PHYS 262: Special Topics in High Energy Physics

Group Theory for Physicists

Prof. Flip Tanedo, Winter 2018; this version: Jan 7

Effective meeting time: MW(F) 4:15 - 5:30pm Conference Room / TBA (see website)
Textbook: *Lie algebras in particle physics*, Howard Georgi
Website: https://tanedo.github.io/Physics262-2019/ (including schedule)

Description

Graduate-level introduction to the representation of continuous (Lie) groups and how they appear in quantum mechanical systems. How are continuous symmetries manifested mathematically in our physical theories? What patterns of spontaneous symmetry breaking are allowed? How do representations combine? Examples will draw from particle and nuclear physics, but the course will focus on the mathematical formalism relevant to many theoretical disciplines. (Strongly recommended to hep-ex/ph students and cond-mat theory students.)

Evaluation

3 problem sets (60%)
1 in-class presentation and essay on an application of group theory in your field (20% + 20%)

Pre-requisites

Familiarity with linear algebra at the level of Physics 221 (Quantum Mechanics). No background (or primary interest) in particle physics, field theory, or abstract algebra necessary.

Syllabus

Week 1: (iso)spin in quantum mechanics, groups and algebras (chapter 3)
Week 2: fundamental, anti-fundamental, adjoint: what is a representation (chapter 1-2)
Week 3: roots and weights (chapter 6)
Week 4: generalization to SU(3) (chapter 7)
Week 5: simple roots (chapter 8 - 9)
Week 6: tensor and irreducible representations, Clebsch-Gordan coefficients (chapter 10)
Week 7: Dynkin diagrams (chapter 6)
Week 8: spontaneous symmetry breaking in physics
Week 9: presentations
Week 10: advanced topics: the Poincare group and fermions