

Physics 220, Lecture 8

★ Reference: Hamermesh; Georgi.

• Last time: S_4 character table. Consider H_0 with symmetry $O \cong S_4$ and H_1 with symmetry subgroup $D_3 \cong S_3$. Splitting of levels.

• Discuss T , and $T_d \cong O$, and $T_h \cong T \times Z_2$. Also O and $O_h \cong O \times Z_2$. Octahedral symmetry group (e.g. UF_6). Include inversion: make 4-body diagonals have arrows, and I flips all. 48 elements in 10 classes.

• Selection rules using example of T . Emit a γ . Electric dipole transition and selection rules for leading order. Quadrupole radiation.

• On to Lie groups! Group elements depend continuously on continuous parameters α_A , $g \in G$ of form $g(\alpha)$, with $g(\alpha)|_{\alpha=0} = e$. Since there is a continuous infinity of group elements, we'll refer to the dimension $|G|$ of Lie groups G as the number of their independent parameters. Examples: rotation in plane, rotation in 3d, Lorentz group, translation group, Poincare group, $GL(n)$, $SL(n)$, $O(n)$, $SO(n)$, $U(n)$, $SU(n)$.

Example of the $SU(2)$ group manifold $\cong S^3$. Compact vs non-compact groups.

• Representations $D_r(g)$. Generators in representation, $T_r^A = -i\partial_{\alpha_A} D(\alpha)|_{\alpha=0}$. Write $D_r(g(\alpha)) = e^{i\alpha_A T_r^A}$.