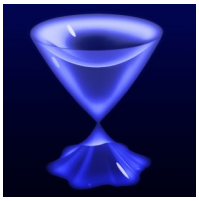

PHYS 731: Solid State Physics

Spring 2015
Tues. and Thurs., 11-12:15, Toll 1204

Prof. James Williams
jwilliams@physics.umd.edu
PSC 2160
Office Hours: TBD
(301) 314-2161

Course Description and Structure: This course will survey a variety of topics from modern condensed matter physics. Focus will be given to electronic phenomena in solids. Specifically, we will focus on departures from free, three-dimensional electron behavior in quantum devices and materials. The course will consist of a series of lectures given by Prof. Williams followed by in-class presentations/discussions of papers on current research topics that complement the material discussed in the lectures. The class will break up in the beginning of the term into groups of 2-4 students (depending on class size). A the beginning of each class when a paper will presented, one of these groups will be chosen at random to lead the discussion. Prof. Williams will present the first paper to demonstrate how this should be done. A final paper that elucidate further a topic discuss in the class will allow the each student to propose a novel line of research into the chosen topic.

Prerequisite(s): Undergraduate quantum mechanics (PHYS 401, 402)
Credit Hours: 3

Text(s): There is no required text for this course. However, there are many good books that cover the topics of this course.

1. *Solid State Physics*, Ashcroft and Mermin
2. *Introduction to Solid State Physics*, Kittel
3. *Many-Body Quantum Theory in Condensed Matter Physics*, Bruus and Flensberg
4. *Mesoscopic Physics of Electrons and Photons*, Ackermans and Montambaux
5. *Topological Insulators and Topological Superconductors*, Bernevig

Grade Distribution:

Homework	25%
In-class presentations and participation	25%
Final Paper	50%

Tentative Course Outline:
The weekly coverage might change as it depends on the progress of the class. NOTE: I will be away to attend the APS March Meeting on Tuesday March 3rd. There will be no class that day.

Week	Topic
Week 1	• Free-electron theory • Energy band structure and Bloch's Theorem
Week 2	• Electron-electron interactions • Hartree-Fock Theory • *Homework 1*
Week 3	• Luttinger Liquids • Discussion of upcoming papers
Week 4	• Papers and presentations
Week 5	• Papers and presentations
Week 6	• Mesoscopic physics • Weak localization • *Submit first abstract for final paper*
Week 7	• One-dimensional structures: Quantum wires and point contacts • *Homework 2*
Week 8	• Zero-dimensional structures: Quantum Dots • Discussion of upcoming papers
Week 9	• Papers and presentations
Week 10	• Papers and presentations
Week 11	• Quantum Hall effect • *Submit revised abstract for final paper*
Week 12	• Graphene • Carbon Nanotubes • *Homework 3*
Week 13	• Topological Insulators • Discussion of upcoming papers
Week 14	• Papers and presentations
Week 15	• Papers and presentations