Introduction to Quantum Fields on a Lattice

Quantum field theory, our description of the fundamental forces in nature, was originally formulated in continuous space–time, where it leads to embarrassing infinities which have to be eliminated by a process called renormalization. A simple but rigorous formulation can be obtained by replacing continuous space–time by a discrete set of points on a lattice. This clarifies the essentials of quantum fields using concepts such as universality of critical phenomena and the renormalization group.

This book provides a clear and pedagogical introduction to quantum fields on a lattice. The path integral on the lattice is explained in concrete examples using weak- and strong-coupling expansions. Fundamental concepts, such as 'triviality' of Higgs fields and confinement of quarks and gluons into hadrons, are described and illustrated with the results of numerical simulations. The book also provides an introduction to chiral symmetry and chiral gauge theory. Based on the lecture notes of a course given by the author, this book contains many explanatory examples and exercises, and is suitable as a textbook for advanced undergraduate and graduate courses. This title, first published in 2002, has been reissued as an Open Access publication on Cambridge Core.

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