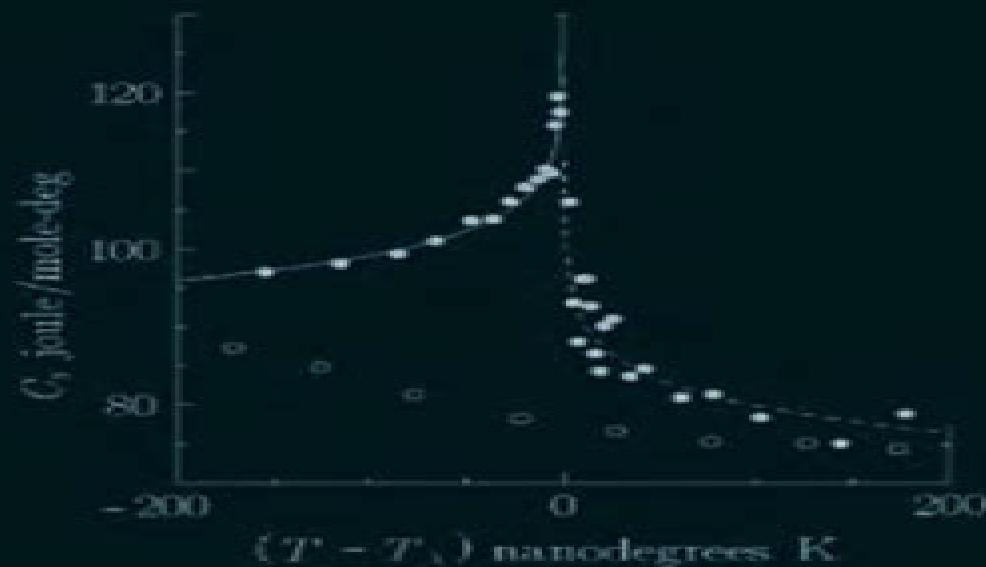


Critical Properties of Φ^4 - Theories

Hagen Kleinert
Verena Schulte-Frohlinde



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Critical Properties Of O4 Theories

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laws They contain critical exponents which are obtained from the renormalization constants in the form of power series These are divergent due to factorially growing expansion coefficients The evaluation requires resummation procedures which are performed in two ways 1 using traditional methods based on Pad and Borel transformations combined with analytic mappings 2 using modern variational perturbation theory where the results follow from a simple strong coupling formula As a crucial test of the accuracy of the methods the critical exponent governing the divergence of the specific heat of superfluid helium is shown to agree very well with the extremely precise experimental number found in the space shuttle orbiting the earth whose data are displayed on the cover of the book The ϕ^4 theories investigated in this book contain any number N of fields in an $O(N)$ symmetric interaction or in an interaction in which $O(N)$ symmetry is broken by a term of a cubic symmetry The crossover behavior between the different symmetries is investigated In addition alternative ways of obtaining critical exponents of ϕ^4 theories are sketched such as variational perturbation expansions in three rather than 4 dimensions and improved ratio tests in high temperature expansions of lattice models

Uncovering Quantum Field Theory and the Standard Model Wolfgang Bietenholz, Uwe-Jens Wiese, 2025-01-02 Ideal for graduate courses on quantum field theory and the Standard Model and as a reference for experienced researchers

Path Integrals in Quantum Mechanics, Statistics, Polymer Physics, and Financial Markets Hagen Kleinert, 2004-03-05 This is the third significantly expanded edition of the comprehensive textbook published in 1990 on the theory and applications of path integrals It is the first book to explicitly solve path integrals of a wide variety of nontrivial quantum mechanical systems in particular the hydrogen atom The solutions have become possible by two major advances The first is a new euclidean path integral formula which increases the restricted range of applicability of Feynman's famous formula to include singular attractive $1/r$ and $1/r^2$ potentials The second is a simple quantum equivalence principle governing the transformation of euclidean path integrals to spaces with curvature and torsion which leads to time sliced path integrals that are manifestly invariant under coordinate transformations In addition to the time sliced definition the author gives a perturbative definition of path integrals which makes them invariant under coordinate transformations A consistent implementation of this property leads to an extension of the theory of generalized functions by defining uniquely integrals over products of distributions The powerful Feynman-Kleinert variational approach is explained and developed systematically into a variational perturbation theory which in contrast to ordinary perturbation theory produces convergent expansions The convergence is uniform from weak to strong couplings opening a way to precise approximate evaluations of analytically unsolvable path integrals Tunneling processes are treated in detail The results are used to determine the lifetime of supercurrents the stability of metastable thermodynamic phases and the large order behavior of perturbation expansions A new variational treatment extends the range of validity of previous tunneling theories from large to small barriers A corresponding extension of large order perturbation theory also applies now to small orders Special attention is devoted to path integrals with topological restrictions These are relevant to

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A Modern Approach to Critical Phenomena Igor Herbut, 2007-01-04 Critical phenomena is one of the

most exciting areas of modern physics This 2007 book provides a thorough but economic introduction into the principles and techniques of the theory of critical phenomena and the renormalization group from the perspective of modern condensed matter physics Assuming basic knowledge of quantum and statistical mechanics the book discusses phase transitions in magnets superfluids superconductors and gauge field theories Particular attention is given to topics such as gauge field fluctuations in superconductors the Kosterlitz Thouless transition duality transformations and quantum phase transitions all of which are at the forefront of physics research This book contains numerous problems of varying degrees of difficulty with solutions These problems provide readers with a wealth of material to test their understanding of the subject It is ideal for graduate students and more experienced researchers in the fields of condensed matter physics statistical physics and many body physics

The Large N Expansion in Quantum Field Theory and Statistical Physics E. Brzin, Spenta R. Wadia, 1993 This book contains an edited comprehensive collection of reprints on the subject of the large N limit as applied to a wide spectrum of problems in quantum field theory and statistical mechanics The topics include 1 Spin Systems 2 Large N Limit of Gauge Theories 3 Two Dimensional QCD 4 Exact Results on Planar Perturbation Series and the Nature of the 1 N Series 5 Schwinger Dyson Equations Approach 6 QCD Phenomenological Lagrangians and the Large N Limit 7 Other Approaches to Large N Eguchi Kawai Model Collective Fields and Numerical Methods 8 Matrix Models 9 Two Dimensional Gravity and String Theory

Introduction to the Theory of Critical Phenomena Dima I. Uzunov, 2010 This book provides a comprehensive introduction to the theory of phase transitions and critical phenomena The content covers a period of more than 100 years of theoretical research of condensed matter phases and phase transitions providing a clear interrelationship with experimental problems It starts from certain basic University knowledge of thermodynamics statistical physics and quantum mechanics The text is illustrated with classic examples of phase transitions Various types of phase transition and multi critical points are introduced and explained The classic aspects of the theory are naturally related with the modern developments This interrelationship and the field theoretical renormalization group method are presented in details The main applications of the renormalization group methods are presented Special attention is paid to the description of quantum phase transitions This edition contains a more detailed presentation of the renormalization group method and its applications to particular systems

A Philosophical Approach to Quantum Field Theory Hans Christian

Öttinger, 2018-01-11 This text presents an intuitive and robust mathematical image of fundamental particle physics based on a novel approach to quantum field theory which is guided by four carefully motivated metaphysical postulates In particular the book explores a dissipative approach to quantum field theory which is illustrated for scalar field theory and quantum electrodynamics and proposes an attractive explanation of the Planck scale in quantum gravity Offering a radically new perspective on this topic the book focuses on the conceptual foundations of quantum field theory and ontological questions It also suggests a new stochastic simulation technique in quantum field theory which is complementary to existing ones

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