Harvard University Physics 144 Fall 2011

Symmetries and geometry in quantum mechanics

Course Meetings
MW 1:00 - 2:30 pm in Jefferson 256

Instructor
Eugene Demler
Office: Lyman 322
Email: demler@physics.harvard.edu

Teaching Fellow
David Benjamin
Email: benjamin@physics.harvard.edu

Course Grade
Grading will be based on homeworks (50%) and final presentations (50%).

Office hours to be arranged
1. Introduction. Symmetry in physics.
7. 'Accidental' degeneracy of Hydrogen atom.
11. Topological states of noninteracting electrons. The quantum Hall effect and the Chern numbers.
12*. Group theory in particle physics.
Primary references


• *The topological theory of defects in ordered media*, N. Mermin, Reviews of Modern Physics, 51:591(1979)


Other useful references


• *Applications of Group Theory in Quantum Mechanics*, M. I. Petrashen, J. L. Trifonov, Dover Books on Physics


• *Lie algebras in particle physics*, H. Georgi, Addison-Wesley publishing company (1996)
Possible topics for final presentations

The icosahedral group and phonon modes of the $C_{60}$ buckyball.
Quasicrystals.
Quantum Spin Hall Effect.
3D topological insulators.
Onsager’s reciprocity relations for transport coefficients.
Fractional quantum Hall states.
Non-Abelian Berry phases.
Topological quantum computing.
Random matrix theory. Applications in nuclear and/or condensed matter physics.
SU(N) groups in particles physics and/or quantum magnetism.
Poincare group.
The gauge groups.