

Preface

The idea to write this book came to my mind after two advanced lecture courses which I have read in summer semesters of the year 2010 as Leverhulme visiting professor in Loughborough University UK and of the year 2011 as a visiting professor in LTPMS-Orsay (associated with the University Paris-Sud).

The first Chapters of this book had the approbation during 16 years of my pedagogical work as a Professor on Galitskii chair of Theoretical Nuclear Physics in Moscow Engineering Physical Institute and during autumn semester of the year 1994 in the University of Amsterdam.

The course is based on the original research work where I actively participated and contributed as a principal scientist and a group leader in P.L. Kapitza Institute for Physical Problems in Moscow during 30 years of my scientific career. It includes the set of eight lectures and eight seminars which cover several important topics of the modern condensed matter physics, namely:

- Quantum hydrodynamics of fermionic and bosonic superfluids and supersolids;
- BCS-BEC crossover in ultracold quantum gases;
- Non-phonon mechanisms of superconductivity in high- T_C materials and other unconventional superconductors;
- Nanoscale phase separation in CMR-materials, heavy-fermions, and other strongly correlated electron systems;
- Mesoscopic electron transport in multi-band and phase-separated metallic and oxide compounds.

I hope the book will be useful for undergraduate students of the senior courses, postgraduate students, and postdocs specializing in solid-state and low-temperature physics.

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