Topics suggestions for term paper. References

Suggested topics, numbered by 1), 2), etc., are grouped into categories corresponding to different parts of the course. The papers are selected according to a combination of the novelty and readability criteria, applied quite freely. I tried to keep in the list only the papers which one can enjoy reading.

Superconductivity

1) Vortices and magnetic flux quantization (2003 Nobel prize):

A. A. Abrikosov, Sov. Phys. JETP 5, 1174 (1957);

useful background material on Ginzburg-Landau equation can be found in the book by M Tinkham, "Introduction to Superconductivity".

2) BCS theory generalized to pairing with nonzero orbital momentum and spin:

L. P. Pitaevskii, Sov Phys JETP **10**, 1267 (1960); D. J. Thouless, Ann Phys (New York) **10**, 553 (1960); K. A. Brueckner, T Soda, P. W. Anderson and P. Morel, Phys Rev **118**, 1442 (1960)

3) The interpretation of the experimental observations of a microKelvin transition in liquid ^3He in terms of anisotropic pairing (2003 Nobel prize):

A. J. Leggett, Phys Rev Lett **29**, 1227 (1972); A. J. Leggett, Phys Rev Lett **31**, 352 (1973); A. J. Leggett, J Phys C**6**, 3187 (1973)

Tunneling in macroscopic systems

1) A unified description of tunneling and thermally activated escape:

I Affleck, Phys Rev Lett. **46**, 388 (1981)

Tunneling stimulated by an external periodic field, considered in terms of trajectories in complex time:

L. V. Keldysh, ...

V. Melnikov and B. Ivlev, Sov Phys JETP ...

2) Tunneling and escape in field theory:

S Coleman, Phys Rev D**15**, 2829 (1977);

C. Callan & S. Coleman, Phys Rev D**16**, 1762 (1977)

Quantum mechanics with dissipation

1) Quantum dissipative Brownian walks and driven dynamics.

A. Schmid, Phys Rev Lett **15**, 1506 (1983)

Fisher, Zwerger, Phys Rev B**32**, 6190 (1985)

A very pedagogical discussion of the relation between dissipative quantum dynamics and classical Langevin dynamics,

A. Schmid, Ann Phys (New York) **170**, 333 (1986)

2) Fermi-liquid as a dissipative bath. Heavy particle moving in Fermi-liquid.

This problem was first considered by Josephson and Lekner in early 70's, and then argued about for a long time, until the views converged. The current situation is summarized in a recent review by A. Rosch, Phys Rep, ...

Orthogonality catastrophe:

P. W. Anderson, Phys Rev Lett **18**, 1049 (1967)

The Fermi liquid problem

1) Kinetic equation approach:

L. D. Landau, Sov Phys JETP **3**, 920 (1956); **5**, 101 (1957)

Instabilities of Landau Fermi liquid via spontaneous Fermi surface deformations:

I. Ya. Pomeranchuk, Sov Phys JETP **8**, 535 (1959)

2) Particle-hole excitations as Tomonaga bosons; oscillator representation of Fermi liquid

K. Sawada, Phys. Rev. **106**, 372 (1957);

K. Sawada et al. Phys. Rev. **108**, 507 (1957);

G. Wentzel, Phys. Rev. **108**, 1593 (1957).

The Kondo problem.

1) Renormalization group from logarithmic kink interaction:

P. W. Anderson, G Yuval, and D. R Hamann, Phys. Rev. B**1**, 4464 (1970) (see also P. W. Anderson, "Basic Notions of Condensed Matter Physics")

2) Renormalization group from diagrammatic calculations, with Kondo spin represented by a pseudofermion:

A. A. Abrikosov, Physics **2**, 5 (1965); (also: H. Suhl, Phys. Rev. **138**, A515 (1965)), see also a discussion in Abrikosov's book "Fundamentals of the Theory of Metals"

3) Large N calculation:

N. Read, J. Phys. C**18**, 2651 (1985) also, see a book by A. C. Hewson, "The Kondo Problem to Heavy Fermions"

4) The Anderson model:

P. W. Anderson, Phys Rev **142**, 41 (1961)

One-dimensional fermions (Luttinger liquid); bosonization

1) The transformation of the intercating 1D fermiona to noninteracting 1D bosons first appeared in:

S. Tomonaga, Progr Theor Phys (Kyoto) **5**, 544 (1950)

The inverse transformation, allowing to express fermi operators through bose fields (bosonization) was first introduced by

K. Schotte and U. Schotte, Phys. Rev. **182**, 479 (1969)

A good summary can be found in:

F. D. M. Haldane, J Phys C**14**, 2585 (1981), and in the book by Mahan, "Many-Body Physics"

2) Tunneling in a 1D Fermi system:

C. Kane, M. P. A. Fisher, Phys. Rev. Lett. **68**, 1220 (1992); Phys. Rev. B**46**, 15223 (1992)

X. G. Wen, Phys. Rev. B**43**, 11025 (1991); Phys Rev Lett **64**, 2206 (1990)