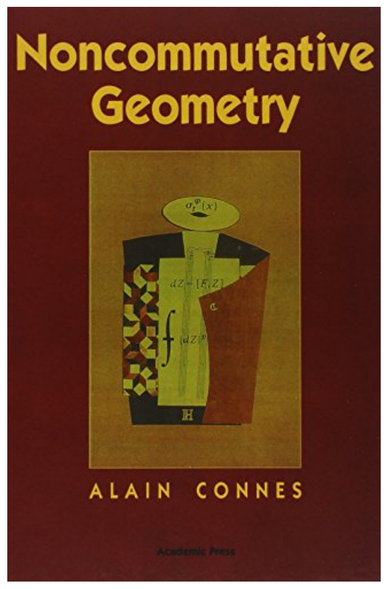

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**Noncommutative Geometry**-Alain Connes 2003-12-15 Noncommutative Geometry is one of the most deep and vital research subjects of present-day Mathematics. Its development, mainly due to Alain Connes, is providing an increasing number of applications and deeper insights for instance in Foliations, K-Theory, Index Theory, Number Theory but also in Quantum Physics of elementary particles. The purpose of the Summer School in Martina Franca was to offer a fresh invitation to the subject and closely related topics; the contributions in this volume include the four main lectures, cover advanced developments and are delivered by prominent specialists.

**Noncommutative Geometry**-Alain Connes 2003-12-08 Noncommutative Geometry is one of the most deep and vital research subjects of present-day Mathematics. Its development, mainly due to Alain Connes, is providing an increasing number of applications and deeper insights for instance in Foliations, K-Theory, Index Theory, Number Theory but also in Quantum Physics of elementary particles. The purpose of the Summer School in Martina Franca was to offer a fresh invitation to the subject and closely related topics; the contributions in this volume include the four main lectures, cover advanced developments and are delivered by prominent specialists.

**Noncommutative Geometry**-Alain Connes 1995-01-17 This English version of the path-breaking French book on this subject gives the definitive treatment of the revolutionary approach to measure theory, geometry, and mathematical physics developed by Alain Connes. Profusely illustrated and invitingly written, this book is ideal for anyone who wants to know what noncommutative geometry is, what it can do, or how it can be used in various areas of mathematics, quantization, and elementary particles and fields. Key Features * First full treatment of the subject and its applications * Written by the pioneer of this field * Broad applications in mathematics * Of interest across most fields * Ideal as an introduction and survey * Examples treated include: @subbul* the space of Penrose tilings * the space of leaves of a foliation * the space of irreducible unitary representations of a discrete group * the phase space in quantum mechanics * the Brillouin zone in the quantum Hall effect * A model of space time

**Elements of Noncommutative Geometry**-Jose M. Gracia-Bondia 2013-11-27

**An Invitation to Noncommutative Geometry**-Masoud Khalkhali 2008 A walk in the noncommutative garden / A. Connes and M. Marcolli -- Renormalization of noncommutative quantum field theory / H. Grosse and R. Wulkenhaar -- Lectures on noncommutative geometry / M. Khalkhali -- Noncommutative bundles and instantons in Tehran / G. Landi and W. D. van Suijlekom -- Lecture notes on noncommutative algebraic geometry and noncommutative tori / S. Mahanta -- Lectures on derived and triangulated categories / B. Noohi -- Examples of noncommutative manifolds: complex tori and spherical manifolds / J. Plazas -- D-branes in noncommutative field theory / R. J. Szabo

**An Introduction to Noncommutative Geometry**-Joseph C. Várilly 2006 Noncommutative geometry, inspired by quantum physics, describes singular spaces by their noncommutative coordinate algebras and metric structures by Dirac-like operators. Such metric geometries are described mathematically by Connes' theory of spectral triples. These lectures, delivered at an EMS Summer School on noncommutative geometry and its applications, provide an overview of spectral triples based on examples. This introduction is aimed at graduate students of both mathematics and theoretical physics. It deals with Dirac operators on spin manifolds, noncommutative tori, Moyal quantization and tangent groupoids, action functionals, and isospectral deformations. The structural framework is the concept of a noncommutative spin geometry; the conditions on spectral triples which determine this concept are developed in detail. The emphasis throughout is on gaining understanding by computing the details of specific examples. The book provides a middle ground between a comprehensive text and a narrowly focused research monograph. It is intended for self-study, enabling the reader to gain access to the essentials of noncommutative geometry. New features since the original course are an expanded bibliography and a survey of more recent examples and applications of spectral triples.

**Noncommutative Geometry, Arithmetic, and Related Topics**-Caterina Consani 2011 Mathematics Institute, these essays collectively provide mathematicians and physicists with a comprehensive resource on the topic.

**Noncommutative Geometry**-Igor V. Nikolaev 2017-11-07 This book covers the basics of noncommutative geometry (NCG) and its applications in topology, algebraic geometry, and number theory. The author takes up the practical side of NCG and its value for other areas of mathematics. A brief survey of the main parts of NCG with historical remarks, bibliography, and a list of exercises is included. The presentation is intended for graduate students and researchers with interests in NCG, but will also serve nonexperts in the field. Contents Part I: Basics Model examples Categories and functors C∗-algebras Part II: Noncommutative invariants Topology Algebraic geometry Number theory Part III: Brief survey of NCG Finite geometries Continuous geometries Connes geometries Index theory Jones polynomials Quantum groups Noncommutative algebraic geometry Trends in noncommutative geometry

**Noncommutative Geometry, Quantum Fields and Motives**-Alain Connes 2019-03-13 The unifying theme of this book is the interplay among noncommutative geometry, physics, and number theory. The two main objects of investigation are spaces where both the noncommutative and the motivic aspects come to play a role: space-time, where the guiding principle is the problem of developing a quantum theory of gravity, and the space of primes, where one can regard the Riemann Hypothesis as a long-standing problem motivating the development of new geometric tools. The book stresses the relevance of noncommutative geometry in dealing with these two spaces. The first part of the book deals with quantum field theory and the geometric structure of renormalization as a Riemann-Hilbert correspondence. It also presents a model of elementary particle physics based on noncommutative geometry. The main result is a complete derivation of the full Standard Model Lagrangian from a very simple mathematical input. Other topics covered in the first part of the book are a noncommutative geometry model of dimensional regularization and its role in anomaly computations, and a brief introduction to motives and their conjectural relation to quantum field theory. The second part of the book gives an interpretation of the Weil explicit formula as a trace formula and a spectral realization of the zeros of the Riemann zeta function. This is based on the noncommutative geometry of the adèle class space, which is also described as the space of commensurability classes of Q-lattices, and is dual to a noncommutative motive (endomotive) whose cyclic homology provides a general setting for spectral realizations of zeros of L-functions. The quantum statistical mechanics of the space of Q-lattices, in one and two dimensions, exhibits spontaneous symmetry breaking. In the low-temperature regime, the equilibrium states of the corresponding systems are related to points of classical moduli spaces and the symmetries to the class field theory of the field of rational numbers and of imaginary quadratic fields, as well as to the automorphisms of the field of modular functions. The book ends with a set of analogies between the noncommutative geometries underlying the mathematical formulation of the Standard Model minimally coupled to gravity and the moduli spaces of Q-lattices used in the study of the zeta function.

**Arithmetic Noncommutative Geometry**-Matilde Marcolli 2005 Arithmetic noncommutative geometry denotes the use of ideas and tools from the field of noncommutative geometry, to address questions and reinterpret in a new perspective results and constructions from number theory and arithmetic algebraic geometry. This general philosophy is applied to the geometry and arithmetic of modular curves and to the fibers at archimedean places of arithmetic surfaces and varieties. The main reason why noncommutative geometry can be expected to say something about topics of arithmetic interest lies in the fact that it provides the right framework in which the tools of geometry continue to make sense on spaces that are very singular and apparently very far from the world of algebraic varieties. This provides a way of refining the boundary structure of certain classes of spaces that arise in the context of arithmetic geometry, such as moduli spaces (of which modular curves are the simplest case) or arithmetic varieties (completed by suitable ``fibers at infinity''), by adding boundaries that are invisible to algebraic geometry, such as degenerations of elliptic curves to noncommutative tori. The text of the book is organized around series of invited lectures delivered by the author at various universities, and the results presented are based on work of the author in collaboration with Alain Connes, Katia Consani, Yuri Manin, and Niranjan Ramachandran.

**Noncommutative Geometry and Number Theory**-Caterina Consani 2007-12-18 In recent years, number theory and arithmetic geometry have been enriched by new techniques from noncommutative geometry, operator algebras, dynamical systems, and K-Theory. This volume collects and presents up-to-date research topics in arithmetic and noncommutative geometry and ideas from physics that point to possible new connections between the fields of number theory, algebraic geometry and noncommutative geometry. The articles collected in this volume present new noncommutative geometry perspectives on classical topics of number theory and arithmetic such as modular forms, class field theory, the theory of reductive p-adic groups, Shimura varieties, the local L-factors of arithmetic varieties. They also show how arithmetic appears naturally in noncommutative geometry and in physics, in the residues of Feynman graphs, in the properties of noncommutative tori, and in the quantum Hall effect.

**Quantum Groups and Noncommutative Geometry**-Yuri I. Manin 2018-10-11 This textbook presents the second edition of Manin's celebrated 1988 Montreal lectures, which influenced a new generation of researchers in algebra to take up the study of Hopf algebras and quantum groups. In this expanded write-up of those lectures, Manin systematically develops an approach to quantum groups as symmetry objects in noncommutative geometry in contrast to the more deformation-oriented approach due to Faddeev, Drinfeld, and others. This new edition contains an extra chapter by Theo Raedschelders and Michel Van den Bergh, surveying recent work that focuses on the representation theory of a number of bi- and Hopf algebras that were first introduced in Manin's lectures, and have since gained a lot of attention. Emphasis is placed on the Tannaka–Krein formalism, which further strengthens Manin's approach to symmetry and moduli-objects in noncommutative geometry.

**Basic Noncommutative Geometry**-Masoud Khalkhali 2009 "Basic Noncommutative Geometry provides an introduction to noncommutative geometry and some of its applications. The book can be used either as a textbook for a graduate course on the subject or for self-study. It will be useful for graduate students and researchers in mathematics and theoretical physics and all those who are interested in gaining an understanding of the subject. One feature of this book is the wealth of examples and exercises that help the reader to navigate through the subject. While background material is provided in the text and in several appendices, some familiarity with basic notions of functional analysis, algebraic topology, differential geometry and homological algebra at a first year graduate level is helpful. Developed by Alain Connes since the late 1970s, noncommutative geometry has found many applications to long-standing conjectures in topology and geometry and has recently made headways in theoretical physics and number theory. The book starts with a detailed description of some of the most pertinent algebra-geometry correspondences by casting geometric notions in algebraic terms, then proceeds in the second chapter to the idea of a noncommutative space and how it is constructed. The last two chapters deal with homological tools: cyclic cohomology and Connes-Chern characters in K-theory and K-homology, culminating in one commutative diagram expressing the equality of topological and analytic index in a noncommutative setting. Applications to integrality of noncommutative topological invariants are given as well."--Publisher's description.

**Advances in Noncommutative Geometry**-Ali Chamseddine 2020-01-13 This authoritative volume in honor of Alain Connes, the foremost architect of Noncommutative Geometry, presents the state-of-the art in the subject. The book features an amalgam of invited survey and research papers that will no doubt be accessed, read, and referred to, for several decades to come. The pertinence and potency of new concepts and methods are concretely illustrated in each contribution. Much of the content is a direct outgrowth of the Noncommutative Geometry conference, held March 23–April 7, 2017, in Shanghai, China. The conference covered the latest research and future areas of potential exploration surrounding topology and physics, number theory, as well as index theory and its ramifications in geometry.

**Noncommutative Geometry and Particle Physics**-Walter D. van Suijlekom 2014-07-21 This book provides an introduction to noncommutative geometry and presents a number of its recent applications to particle physics. It is intended for graduate students in mathematics/theoretical physics who are new to the field of noncommutative geometry, as well as for researchers in mathematics/theoretical physics with an interest in the physical applications of noncommutative geometry. In the first part, we introduce the main concepts and techniques by studying finite noncommutative spaces, providing a “light” approach to noncommutative geometry. We then proceed with the general framework by defining and analyzing noncommutative spin manifolds and deriving some main results on them, such as the local index formula. In the second part, we show how noncommutative spin manifolds naturally give rise to gauge theories, applying this principle to specific examples. We subsequently geometrically derive abelian and non-abelian Yang-Mills gauge theories, and eventually the full Standard Model of particle physics, and conclude by explaining how noncommutative geometry might indicate how to proceed beyond the Standard Model.

**Methods of Noncommutative Geometry for Group C*-Algebras**-Do Ngoc Diep 1999-12-06 The description of the structure of group C*-algebras is a difficult problem, but relevant to important new developments in mathematics, such as non-commutative geometry and quantum groups. Although a significant number of new methods and results have been obtained, until now they have not been available in book form. This volume provides an introduction to and presents research on the study of group C*-algebras, suitable for all levels of readers - from graduate students to professional researchers. The introduction provides the essential features of the methods used. In Part I, the author offers an elementary overview - using concrete examples-of using K-homology, BFD functors, and KK-functors to describe group C*-algebras. In Part II, he uses advanced ideas and methods from representation theory, differential geometry, and KK-theory, to explain two primary tools used to study group C*-algebras: multidimensional quantization and construction of the index of group C*-algebras through orbit methods. The structure of group C*-algebras is an important issue both from a theoretical viewpoint and in its applications in physics and mathematics. Armed with the background, tools, and research provided in Methods of Noncommutative Geometry for Group C*-Algebras, readers can continue this work and make significant contributions to perfecting the theory and solving this problem.

**Noncommutative Geometry and Cayley-smooth Orders**-Lieven Le Bruyn 2007-08-24 Noncommutative Geometry and Cayley-smooth Orders explains the theory of Cayley-smooth orders in central simple algebras over function fields of varieties. In particular, the book describes the etale local structure of such orders as well as their central singularities and finite dimensional representations. After an introduction to partial d

**Noncommutative Geometry and the Standard Model of Elementary Particle Physics**-Florian Scheck 2008-01-11 The outcome of a close collaboration between mathematicians and mathematical physicists, these lecture notes present the foundations of A. Connes noncommutative geometry as well as its applications in particular to the field of theoretical particle physics. The coherent and systematic approach makes this book useful for experienced researchers and postgraduate students alike.

**Noncommutative Geometry and Global Analysis**-Henri Moscovici 2011 This volume represents the proceedings of the conference on Noncommutative Geometric Methods in Global Analysis, held in honor of Henri Moscovici, from June 29-July 4, 2009, in Bonn, Germany. Henri Moscovici has made a number of major contributions to noncommutative geometry, global analysis, and representation theory. This volume, which includes articles by some of the leading experts in these fields, provides a panoramic view of the interactions of noncommutative geometry with a variety of areas of mathematics. It focuses on geometry, analysis and topology of manifolds and singular spaces, index theory, group representation theory, connections of noncommutative geometry with number theory and arithmetic geometry, Hopf algebras and their cyclic cohomology.

**K-theory and Noncommutative Geometry**-Guillermo Cortiñas 2008 Since its inception 50 years ago, K-theory has been a tool for understanding a wide-ranging family of mathematical structures and their invariants: topological spaces, rings, algebraic varieties and operator algebras are the dominant examples. The invariants range from characteristic classes in cohomology, determinants of matrices, Chow groups of varieties, as well as traces and indices of elliptic operators. Thus K-theory is notable for its connections with other branches of mathematics. Noncommutative geometry develops tools which allow one to think of noncommutative algebras in the same footing as commutative ones: as algebras of functions on (noncommutative) spaces. The algebras in question come from problems in various areas of mathematics and mathematical physics; typical examples include algebras of pseudodifferential operators, group algebras, and other algebras arising from quantum field theory. To study noncommutative geometric problems one considers invariants of the relevant noncommutative algebras. These invariants include algebraic and topological K-theory, and also cyclic homology, discovered independently by Alain Connes and Boris Tsygan, which can be regarded both as a noncommutative version of de Rham cohomology and as an additive version of K-theory. There are primary and secondary Chern characters which pass from K-theory to cyclic homology. These characters are relevant both to noncommutative and commutative problems and have applications ranging from index theorems to the detection of singularities of commutative algebraic varieties. The contributions to this volume represent this range of connections between K-theory, noncommmutative geometry, and other branches of mathematics.

**Geometric Models for Noncommutative Algebras**-Ana Cannas da Silva 1999 The volume is based on a course, ``Geometric Models for Noncommutative Algebras'' taught by Professor Weinstein at Berkeley. Noncommutative geometry is the study of noncommutative algebras as if they were algebras of functions on spaces, for example, the commutative algebras associated to affine algebraic varieties, differentiable manifolds, topological spaces, and measure spaces. In this work, the authors discuss several types of geometric objects (in the usual sense of sets with structure) that are closely related to noncommutative algebras. Central to the discussion are symplectic and Poisson manifolds, which arise when noncommutative algebras are obtained by deforming commutative algebras. The authors also give a detailed study of groupoids (whose role in noncommutative geometry has been stressed by Connes) as well as of Lie algebroids, the infinitesimal approximations to differentiable groupoids. Featured are many interesting examples, applications, and exercises. The book starts with basic definitions and builds to (still) open questions. It is suitable for use as a graduate text. An extensive bibliography and index are included.

**Topics in Noncommutative Geometry**-Guillermo Cortiñas 2012 Luis Santalo Winter Schools are organized yearly by the Mathematics Department and the Santalo Mathematical Research Institute of the School of Exact and Natural Sciences of the University of Buenos Aires (FCEN). This volume contains the proceedings of the third Luis Santalo Winter School which was devoted to noncommutative geometry and held at FCEN July 26-August 6, 2010. Topics in this volume concern noncommutative geometry in a broad sense, encompassing various mathematical and physical theories that incorporate geometric ideas to the study of noncommutative phenomena. It explores connections with several areas including algebra, analysis, geometry, topology and mathematical physics. Bursztyn and Waldmann discuss the classification of star products of Poisson structures up to Morita equivalence. Tsygan explains the connections between Kontsevich's formality theorem, noncommutative calculus, operads and index theory. Hoefel presents a concrete elementary construction in operad theory. Meyer introduces the subject of $\mathrm{C}^*$-algebraic crossed products. Rosenberg introduces Kasparov's $KK$-theory and noncommutative tori and includes a discussion of the Baum-Connes conjecture for $K$-theory of crossed products, among other topics. Lafont, Ortiz, and Sanchez-Garcia carry out a concrete computation in connection with the Baum-Connes conjecture. Zuk presents some remarkable groups produced by finite automata. Mesland discusses spectral triples and the Kasparov product in $KK$-theory. Trinchero explores the connections between Connes' noncommutative geometry and quantum field theory. Karoubi demonstrates a construction of twisted $K$-theory by means of twisted bundles. Tabuada surveys the theory of noncommutative motives.

**Noncommutative Geometry and Representation Theory in Mathematical Physics**-Jürgen Fuchs 2005 Mathematics provides a language in which to formulate the laws that govern nature. It is a language proven to be both powerful and effective. In the quest for a deeper understanding of the fundamental laws of physics, one is led to theories that are increasingly difficult to put to the test. In recent years, many novel questions have emerged in mathematical physics, particularly in quantum field theory. Indeed, several areas of mathematics have lately become increasingly influential in physics and, in turn, have become influenced by developments in physics. Over the last two decades, interactions between mathematicians and physicists have increased enormously and have resulted in a fruitful cross-fertilization of the two communities.This volume contains the plenary talks from the international symposium on Noncommutative Geometry and Representation Theory in Mathematical Physics held at Karlstad University (Sweden) as a satellite conference to the Fourth European Congress of Mathematics. The scope of the volume is large and its content is relevant to various scientific communities interested in noncommutative geometry and representation theory. It offers a comprehensive view of the state of affairs for these two branches of mathematical physics. The book is suitable for graduate students and researchers interested in mathematical physics.

**Topics in Non-Commutative Geometry**-Y. Manin 2014-07-14 There is a well-known correspondence between the objects of algebra and geometry: a space gives rise to a function algebra; a vector bundle over the space corresponds to a projective module over this algebra; cohomology can be read off the de Rham complex; and so on. In this book Yuri Manin addresses a variety of instances in which the application of commutative algebra cannot be used to describe geometric objects, emphasizing the recent upsurge of activity in studying noncommutative rings as if they were function rings on "noncommutative spaces." Manin begins by summarizing and giving examples of some of the ideas that led to the new concepts of noncommutative geometry, such as Connes' noncommutative de Rham complex, supergeometry, and quantum groups. He then discusses supersymmetric algebraic curves that arose in connection with superstring theory; examines superhomogeneous spaces, their Schubert cells, and superanalogues of Weyl groups; and provides an introduction to quantum groups. This book is intended for mathematicians and physicists with some background in Lie groups and complex geometry. Originally published in 1991. The Princeton Legacy Library uses the latest print-on-demand technology to again make available previously out-of-print books from the distinguished backlist of Princeton University Press. These editions preserve the original texts of these important books while presenting them in durable paperback and hardcover editions. The goal of the Princeton Legacy Library is to vastly increase access to the rich scholarly heritage found in the thousands of books published by Princeton University Press since its founding in 1905.

**Perspectives on Noncommutative Geometry**-Masoud Khalkhali 2011 This volume represents the proceedings of the Noncommutative Geometry Workshop that was held as part of the thematic program on operator algebras at the Fields Institute in May 2008. Pioneered by Alain Connes starting in the late 1970s, noncommutative geometry was originally inspired by global analysis, topology, operator algebras, and quantum physics. Its main applications were to settle some long-standing conjectures, such as the Novikov conjecture and the Baum-Connes conjecture. Next came the impact of spectral geometry and the way the spectrum of a geometric operator, like the Laplacian, holds information about the geometry and topology of a manifold, as in the celebrated Weyl law. This has now been vastly generalized through Connes' notion of spectral triples. Finally, recent years have witnessed the impact of number theory, algebraic geometry and the theory of motives, and quantum field theory on noncommutative geometry. Almost all of these aspects are touched upon with new results in the papers of this volume. This book is intended for graduate students and researchers in both mathematics and theoretical physics who are interested in noncommutative geometry and its applications.

**Operator Algebras, Quantization, and Noncommutative Geometry**-Marshall Harvey Stone 2004 John von Neumann and Marshall Stone were two giants of Twentieth Century mathematics. In honor of the 100th anniversary of their births, a mathematical celebration was organized featuring developments in fields where both men were major influences. This volume contains articles from the AMS Special Session, Operator Algebras, Quantization and Noncommutative Geometry: A Centennial Celebration in Honor of John von Neumann and Marshall H. Stone.Papers range from expository and historical surveys to original research articles. All articles were carefully refereed and cover a broad range of mathematical topics reflecting the fundamental ideas of von Neumann and Stone. Most contributions are expanded versions of the talks and were written exclusively for this volume. Included, among others, are articles by George W. Mackey, Nigel Higson, and Marc Rieffel. Also featured is a reprint of P.R. Halmos' ""The Legend of John von Neumann"". The book is suitable for graduate students and researchers interested in operator algebras and applications, including noncommutative geometry.

**Noncommutative Geometry and Physics, 3**-Giuseppe Dito 2013 Noncommutative differential geometry is a novel approach to geometry, aimed in part at applications in physics. It was founded in the early eighties by the 1982 Fields Medalist Alain Connes on the basis of his fundamental works in operator algebras. It is now a very active branch of mathematics with actual and potential applications to a variety of domains in physics ranging from solid state to quantization of gravity. The strategy is to formulate usual differential geometry in a somewhat unusual manner, using in particular operator algebras and related concepts, so as to be able to plug in noncommutativity in a natural way. Algebraic tools such as K-theory and cyclic cohomology and homology play an important role in this field. It is an important topic both for mathematics and physics.

**Surveys in Noncommutative Geometry**-Nigel Higson 2006 In June 2000, the Clay Mathematics Institute organized an Instructional Symposium on Noncommutative Geometry in conjunction with the AMS-IMS-SIAM Joint Summer Research Conference. These events were held at Mount Holyoke College in Massachusetts from June 18 to 29, 2000. The Instructional Symposium consisted of several series of expository lectures which were intended to introduce key topics in noncommutative geometry to mathematicians unfamiliar with the subject. Those expository lectures have been edited and are reproduced in this volume. The lectures of Rosenberg and Weinberger discuss various applications of noncommutative geometry to problems in ``ordinary'' geometry and topology. The lectures of Lagarias and Tretkoff discuss the Riemann hypothesis and the possible application of the methods of noncommutative geometry in number theory. Higson gives an account of the ``residue index theorem'' of Connes and Moscovici. Noncommutative geometry is to an unusual extent the creation of a single mathematician, Alain Connes. The present volume gives an extended introduction to several aspects of Connes' work in this fascinating area.

**Cyclic Cohomology and Noncommutative Geometry**-Joachim J. R. Cuntz 1997-01-01 Noncommutative geometry is a new field that is among the great challenges of present-day mathematics. Its methods allow one to treat noncommutative algebras - such as algebras of pseudodifferential operators, group algebras, or algebras arising from quantum field theory - on the same footing as commutative algebras, that is, as spaces. Applications range over many fields of mathematics and mathematical physics. This volume contains the proceedings of the workshop on "Cyclic Cohomology and Noncommutative Geometry" held at The Fields Institute (Waterloo, ON) in June 1995. The workshop was part of the program for the special year on operator algebras and its applications.

**Noncommutative Geometry and Physics**-Alan L. Carey 2011 This collection of expository articles grew out of the workshop ``Number Theory and Physics'' held in March 2009 at The Erwin Schrodinger International Institute for Mathematical Physics, Vienna. The common theme of the articles is the influence of ideas from noncommutative geometry (NCG) on subjects ranging from number theory to Lie algebras, index theory, and mathematical physics. Matilde Marcolli's article gives a survey of relevant aspects of NCG in number theory, building on an introduction to motives for beginners by Jorge Plazas and Sujatha Ramdorai. A mildly unconventional view of index theory, from the viewpoint of NCG, is described in the article by Alan Carey, John Phillips, and Adam Rennie. As developed by Alain Connes and Dirk Kreimer, NCG also provides insight into novel algebraic structures underlying many analytic aspects of quantum field theory. Dominique Manchon's article on pre-Lie algebras fits into this developing research area. This interplay of algebraic and analytic techniques also appears in the articles by Christoph Bergbauer, who introduces renormalization theory and Feynman diagram methods, and Sylvie Paycha, who focuses on relations between renormalization and zeta function techniques.

**Spectral Action in Noncommutative Geometry**-Michał Eckstein 2018-12-18 What is spectral action, how to compute it and what are the known examples? This book offers a guided tour through the mathematical habitat of noncommutative geometry à la Connes, deliberately unveiling the answers to these questions. After a brief preface flashing the panorama of the spectral approach, a concise primer on spectral triples is given. Chapter 2 is designed to serve as a toolkit for computations. The third chapter offers an in-depth view into the subtle links between the asymptotic expansions of traces of heat operators and meromorphic extensions of the associated spectral zeta functions. Chapter 4 studies the behaviour of the spectral action under fluctuations by gauge potentials. A subjective list of open problems in the field is spelled out in the fifth Chapter. The book concludes with an appendix including some auxiliary tools from geometry and analysis, along with examples of spectral geometries. The book serves both as a compendium for researchers in the domain of noncommutative geometry and an invitation to mathematical physicists looking for new concepts.

**Quantum Stochastic Processes and Noncommutative Geometry**-Kalyan B. Sinha 2007-01-25 The classical theory of stochastic processes has important applications arising from the need to describe irreversible evolutions in classical mechanics; analogously quantum stochastic processes can be used to model the dynamics of irreversible quantum systems. Noncommutative, i.e. quantum, geometry provides a framework in which quantum stochastic structures can be explored. This book is the first to describe how these two mathematical constructions are related. In particular, key ideas of semigroups and complete positivity are combined to yield quantum dynamical semigroups (QDS). Sinha and Goswami also develop a general theory of Evans-Hudson dilation for both bounded and unbounded coefficients. The unique features of the book, including the interaction of QDS and quantum stochastic calculus with noncommutative geometry and a thorough discussion of this calculus with unbounded coefficients, will make it of interest to graduate students and researchers in functional analysis, probability and mathematical physics.

**Noncommutative Geometry and Physics 2005**- 2007 This book provides a comprehensive overview of the authors' pioneering contributions to nonlinear set-valued analysis by topological methods. The coverage includes fixed point theory, degree theory, the KKM principle, variational inequality theory, the Nash equilibrium point in mathematical economics, the Pareto optimum in optimization, and applications to best approximation theory, partial equations and boundary value problems. Self-contained and unified in presentation, the book considers the existence of equilibrium points of abstract economics in topological vector spaces from the viewpoint of Ky Fan minimax inequalities. It also provides the latest developments in KKM theory and degree theory for nonlinear set-valued mappings.

**Supersymmetry and Noncommutative Geometry**-Wim Beenakker 2015-10-22 In this work the question whether noncommutative geometry allows for supersymmetric theories is addressed. Noncommutative geometry has seen remarkable applications in high energy physics, viz. the geometrical interpretation of the Standard Model, however such a question has not been answered in a conclusive way so far.The book starts with a systematic analysis of the possibilities for so-called almost-commutative geometries on a 4-dimensional, flat background to exhibit not only a particle content that is eligible for supersymmetry, but also have a supersymmetric action. An approach is proposed in which the basic `building blocks' of potentially supersymmetric theories and the demands for their action to be supersymmetric are identified. It is then described how a novel kind of soft supersymmetry breaking Lagrangian arises naturally from the spectral action. Finally, the above formalism is applied to explore the existence of a noncommutative version of the minimal supersymmetric Standard Model.This book is intended for mathematical/theoretical physicists with an interest in the applications of noncommutative geometry to supersymmetric field theories.

**Noncommutative Geometry and Optimal Transport**-Pierre Martinetti 2016-10-26 The distance formula in noncommutative geometry was introduced by Connes at the end of the 1980s. It is a generalization of Riemannian geodesic distance that makes sense in a noncommutative setting, and provides an original tool to study the geometry of the space of states on an algebra. It also has an intriguing echo in physics, for it yields a metric interpretation for the Higgs field. In the 1990s, Rieffel noticed that this distance is a noncommutative version of the Wasserstein distance of order 1 in the theory of optimal transport. More exactly, this is a noncommutative generalization of Kantorovich dual formula of the Wasserstein distance. Connes distance thus offers an unexpected connection between an ancient mathematical problem and the most recent discovery in high energy physics. The meaning of this connection is far from clear. Yet, Rieffel's observation suggests that Connes

distance may provide an interesting starting point for a theory of optimal transport in noncommutative geometry. This volume contains several review papers that will give the reader an extensive introduction to the metric aspect of noncommutative geometry and its possible interpretation as a Wasserstein distance on a quantum space, as well as several topic papers.

**Quantum Field Theory and Noncommutative Geometry**-Ursula Carow-Watamura 2005-02-21 This volume reflects the growing collaboration between mathematicians and theoretical physicists to treat the foundations of quantum field theory using the mathematical tools of q-deformed algebras and noncommutative differential geometry. A particular challenge is posed by gravity, which probably necessitates extension of these methods to geometries with minimum length and therefore quantization of space. This volume builds on the lectures and talks that have been given at a recent meeting on "Quantum Field Theory and Noncommutative Geometry." A considerable effort has been invested in making the contributions accessible to a wider community of readers - so this volume will not only benefit researchers in the field but also postgraduate students and scientists from related areas wishing to become better acquainted with this field.

**Noncommutative Geometry And Physics 4 - Workshop On Strings, Membranes And Topological Field Theory**-Kotani Motoko 2017-03-16 This book is a collection of the lectures and talks presented in the Tohoku Forum for Creativity in the thematic year 2015 "Fundamental Problems in Quantum Physics: Strings, Black Holes and Quantum Information", and related events in the period 2014–2016. This volume especially contains an overview of recent developments in the theory of strings and membranes, as well as topological field theory.

**Elliptic Theory and Noncommutative Geometry**-Vladimir E. Nazaykinskiy 2008-06-30 This comprehensive yet concise book deals with nonlocal elliptic differential operators. These are operators whose coefficients involve shifts generated by diffeomorphisms of the manifold on which the operators are defined. This is the first book featuring a consistent application of methods of noncommutative geometry to the index problem in the theory of nonlocal elliptic operators. To make the book self-contained, the authors have included necessary geometric material.

**Noncommutative Algebra and Geometry**-Corrado De Concini 2005-09-01 A valuable addition to the Lecture Notes in Pure and Applied Mathematics series, this reference results from a conference held in St. Petersburg, Russia, in honor of Dr. Z. Borevich. This volume is mainly devoted to the contributions related to the European Science Foundation workshop, organized under the framework of noncommuntative geometry and integrated in the Borevich meeting. The topics presented, including algebraic groups and representations, algebraic number theory, rings, and modules, are a timely distillation of recent work in the field. Featuring a wide range of international experts as contributors, this book is an ideal reference for mathematicians in algebra and algebraic geometry.

**Noncommutative Spacetimes**-Paolo Aschieri 2009-07-07 There are many approaches to noncommutative geometry and its use in physics, the ? operator algebra and C -algebra one, the deformation quantization one, the qu- tum group one, and the matrix algebra/fuzzy geometry one. This volume introduces and develops the subject by presenting in particular the ideas and methods recently pursued by Julius Wess and his group. These methods combine the deformation quantization approach based on the - tion of star product and the deformed (quantum) symmetries methods based on the theory of quantum groups. The merging of these two techniques has proven very fruitful in order to formulate ?eld theories on noncommutative spaces. The aim of the book is to give an introduction to these topics and to prepare the reader to enter the research ?eld himself/herself. This has developed from the constant interest of Prof. W. Beiglboeck, editor of LNP, in this project, and from the authors experience in conferences and schools on the subject, especially from their interaction with students and young researchers. In fact quite a few chapters in the book were written with a double purpose, on the one hand as contributions for school or conference proceedings and on the other handaschaptersforthepresentbook.Thesearenowharmonizedandcomplemented by a couple of contributions that have been written to provide a wider background, to widen the scope, and to underline the power of our methods.