

Methods of Contemporary Gauge Theory

This book introduces the quantum theory of gauge fields. Emphasis is placed on four nonperturbative methods: path integrals, lattice gauge theories, the $1/N$ -expansion, and reduced matrix models, all of which have important contemporary applications. Written as a textbook, it assumes a knowledge of quantum mechanics and elements of perturbation theory, while many relevant concepts are pedagogically introduced at a basic level in the first half of the book. The second half comprehensively covers large- N Yang–Mills theory. The book uses a modern approach to gauge theories based on path-dependent phase factors known as the Wilson loops, and contains problems with detailed solutions to aid understanding.

Suitable for advanced graduate courses in quantum field theory, the book will also be of interest to researchers in high-energy theory and condensed matter physics as a survey of recent developments in gauge theory. This title, first published in 2002, has been reissued as an Open Access publication on Cambridge Core.

YURI MAKEENKO received his PhD in theoretical and mathematical physics from the Institute of Theoretical and Experimental Physics (ITEP), Moscow. He has been a staff member at the ITEP since 1983, and since 1993 has been a visiting professor at the Niels Bohr Institute, Copenhagen. He has given lecture courses at universities throughout Europe and has published numerous papers and review articles in journals.

Professor Makeenko has been working on nonperturbative quantum field theory since 1975. His research has covered four-dimensional conformal field theories and the $1/N$ -expansion of QCD, where he derived in 1979 an equation presently known as the Makeenko–Migdal equation or the “loop equation”, in collaboration with A.A. Migdal. In the early 1980s he explored lattice gauge theories, including the Monte Carlo simulations, and went on to work on matrix models and string theory in the 1990s. His recent work has focused on matrix theory and noncommutative gauge theories.

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