1. Record Nr. UNISA996466835603316

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Titolo	Introduction to the Functional Renormalization Group [[electronic resource] /] / by Peter Kopietz, Lorenz Bartosch, Florian Schütz
Pubbl/distr/stampa	Berlin, Heidelberg : , : Springer Berlin Heidelberg : , : Imprint : Springer, , 2010
ISBN	3-642-05094-8
Edizione	[1st ed. 2010.]
Descrizione fisica	1 online resource (XII, 380 p. 68 illus.)
Collana	Lecture Notes in Physics, , 0075-8450 ; ; 798
Disciplina	515/.7
Soggetti	Physics Solid state physics Spectroscopy Microscopy Statistical physics Dynamical systems Quantum physics Magnetism Magnetic materials Mathematical Methods in Physics Solid State Physics Spectroscopy and Microscopy Complex Systems Quantum Physics Magnetism, Magnetic Materials
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Note generali	Bibliographic Level Mode of Issuance: Monograph
Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	I Foundations of the renormalization group -- Phase Transitions and the Scaling Hypothesis -- Mean-Field Theory and the Gaussian Approximation -- Wilsonian Renormalization Group -- Critical Behavior of the Ising Model Close to Four Dimensions -- Field-Theoretical Renormalization Group -- II Introduction to the functional renormalization group -- Functional Methods -- Exact FRG Flow Equations -- Vertex Expansion -- Derivative Expansion -- III Functional

renormalization group approach to fermions -- Fermionic Functional Renormalization Group -- Normal Fermions: Partial Bosonization in the Forward Scattering Channel -- Superfluid Fermions: Partial Bosonization in the Particle–Particle Channel.

Sommario/riassunto

This book, based on a graduate course given by the authors, is a pedagogic and self-contained introduction to the renormalization group with special emphasis on the functional renormalization group. The functional renormalization group is a modern formulation of the Wilsonian renormalization group in terms of formally exact functional differential equations for generating functionals. In Part I the reader is introduced to the basic concepts of the renormalization group idea, requiring only basic knowledge of equilibrium statistical mechanics. More advanced methods, such as diagrammatic perturbation theory, are introduced step by step. Part II then gives a self-contained introduction to the functional renormalization group. After a careful definition of various types of generating functionals, the renormalization group flow equations for these functionals are derived. This procedure is shown to encompass the traditional method of the mode elimination steps of the Wilsonian renormalization group procedure. Then, approximate solutions of these flow equations using expansions in powers of irreducible vertices or in powers of derivatives are given. Finally, in Part III the exact hierarchy of functional renormalization group flow equations for the irreducible vertices is used to study various aspects of non-relativistic fermions, including the so-called BCS-BEC crossover, thereby making the link to contemporary research topics.