

RENORMALIZATION AND EFFECTIVE LAGRANGIANS

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There is a strong intuitive understanding of renormalization, due to Wilson, in terms of the scaling of effective lagrangians. We show that this can be made the basis for a proof of perturbative renormalization. We first study renormalizability in the language of renormalization group flows for a toy renormalization group equation. We then derive an exact renormalization group equation for a four-dimensional $\lambda\phi^4$ theory with a momentum cutoff. We organize the cutoff dependence of the effective lagrangian into relevant and irrelevant parts, and derive a linear equation for the irrelevant part. A lengthy but straightforward argument establishes that the piece identified as irrelevant actually is so in perturbation theory. This implies renormalizability. The method extends immediately to any system in which a momentum-space cutoff can be used, but the principle is more general and should apply for any physical cutoff. Neither Weinberg's theorem nor arguments based on the topology of graphs are needed.

1. Introduction

The understanding of renormalization has advanced greatly in the past two decades. Originally it was just a means of removing infinities from perturbative calculations. The question of why nature should be described by a renormalizable theory was not addressed. These were simply the only theories in which calculations could be done.

A great improvement comes when one takes seriously the idea of a physical cutoff at a very large energy scale Λ . The theory at energies above Λ could be another field theory, a lattice, spacetime foam, or anything else. The theory just below Λ should be represented by a very general lagrangian in which the various terms have coefficients of the order of Λ to the appropriate power to make the dimensions correct. Consider the physics at an energy E far below Λ . The non-renormalizable terms, those with coefficients of Λ to negative powers, typically give contributions that are suppressed by powers of Λ . This is true unless the non-renormalizable term is embedded in a Feynman graph sufficiently divergent to make up for the small coefficient. Power counting shows that the only n -point functions sufficiently divergent are those which would be divergent even if they contained only renormal-

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Nonpolynomial Lagrangians Renormalization And Gravity

Jagdish Mehra



Nonpolynomial Lagrangians Renormalization And Gravity:

Nonpolynomial Lagrangians, Renormalisation [sic] and Gravity Abdus Salam, 1971 **Quantum Mechanics and Nonlinear Waves** Philip Barnes Burt, 1981 **Superconductivity: A New Approach Based On The Bethe-salpeter Equation In The Mean-field Approximation** G P Malik, 2016-02-29

Given the Debye temperature of an elemental superconductor SC and its T_c BCS theory enables one to predict the value of its gap Δ at $T = 0$ or vice versa This monograph shows that non elemental SCs can be similarly dealt with via the generalized BCS equations GBCSEs which given any two parameters of the set T_c, Δ, ρ enable one to predict the third Also given herein are new equations for the critical magnetic field and critical current density of an elemental and a non elemental SC equations that are derived directly from those that govern pairing in them The monograph includes topics that are usually not covered in any one text on superconductivity e g BCS BEC crossover physics the long standing puzzle posed by SrTiO_3 and heavy fermion superconductors all of which are still imperfectly understood and therefore continue to avidly engage theoreticians It suggests that addressing the T_c s and other properties e g number densities of charge carriers of high T_c SCs via GBCSEs incorporating chemical potential may lead to tangible clues about raising their T_c s The final chapter in this monograph deals with solar emission lines and quarkonium spectra because of a feature common between them and superconductivity existence of a bound state in a medium at finite temperature This is a problem on which the author has worked for more than 25 years The treatment in the text is elementary even those who have only a cursory familiarity with Feynman diagrams should be able to follow it without much difficulty

Unification of the Fundamental Particle Interactions II John Ellis, 2012-12-06 Work on the unification of the fundamental particle interactions has continued vigorously since the first Europhysics study Conference on this subject At that time we emphasized the existence of two main approaches one based on supersymmetry and possibly its local version supergravity and the other approach based on grand unified gauge theories Discussion of the possible tests of these theoretical speculations included experiments on baryon decay and neutrino oscillations In view of the uncertainties surrounding the observability of such phenomena the early Universe was welcomed as a possible Laboratory for testing new theoretical ideas At that time we expressed the hope that the different gauge and supersymmetry approaches would cross fertilize each other and it is appropriate to ask now how much of that hope has been realized We believe there has recently been considerable theoretical rapprochement which is amply reflected in these Proceedings On the one hand it has been realized that many of the technical problems in grand unified gauge theories such as arranging the hierarchy of different mass scales may be alleviated using simple global supersymmetry On the other hand there has been growing interest in the possibility that extended supergravity theories may furnish a suitable framework for the unification of all the fundamental particle interactions Many physicists in fact now question actively whether the known fundamental particles are in deed elementary or whether they are composite

Nuclear Science Abstracts , 1976

Physics and Contemporary Needs Riazuddin, 2012-12-06 These proceedings cover the lectures delivered at the Second International Summer College on Physics and Contemporary Needs held from June 20 to July 7 1977 at Nathiagali one of the scenic hill resorts in the northern part of Pakistan The college was organised by the Pakistan Atomic Energy Commission PAEC and co sponsored by the International Centre for Theoretical Physics Trieste ICTP It also received a financial grant by the University Grants Commission for the participation of physicists from various universities of Pakistan The college was attended by 13 lecturers 7 invited seminar speakers and 134 participants from 26 countries and consisted of 15 concentrated days of lectures seminars and informal discussions These proceedings contain only regular lectures delivered there but the seminars which were held are listed in the Appendix The theme of the college covered two important aspects of science in general and physics in particular first to provide to the participants from developing countries some of the excitement of what is happening at the frontiers of physics secondly as the name of the college emphasises it was to encourage the physicists from developing countries to interest themselves in and to use their knowledge and methodology of research for attacking some of the problems faced by their respective countries The lectures delivered at the college covered a wide spectrum of physics and indicated similarity of methodology used in various branches of physics as well as practical applications of some of the topics discussed New Research on Superconductivity Barry P. Martins, 2007

Superconductivity is the ability of certain materials to conduct electrical current with no resistance and extremely low losses High temperature superconductors such as $\text{La}_{2-x}\text{Sr}_x\text{CuO}_x$ T_c 40K and $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ T_c 90K were discovered in 1987 and have been actively studied since In spite of an intense world wide research effort during this time a complete understanding of the copper oxide cuprate materials is still lacking Many fundamental questions are unanswered particularly the mechanism by which high T_c superconductivity occurs More broadly the cuprates are in a class of solids with strong electron electron interactions An understanding of such strongly correlated solids is perhaps the major unsolved problem of condensed matter physics with over ten thousand researchers working on this topic High T_c superconductors also have significant potential for applications in technologies ranging from electric power generation and transmission to digital electronics This ability to carry large amounts of current can be applied to electric power devices such as motors and generators and to electricity transmission in power lines For example superconductors can carry as much as 100 times the amount of electricity of ordinary copper or aluminium wires of the same size Many universities research institutes and companies are working to develop high T_c superconductivity applications and considerable progress has been made This volume brings together new leading edge research in the field **Cosmology and Gravitation** Peter G. Bergmann, Venzon De Sabbata, 2012-12-06 For the Sixth Course of the International School of Cosmology and Gravitation of the Ettore Majorana Centre for Scientific Culture we choose as the principal topics torsion and supergravity because in our opinion it is one of the principal tasks of today's theoretical physics to attempt to link together the theory of elementary particles and

general relativity Our aim was to delineate the present status of the principal efforts directed toward this end and to explore possible directions of work in the near future Efforts to incorporate spin as a dynamic variable into the foundations of the theory of gravitation were pioneered by E Cartan whose contributions to this problem go back half a century According to A Trautman this so called Einstein Cartan theory is the simplest and most natural modification of Einstein's 1916 theory F Hehl has contributed a very detailed and comprehensive analysis of this topic original view of non Riemannian space time Characteristic of Einstein Cartan theories is the enrichment of Riemannian geometry by torsion the non symmetric part of the otherwise metric compatible affine connection Torsion has a impact on the theory of elementary particles According to V de Sabbata weak interactions can be based on the Einstein Cartan geometry in that the Lagrangian describing weak interactions and torsion interaction possess analogous structures leading to a unification of weak and gravitational forces

Dyson-Schwinger Equations, Renormalization Conditions, and the Hopf Algebra of Perturbative Quantum Field Theory Paul-Hermann Balduf, 2024-04-26 This book offers a systematic introduction to the Hopf algebra of renormalization in quantum field theory with a special focus on physical motivation the role of Dyson Schwinger equations and the renormalization group All necessary physical and mathematical constructions are reviewed and motivated in a self contained introduction The main part of the book concerns the interplay between Dyson Schwinger equations DSEs and renormalization conditions The book is explicit and consistent about whether a statement is true in general or only in particular renormalization schemes or approximations and about the dependence of quantities on regularization parameters or coupling constants With over 600 references the original literature is cited whenever possible and the book contains numerous references to other works discussing further details generalizations or alternative approaches There are explicit examples and remarks to make the connection from the scalar fields at hand to QED and QCD The book is primarily targeted at the mathematically oriented physicist who seeks a systematic conceptual overview of renormalization Hopf algebra and DSEs These may be graduate students entering the field as well as practitioners seeking a self contained account of the Hopf algebra construction Conversely the book also benefits the mathematician who is interested in the physical background of the exciting interplay between Hopf algebra combinatorics and physics that is renormalization theory today Selected Papers Of Abdus Salam (With Commentary) Chris J Isham, Tom Kibble, A Ali, Riazuddin, 1994-05-27 This is a selection from over 250 papers published by Abdus Salam Professor Salam has been Professor of Theoretical Physics at Imperial College London and Director of the International Centre for Theoretical Physics in Trieste for which he was largely responsible for creating He is one of the most distinguished theoretical physicists of his generation and won the Nobel Prize for Physics in 1979 for his work on the unification of electromagnetic and weak interactions He is well known for his deep interest in the development of scientific research in the third world to which ICTP is devoted and has taken a leading part in setting up the Third World Academy His research work has ranged widely over quantum field theory and all aspects of the theory of

elementary particles and more recently into other fields including high temperature superconductivity and theoretical biology The papers selected represent a cross section of his work covering the entire period of 50 years from his student days to the present *Nuclear Science Abstracts* ,1973 *Mededelingen van de Koninklijke Academie voor Wetenschappen, Letteren en Schone Kunsten van België, Klasse der Wetenschappen* ,1981 *Functional and Probabilistic Methods in Quantum Field Theory* ,1976 **Random Surfaces and Quantum Gravity** Orlando Alvarez, Enzo Marinari, Paul Windey, 2013-03-09 The Cargèse Workshop Random Surfaces and Quantum Gravity was held from May 27 to June 2 1990 Little was known about string theory in the non perturbative regime before October 1989 when non perturbative equations for the string partition functions were found by using methods based on the random triangulations of surfaces This set of methods provides a description of non critical string theory or equivalently of the coupling of matter fields to quantum gravity in two dimensions The Cargèse meeting was very successful in that it provided the first opportunity to gather most of the active workers in the field for a full week of lectures and extensive informal discussions about these exciting new developments The main results were reviewed recent advances were explained new results and conjectures which appear for the first time in these proceedings were presented and discussed Among the most important topics discussed at the workshop were The relation of KdV theory to loop equations and the Virasoro algebra new results in Liouville field theory effective 1+1 dimensional theory for 2 D quantum gravity coupled to $c=1$ matter and its fermionization proposal for a new geometrical interpretation of the string equation and possible definition of quantum Riemann surfaces discussion of the string equation for the multi matrix models links with topological field theories of gravity issues in using target space supersymmetry to define good theories definition of the partition function via analytic continuation new models of random surfaces *Papers in Algebra, Analysis and Statistics* Australian Mathematical Society. Summer Research Institute, Rudolf Lidl, 1982 *The Physicist's Conception of Nature* Jagdish Mehra, 1973-12-01 The fundamental conceptions of twentieth century physics have profoundly influenced almost every field of modern thought and activity Quantum Theory Relativity and the modern ideas on the Structure of Matter have contributed to a deeper understanding of Nature and they will probably rank in history among the greatest intellectual achievements of all time The purpose of our symposium was to review in historical perspective the current horizons of the major conceptual structures of the physics of this century Professors Abdus Salam and Hendrik Casimir in their remarks at the opening of the symposium have referred to its origin and planning Our original plan was to hold a two week symposium on the different aspects of five principal themes 1 Space Time and Geometry including the structure of the universe and the theory of gravitation 2 Quantum Theory including the development of quantum mechanics and quantum field theory 3 Statistical Description of Nature including the discussion of equilibrium and non equilibrium phenomena and the application of these ideas to the evolution of biological structure 4 The Structure of Matter including the discussion in a unified perspective of atoms molecules nuclei elementary particles and the physics of

condensed matter and finally 5 Physical Description and Epistemology including the distinction between classical and quantum descriptions and the epistemological and philosophical problems raised by them **Nonpolynomial Lagrangians**
Renormalization and Gravity Abdus Salam, 1971 *General physics, relativity, astronomy and plasmas*, 1979 **Subject**
Guide to Books in Print, 1993 Books in Print, 1987

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