**Group Theory for Graduates**

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Hilary & Trinity Terms 1995

**1 Basic Concepts**
Group axioms Generators Cosets & classes Representations Equivalent representations Generation of inequivalent representations Irreducible representations

**2 Schur's lemmas and orthogonality relations**
Orthogonality relations; characters of representations; reduction of representations; the regular representation; reduction of a direct product representation.

**3 Applications to quantum mechanics**
Function spaces; commuting observables; dynamical symmetries; two-particle states & Clebsch–Gordon coefficients; Wigner–Eckart theorem.

**4 Important Lie Groups**
$\mathcal{R}^3$; $\mathcal{R}(3)$; $GL(n,\mathcal{R})$; $SL(n,\mathcal{R})$; $SL(2,\mathcal{C})$; $\mathcal{O}(n)$; $SO(n)$; $U(n)$; $SU(n)$.

**5 General theory of Lie Groups**
Summary of the theory; proof of key results; concrete calculations.

**6 Infinitesimal generators**
The Lie algebra $\Lambda(\mathcal{R}(3))$; the Lie algebra $\Lambda(SU(2))$ the Lie algebra $\Lambda(SU(3))$

**7 Representations of Lie groups**
Representations of $\Lambda(SU(2)) = \Lambda(\mathcal{R}(3))$; characters of the $D^{(j)}$ irreps; integration over a Lie group; Casimir operators.

**8 Representations of $SU(3)$**
Quarks and $SU(3)$; Young's tableaux; colour;

**9 The Lorentz Groups**
The Lie Algebra $\Lambda(\text{Ł})$; the Lorentz group with inversions; the Poincaré group.

Most topics are covered in either vol. 1 or vol. 2 of *Group Theory in Physics* by Elliott & Dawber (OUP).