigid body with principal moments of inertia $I_1^{-1} = a$, $I_2^{-1} = b$, $I_3^{-1} = c$. Find the matrix representation of the hamiltonian $H = \sum_{i=1}^{3} \frac{L_i^2}{2I_i}$ in the basis of spherical harmonics for $l = 1$.

2. Find one eigenvector of H and its corresponding eigenvalue. Hint: One of the three Y_{1m}'s is itself an eigenvector.

3. Find the characteristic equation for eigenvalues of H.

4. Find the $l = 1$ energy levels of such a rigid body. Hint: Use the knowledge of one eigenvalue and cyclic symmetry to guess the others. Check your answer.

5. Find the corresponding energy eigenstates, say which energy level each corresponds to.

6. Find the unitary transformation that diagonalizes the hamiltonian in the $l = 1$ subspace.