

PHYSICS 556 ADVANCED SOLID-STATE PHYSICS

Spring 2018

Tuesday, Thursday 10:00 AM -- 11:20 AM, Room B-131, Physics Building

(NOTE the room: NOT the one given in the university class schedule.)

Instructor: Dmitri Averin, dmitri.averin@stonybrook.edu

office hour: time TBD, B-140

Textbook: Piers Coleman, "Introduction to many-body physics", Cambridge, 2015.

Supplementary reading: E.M. Lifshitz and L.P. Pitaevskii, "Statistical physics II",
P.G. de Gennes, "Superconductivity of metals and alloys".

This is the second part of a graduate course in solid-state physics. The goal is to introduce the many-body phenomena in solid-state physics with the emphasis on the modern developments in this area. The number of possible topics that fit this description is much larger than what can realistically be covered in one semester, and we will address only some subset of them. The course will be balanced between the discussion of the theoretical tools like Green's functions and the path-integral formulation of quantum mechanics, and the actual effects solid state physics that rely on the particle-particle interaction. Both the well-established areas: superconductivity, Coulomb blockade transport, fractional quantum Hall effect, and more recent developments including solid-state quantum information and topological materials will be considered. Full list of topics will be finalized as the course proceeds, but will include:

- reminder of the many-particle quantum mechanics: exchange statistics, second-quantization;
- superfluidity of weakly-interacting Bose gas;
- superconductivity: Ginzburg-Landau theory, BCS theory, Bogolyubov-de Gennes equations,
- reminder of the density matrix and linear-response theory; fluctuations-dissipation theorem;
- superconducting tunneling, Josephson effect;
- mesoscopic transport and Coulomb blockade phenomena;
- quantum mechanics of dissipative systems;
- solid-state quantum computation and macroscopic quantum mechanics;
- mesoscopic detectors and quantum measurements.

Grading will be based on attendance and homework.

DSS STATEMENT:

If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact Disability Support Services (631) 632-6748 or

<http://studentaffairs.stonybrook.edu/dss/>

They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and Disability Support Services. For procedures and information go to the following website:

<http://www.stonybrook.edu/ehs/fire/disabilities.shtml>

ACADEMIC INTEGRITY STATEMENT:

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty members are required to report any suspected instance of academic dishonesty to the Academic Judiciary. For more comprehensive information on academic integrity, including categories of academic dishonesty, please refer to the academic judiciary website at:

<http://www.stonybrook.edu/uaa/academicjudiciary/>

CRITICAL INCIDENT MANAGEMENT:

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Judicial Affairs any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, and/or inhibits students' ability to learn.

<http://www.stonybrook.edu/uaa/academicjudiciary/>