

SYLLABUS

Physics 752 Many-Body Problems in Solid State Physics Spring, 1995

Instructor:	Prof. Andrey V. Chubukov
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Office hours	Any time, but please be reasonable
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Text: E.M. Lifshitz , L.P. Pitaevskii Statistical Physics, v.2, Pergamon Press, 1980;
G. Mahan, Many Particle Physics. These books are available for purchase
in the University Bookstore and are on reserve at the Physics Library.

Tentative Schedule of Topics

9/04	Introduction, summary of Physics 751
	Fluctuation-dissipation theorem
9/06	Retarded and time ordered susceptibilities, structure factor, relevance to neutron scattering and NMR relaxation rate.
9/09-9/16	Generalized susceptibility, Kramers-Kronig relations, fluctuation-dissipation theorem.

Superfluidity

9/18	Fundamental properties of ${}^4\text{He}$.
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9/20-9/27	Bose-Einstein condensation, weakly-nonideal Bose-gas, phonons and rotons.
9/30-10/04	Hydrodynamics of ^4He : two-fluid model, mass current, superfluid velocity.
10/07	Vortex filaments in ^4He .
10/09-10/18	Liquid ^3He . Fundamental properties, pairing mechanism, two types of superfluid ^3He , collective modes, angular momentum paradox.

Quantum magnetism

10/21-10/25	Magnetic order as a spontaneous symmetry breaking, experimental facts, various types of magnetic ordering.
10/28-11/01	Spin-wave theory for ferromagnets and antiferromagnets, transformations to Bosons, Goldstone modes, Mermin-Wagner theorem.
11/04-11/08	Hydrodynamics of magnets: low-energy description, sigma-model, spin stiffness and spin susceptibility.
11/11-11/13	Perturbation theory for the sigma-model, difference between planar and isotropic systems.
11/15-11/20	2D planar systems at finite temperature. Kosterlitz-Thouless transition, application to 2D superconductivity and superfluidity.
11/22	Absence of phase transitions in 2D isotropic systems, correlation length at low T , summary of experiments.
11/25-11/27	1D systems, exact solutions, difference between integer and half-integer spins.

Critical phenomenon

12/02	Critical exponents, summary of experiments.
12/04-12/06	Landau-Ginzburg approach, Gaussian fluctuations, $D = 4$ as a critical dimension.
12/09-12/13	Renormalization-group approach, $4 - \epsilon$ expansion.

Exam schedule

9/20-10/1	Homeset #1
10/4-10/11	Mid-Term Exam.
10/25-11/4	Homeset #2
11/8-11/15	Mid-Term exam
11/22-12/2	Homeset #3
12/16-12/20	FINAL EXAM

Three credit students

1. Exams. Each three-credit student will take a total of three exams (including the final exam). Each mid-term exam will have 3 questions, final exam will have 5 questions. Exam dates are listed on the Schedule of Topics. The dates are tentative and are subject to change. Exams will cover the assigned lectures. Approximately 2/3 of the questions will be drawn from the textbook, others will be drawn from lectures.

2. Class attendance is required.