Spinless particles scattering through states of J=0, 1, or 2 (from the problem set)

For spinless particles A and B in two to two scattering A+B→C→A+B through the state C with J=0, 1, or 2, the general result for the scattering amplitude specializes to

\[ T(\theta, \varphi) = \sum J T_J P_J(\cos \theta). \] (This was given in a handout. The energy dependence in T and T_J is suppressed.) Thus if a single J channel dominates, we have

\[ \frac{d\sigma}{d\Omega} \propto |P_J(\cos \theta)|^2, \]

and the angular distribution is 1, \( \cos^2 \theta \), and \( [(3/2)\cos^2 \theta - 1/2]^2 \) for J=0, 1, and 2, respectively. For J ≠ 0, this is not spherically symmetric because not all the \( J_3 \) states are available. In particular, spinless particles approaching along the 3-axis can have \( J_3=0 \) only.