

Physics 711 Homework Problems

1. Prove the addition theorem for spherical harmonics by considering rotation of an orbital angular momentum state $|lm\rangle$, i.e., prove that

$$P_l(\cos \gamma) = \frac{4\pi}{2l+1} \sum_m Y_l^{m*}(\theta', \phi') Y_l^m(\theta, \phi)$$

2. Using the Clebsch-Gordan series, the unitarity of \mathcal{D} matrices and the orthogonality of Clebsch-Gordan coefficients, prove that

$$\sum_{m'_2} \langle m'_1 m'_2 | jm \rangle \mathcal{D}_{m'_2 m_2}^{(j_2)}(R) = \sum_{m_1 m'} \mathcal{D}_{m m'}^{(j)}(R) \langle m_1 m_2 | jm' \rangle \mathcal{D}_{m'_1 m_1}^{(j_1)*}(R)$$