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J. Zinn-Justin: Phase Transitions and Renormalization Group

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Quantum field theory provides the mathematical and conceptual framework of many of the theoretical physics developments achieved in the last century. It describes fundamental interactions at the microscopic scale, accounts for the singular behaviour of matter in the vicinity of a critical point and furnishes what is needed to deal with systems having a large number of strongly interacting local degrees of freedom. For this reason, quantum field theory has become an important subject in the study of physics. This publication is therefore very timely and there is no doubt that it will contribute to disseminate this theory as well as its many potential applications.

The purpose of the book is basically to present an introduction to the notion of the continuum limit and universality in physical systems. Any book aiming to accomplish this task must build up a self-consistent framework able to describe a great number of situations. The concepts introduced must be pertinent for the phenomena in question and sufficiently elaborated to be able to furnish solid conclusions clearly and concisely. These requirements have been perfectly fulfilled in the material presented in this book. Throughout its chapters the reader can find a comprehensive exposition of the basics of the theory and its application to the study of fundamental interactions as well as of phase transitions in macroscopic systems.

The book starts with a brief history of the origin and development of quantum field theory and the emergence of infinities and their understanding by means of renormalization group arguments. The next chapters are devoted to discussions of themes such as universality and the continuum limit, models defined on one-dimensional lattices and path integrals. The concepts and tools introduced in these chapters are subsequently applied to more general models. The remaining chapters give general aspects and examples of phase transitions as well as providing introductions to renormalization group techniques. Each chapter incorporates a number of selected exercises with solutions. The last part of the book includes diverse appendices containing technical results and complements.

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The clear exposition of the main ideas and the simple and agile notation the author uses help facilitate the comprehension of the different concepts presented. Researchers familiar with statistical physics methods will find a self-contained framework to grasp the essence of quantum field theory and the renormalization group and to elucidate the prominent role they play at present in physics. For this reason, this book is highly recommendable due to the insight it gives into the field of quantum field theories, providing sound basis for further research.