

Quantum Theory of Many-Particle Systems

Physics 540, Fall 2000

Tentative Schedule

August 30, 2000

Instructor: Wim Dickhoff

Textbook: Fetter & Walecka (very, very optional: sticker price \$140 in the bookstore)

The outline below is still very tentative for classes later in the Semester. Reading assignments should be taken very seriously. The reading of handout pages is required. Other references to various books are optional but recommended to get a broader perspective. The table below should be read as follows: the third row of the table in the column under reading assignment refers to the reading of handout pages 3-9. These should be read before the first meeting of the class (August 30). The plan is to distribute the handout pages by e-mail in the form of a postscript file that can be printed on a favorite printer.

Hwk	Mtg#	Date	Reading Assignment	Topics
	1	Wed 8/30	Handout p.1-2 Handout p.3-9 Sakurai Ch. 6.1-2	Getting acquainted; what's the plan; course rules Identical particles; (Anti)-Symmetric two-body and many-body states; Fermion and boson scattering
1	2	Fri 9/1	Handout p. 10-18	Second quantization; Occupation number representation; Fock space; Operators
		Mo 9/4		LABOR DAY; NO CLASS
	3	Wed 9/6	Handout p.19-24 Sakurai Ch. 3.7	Independent particle model; Atoms; Nuclei;
2	4	Fri 9/8	Handout p.24-31 FW Ch. 1.3	Isospin; Fermi gases: Electron gas, Nuclear/neutron matter, ^3He liquid; Symmetry considerations for two particles
	5	Mon 9/11	Handout p.32-36	Interactions; Examples of two-body interactions
	6	Wed 9/13	Handout p.37-41 FW Ch. 2.4-5 Phys. Today 12/99	Statistical mechanics; Ideal gas; Bosons at finite temperature; Bose-Einstein condensation
3	7	Fri 9/15	Handout p.41-45	Trapped bosons at finite temperature; Fermions at finite temperature; Fermion degeneracy in traps
	8	Mon 9/18	Handout p.46-49 Sakurai Adv QM	Quantization of the electromagnetic Field; Maxwell's equations ; Free field solutions; Photons and many-photon states
	9	Wed 9/20	Koltun Eisenberg Ch. 3 Handout p.49-52 Sakurai Adv QM	Interaction of electrons with the EM-field; Emission and absorption of photons by atoms;
4	10	Fri 9/22	Koltun Eisenberg Ch. 3 Handout p. 53-58 Sakurai Ch. 2.5	Blackbody radiation; Laser principle Single-particle propagator in one-particle QM; Time-evolution; Eigenvalue problems; Diagrams
	11	Mon 9/25	Handout p. 58-62	Scattering theory and propagators; Partial waves and phase shifts
	12	Wed 9/27	Handout p.63-67 Sakurai Ch. 2.1-2&5.6	Time-evolution; Pictures Schrödinger / Heisenberg / Interaction;
5	13	Fri 9/29	Handout p. 67-71 FW Ch. 3.6	Adiabatic turning on of the interaction; Gell-Mann and Low theorem
	14	Mon 10/2	Handout p. 72-75 FW Ch. 3.7	Single-particle propagator in a many-particle system; Spectral functions

	15	Wed 10/4	Handout p. 75-77	Single-particle propagator in the independent particle model; Comparison with experimental results: $e, 2e; e, e'p$
6	16	Fri 10/6	FW Ch. 3.8-9	Wick's theorem; diagrams
	17	Mon 10/9	Continue	Analysis of perturbation theory
	18	Wed 10/11	Continue	Self-energy; Equation of motion method
7	19	Fri 10/13	FW Ch. 4.10 Handout	Hartree-Fock; infinite system Atoms
	20	Mon 10/16	Lindgren Morrison	Atoms (nuclei)
8	21	Wed 10/18 Fri 10/20	Handout	Beyond Hartree-Fock ; Second order FALL BREAK; NO CLASS
	22	Mon 10/23	RPA	Dynamic structure function (weak probe); Excited states; separable interaction & finite system
	23	Wed 10/25	Electron gas reading	Lindhard function; Plasmons (data including atoms)
9	24	Fri 10/27	Landau paper	Zero sound (data); Landau parameters
	25	Mon 10/30	RPA and self-energy	Results for electrons (GW) and nuclei
	26	Wed 11/1	Repulsive core	Brueckner Ladder diagrams; Galitski development; scattering in free space; Scattering length
10	27	Fri 11/3	Nuclear matter	Scattering of dressed particles
	28	Mon 11/6	Self-energy BCA	Results including second order; effective mass
	29	Wed 11/8	Nuclear matter	History and present status; Healing argument
11	30	Fri 11/10	Nuclei	PP RPA finite nuclei; instability Pairing in nuclei
	31	Mon 11/13	Pairing infinite matter	Cooper problem; instability; eigenvalues
	32	Wed 11/15	BCS	Superconductivity; superfluidity of ^3He ; d-waves
12	33	Fri 11/17	Nambu, Gorkov, Migdal	More formalism; neutron stars
	34	Mon 11/20 Wed 11/22 Fri 11/24	Baym Kadanoff or FW	Finite temperature I Thanksgiving Recess; NO CLASS Thanksgiving Recess; NO CLASS
	35	Mon 11/27	BK or FW	Finite temperature II
	36	Wed 11/29	BK or FW	Finite temperature III
13	37	Fri 12/1	Baym-Kadanoff	Transport
	38	Mon 12/4	Baym-Kadanoff	Applications; connection with field theory
	39	Wed 12/6	Gersch-Rodriguez	Compton profile; density matrices
14	40	Fri 12/8	Momentum distributions	Bose condensate; Gross-Pitaevski
	41	Mon 12/11	^4He	Lambda-transition; superfluidity
	42	Wed 12/13	2D-electrons in magnetic field $e, 3e; e, e'2N$ experiments	Quantum and fractional quantum Hall effect