

Homework 6

1. (30 point) Show that for any L and S :

ψ_{l,m_l,s,m_s} is an eigenstate of \hat{J}_z operator and $m_j = m_l + m_s$.

However, show that ψ_{l,m_l,s,m_s} is not an eigenstate of \hat{J}^2 operator in general.

2. (40 points) Express Φ_{j,m_j} through ψ_{l,m_l,s,m_s} for a system consisting of $s = 1/2$ and $l = 1$.

3. (40 points) Express Φ_{j,m_j} through ψ_{l,m_l,s,m_s} for general case of $s = 1/2$ and l .

4. (40 points) Obtain Recursion Relation for Clebsch - Gordan coefficients

5. (40 points) Obtain the Hamiltonian of the deuteron nucleus. Show why it has only $l = 0$ and $l = 2$ orbital angular momentum states and why the total spin of proton and neutron; $S = S_p + S_n = 1$

6. (40 points) Express the deuteron wave function at different total angular momentum J projections (1, 0, -1) through the radial wave functions and spherical wave functions.

7. (30 points) Construct the total spin state of bound quark - antiquark system.