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Autore	Kagan M. Yu (Maxim Yu.)
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Nota di contenuto	Introduction -- Part I -- Hydrodynamics of rotating superfluids with quantized vortices -- The foundation of Landau theory for superfluid hydrodynamics -- Hydrodynamics of rotating superfluids. - Hydrodynamics of fast rotations -- Opposite case of a single bended vortex line for extremely slow rotations (~ C1) -- Experimental situation and discussion. How to achieve the limit of the fast rotations at not very high frequencies in He II – 3He mixtures and in superfluid 3He-B -- Reference list to Chapter 1 -- 2. Quantum crystals. The search of supersolidity -- Quantum crystals. Phase diagram. The search of supersolidity -- The surface physics of quantum crystals. Atomically smooth and atomically rough surfaces.-Reference list to Chapter 2 -- Melting-crystallization waves on the phase-interface between quantum crystal and superfluid -- Surface hydrodynamics for rough surface at low temperatures -- Surface hydrodynamics of the mobile rough interface at and in the presence of 3He impurities -- Reference list to Chapter 3 -- Quantum hydrodynamics of the p-wave superfluids with the symmetry of 3He-A -- Orbital hydrodynamics of bosonic and fermionic superfluids with the symmetry of A-phase of 3He -- Two approaches to a complicated problem of chiral anomaly, anomalous current in fermionic (BCS) A-phase -- Reference list to Chapter 4 -- Part II -- Bose-Einstein condensation and Feshbach resonance in

ultracold quantum gases and mixtures -- BEC in trapped Bose-gasses -- Feshbach resonance in ultracold quantum gases and mixtures. - Experiments on molecular BEC in 6Li and 40K -- Reference list to Chapter 5 -- Composed particles, trios and quartets in resonance quantum gasses and mixtures -- Two-particle pairing and phase-separation in Bose-gas with one or two sorts of bosons.- Composed fermions in the Fermi-Bose mixture with attractive interaction between fermions and bosons -- Bound states of three and four resonantly interacting particles -- Reference list to Chapter 6 -- BCS-BEC crossover and the spectrum of collective excitations in s-wave and p-wave resonance superfluids -- Phase-diagram of the resonance Fermi-gas in 3D and 2D -- Self-consistent Leggett theory for T = 0 in 3D and 2D case -- Anderson-Bogolubov theory for collective excitations -- Feshbach resonance and phase-diagram for p-wave superfluid Fermi-gas -- Reference list to Chapter 7 -- Phase diagrams and the physics of the pseudogap in the superconductors with attractive interaction -- Attractive-U fermionic Hubbard model -- Attracting fermions in 2D -- T-matrix approximation -- Experimental predictions of the model -- Reference list to Chapter 8 -- Part III -- Superconductivity in the low-density electron systems with repulsion -- Kohn-Luttinger mechanism of SC in purely repulsive Fermi-systems -- Unconventional (anomalous) superconductive materials -- SC in 3D and 2D Hubbard model with repulsion at low electron density -- SC in the jelly model for Coulomb electron plasma -- SC and phase separation in Shubin-Vonsovsky model -- Reference list to Chapter 9 -- Strong TC enhancement in spin-polarized Fermi-gas and in the two-band superconductors.- TC enhancement in a spin-polarized neutral Fermi-gas.- TC enhancement in quasi-2D charged SC in a parallel magnetic field -- Strong TC enhancement in the two-band model -- Reference list to Chapter 10 -- Fermionic superfluidity in three- and two-dimensional solutions of 3He in 4He -- Bardeen-Baym-Pines theory for the solutions of 3He in 4He. Direct and exchange interactions -- Two-dimensional case. 3He submonolayers -- Superfluidity in polarized solutions -- Experimental situation and limitations on the existing theories -- Two-dimensional monolayers as a bridge between superfluidity and high-TC superconductivity -- Reference list to Chapter 11 -- Triplet pairing and superfluid phase-diagram in Fermi gas of neutral particles and in superfluid 3He -- Fermionic superfluidity of 6Li in magnetic traps at ultralow temperatures.- p-wave pairing in the Fermi-Bose mixture of 6Li-7Li with repulsive interaction between the different isotopes -- Ginzburg-Landau functional for triplet superfluid Fermi gas and for the superfluid 3He -- GL-functional and global phase-diagram of the 2D superfluid Fermi gas with repulsion -- Reference list to Chapter 12 -- Spin-charge separation and confinement in ladder systems and in high-TC superconductors -- Spin-charge separation and Luttinger liquid in doped spin-chains -- Two-leg ladder systems. Spin-charge confinement. Luther-Emery liquid -- Three-leg ladders. Anisotropic t-J model for strong-coupling along the rungs -- Superconductivity in isotropic 2D t-J model -- Reference list to Chapter 13 -- Part IV -- The search for non-Fermi liquid behavior in the normal state of the low density fermion systems.- The search for non-Fermi liquid behavior in 2D models at low density -- Antibound state of Hubbard-Anderson on the lattice. Manifestation of the upper Hubbard band at low density -- The search for marginal Fermi liquid behavior in the two-band models -- Weak-localization corrections in the 2D case -- Reference list to Chapter 14 -- Nanoscale phase separation in complex magnetic oxides -- Inhomogeneous states and nanoscale phase separation in complex magnetic oxides. Similarities with cuprates -- Crystal structure.

Electronic and transport properties of manganites -- The minimal theoretical model for manganites -- Temperature ferrons. FM-polarons in a layered case -- Free and bound magnetic polarons -- Phase separation in charge-ordered manganites -- Orbital ferrons -- Experimental confirmation of the gross phase-diagram and phase separation in manganites -- Reference list to Chapter 15 -- Mesoscopic transport properties in the phase-separated manganites -- Mesoscopic transport properties in strongly-correlated systems -- 1/f - noise power spectrum. Discussion. Comparison with experiments -- Comparison of the theoretical predictions for tunneling conductivity with experimental results in different families of CMR-systems -- Reference list to Chapter 16 -- Conclusion. Unresolved problems in condensed-matter physics. Encouragement to young researches to stay in the field.

Sommario/riassunto

This book concisely presents the latest trends in the physics of superconductivity and superfluidity and magnetism in novel systems, as well as the problem of BCS-BEC crossover in ultracold quantum gases and high-Tc superconductors. It further illuminates the intensive exchange of ideas between these closely related fields of condensed matter physics over the last 30 years of their dynamic development. The content is based on the author’s original findings obtained at the Kapitza Institute, as well as advanced lecture courses he held at the Moscow Engineering Physical Institute, Amsterdam University, Loughborough University and LPTMS Orsay between 1994 and 2011. In addition to the findings of his group, the author discusses the most recent concepts in these fields, obtained both in Russia and in the West. The book consists of 16 chapters which are divided into four parts. The first part describes recent developments in superfluid hydrodynamics of quantum fluids and solids, including the fashionable subject of possible supersolidity in quantum crystals of 4He, while the second describes BCS-BEC crossover in quantum Fermi-Bose gases and mixtures, as well as in the underdoped states of cuprates. The third part is devoted to non-phonon mechanisms of superconductivity in unconventional (anomalous) superconductors, including some important aspects of the theory of high-Tc superconductivity. The last part considers the anomalous normal state of novel superconductive materials and materials with colossal magnetoresistance (CMR). The book offers a valuable guide for senior-level undergraduate students and graduate students, postdoctoral and other researchers specializing in solid-state and low-temperature physics.