

Solitons and Instantons

An Introduction to Solitons and Instantons in Quantum Field Theory

This book offers an elementary and unified introduction to the non-perturbative results obtained in relativistic quantum field theory based on classical soliton and instanton solutions. Such solutions are derived for a variety of models and classified by topological indices. The methods are then developed for quantizing solitons to obtain quantum particles. Vacuum tunneling, θ -vacua and the dilute-instanton-gas approximation are described in detail. Other instanton effects related to quark-quark forces, confinement, the $U(1)$ problem and Borel summability are also discussed. The emphasis is on presenting the basic ideas in a simple pedagogical way. Technical tools like functional methods, Grassman integrals, homotopy classification, collective co-ordinates etc. are developed ab initio. The presentation of this work is kept at a fairly simple level and ideas are developed through illustrative examples. Techniques not covered in older field theory textbooks, such as functional integral methods, are presented in some detail to the necessary extent. These techniques are important in their own right. Although the book is mainly addressed to particle physicists and quantum field theorists, several portions will be of relevance to other branches of physics, particularly statistical mechanics. These include three chapters devoted to deriving classical soliton and instanton solutions and one on collective co-ordinates, as well as sections devoted to general techniques.

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