Н. НАҐАОСА
КВАНТОВА ТЕОРІЯ ПОЛЯ В ФІЗИЦІ КОНДЕНСОВАНОЇ МАТЕРІЇ
(Шпрінґер, Берлін, 1999, 206 с.)

N. NAGAOSA
QUANTUM FIELD THEORY IN CONDENSED MATTER PHYSICS
(Springer-Verlag, Berlin, 1999, 206 p.)

In the second half of the 1980s, a paper on superfluidity, using modern field-theoretic concepts, submitted to a prestigious (western) condensed-matter journal, could prompt a short referee report with the punchline: "We're not doing field theory here." Naoto Nagaosa's book *Quantum Field Theory in Condensed Matter Physics* proves that those days are over now.

In the past two decades we have witnessed some remarkable discoveries in condensed matter physics, starting with the discovery in 1980 by von Klitzing and collaborators that the Hall conductance is quantized in integer units of e^2/h, with e the electric charge and h Planck's constant. This discovery, which has become known since as the integer quantum Hall effect, was followed in 1982 by the discovery of the fractional quantum Hall effect by Tsui, Stromer, and Gossard, where the Hall conductance takes fractional values of the fundamental unit. Perhaps the most important discovery in this period was that of superconductivity with high transition temperatures (T_c) in CuO compounds by Bednorz and Müller in 1986, and the subsequent findings of materials with T_c's above the liquid nitrogen point. The final remarkable discovery was that in 1995 of Bose-Einstein condensation in a cloud of weakly interacting ^{87}Rb atoms trapped in a magnetic field by Cornell, Wieman, and collaborators, and the second definite observation of Bose-Einstein condensation in a vapor of Na atoms by Ketterle and collaborators. Each of these discoveries attracted great attention from theorists, and not only from those traditionally working in the field of condensed-matter physics, leading to rapid developments in the theoretical understanding of these phenomena. *Quantum Field Theory in Condensed Matter Physics* covers many of these new insights.

More specifically, this concise textbook takes the reader on an original tour of contemporary condensed-matter physics, visiting landmarks such as, in order of appearance: Landau's theory of continuous phase transitions, spontaneous symmetry breaking, gapless Goldstone modes, the Berezinskii-Kosterlitz-Thouless transition in superfluid films, the Coulomb gas in the random phase approximation, Bogoliubov's theory of superfluidity, the theory of superconductivity (both the microscopic Bardeen-Cooper-Schrieffer as well as the effective Ginzburg-Landau theory), Josephson junctions with dissipative coupling, the superconductor-insulator transition (an example of a quantum phase transition driven by quantum fluctuations rather than by thermal fluctuations as in a thermal phase transition), and the theory of quantum Hall liquids.

All these topics are described in a unified way, using quantum field (as opposed to the more traditionally used many-particle) theory in the functional-integral approach. Apart from its unifying aspect, two other advantages of this approach are that it requires a minimum of formalism (covered in Ch. 2), and is a powerful computational tool, leading quickly to results. Typically, the author starts from a microscopic quantum-mechanical model describing the condensed-matter system under consideration, and then proceeds by integrating out irrelevant degrees of freedom to arrive at an effective classical field theory which encodes the low-energy, long-wavelength physics seen in experiments. Throughout the text, the author shares in concise and deep remarks his physical insights, making the derived results easy to understand. Although the temperature of the condensed-matter systems considered is low, it is nevertheless finite and requires the use of finite-temperature field theory to calculate the temperature-dependence of quantum effects. The author uses the imaginary-time (as opposed to the real-time) formalism, named after Matsubara, which is the simplest approach and an effective computational tool. Concepts probably better known from high-energy physics, such as lattice gauge theory, confinement, instantons, magnetic monopoles, charge-vortex duality, and Chern-Simons field theory are nicely introduced to readers without background in that area and put to use. Being a self-contained and original textbook, the number of references is kept to a minimum, so that readers don't feel a constant urge to consult the literature, and makes for a pleasant reading. The book is carefully crafted and hardly contains any typos (this reviewer found only a handful of trivial ones in the formulas).

Quantum Field Theory in Condensed Matter Physics is advertised for use as self-study by graduate students and researchers working in related fields. I would add that it makes an excellent choice as a course text for advanced undergraduates in theoretical physics, with the lecturer providing necessary background and details omitted from the text. Before this book came out, a lecturer wishing to teach a modern course on contemporary condensed-matter physics had to write his or her own lecture notes–those days, too, are over now.

Adriaan M. J. Schakel
Low Temperature Laboratory, Helsinki University of Technology, Finland

ВІКТОР В. КУЛІШ
ІЄРАРХІЧНІ МЕТОДИ: ІЄРАРХІЯ І ІЄРАРХІЧНІ АСИМПТОТИЧНІ МЕТОДИ В ЕЛЕКТРОДИНАМІЦІ
(Фундаментальні теорії фізики, том. 123, Клювер, 2002)

VICTOR V. KULISH
HIERARCHICAL METHODS: HIERARCHY AND HIERARCHICAL ASYMPTOTIC METHODS IN ELECTRODYNAMICS
(Fundamental Theories of Physics, Vol. 123, Kluwer Academic Publishers, 2002)

This monograph consists of two volumes and provides a unified comprehensive presentation of a new hierarchic paradigm and discussions of various applications of hierarchical methods for nonlinear electrodynamic problems. Volume 1 is the first book, in which a new hierarchical model for dynamic non-linear systems is described and analysed and a set of new hierarchical principles is discussed. The modern hierarchic asymptotic methods are set forth systematically, taking into account specific features of electrodynamic problems, and the phenomenon of hierarchy in electrodynamics, in itself, is thoroughly discussed from a new point of view. A set of hierarchical asymptotic calculative methods of two types is discussed in detail. The methods of the first type are destined for asymptotic integration of non-linear differential equations with total derivatives and with multifrequency (including multi-scale) non-linear right hand parts. These are the Van der Pol method, Krylov-Bogolyubov method, Bogolyubov-Zubarev method and their hierarchical versions. The methods of the second type include the method of slowly varying amplitudes, the method of averaged characteristics, the methods of averaged kinetic and quasihydrodynamic equations, and some other. These methods are intended for asymptotic integration of non-linear differential equations with partial derivatives and multifrequency (including multi-scale) right hand parts. Detailed calculative technologies for practical application of all mentioned methods are illustrated by examples of real electrodynamic systems (free electron lasers, undulative induction accelerators, systems for transformation of laser signals, etc.) (Summary).