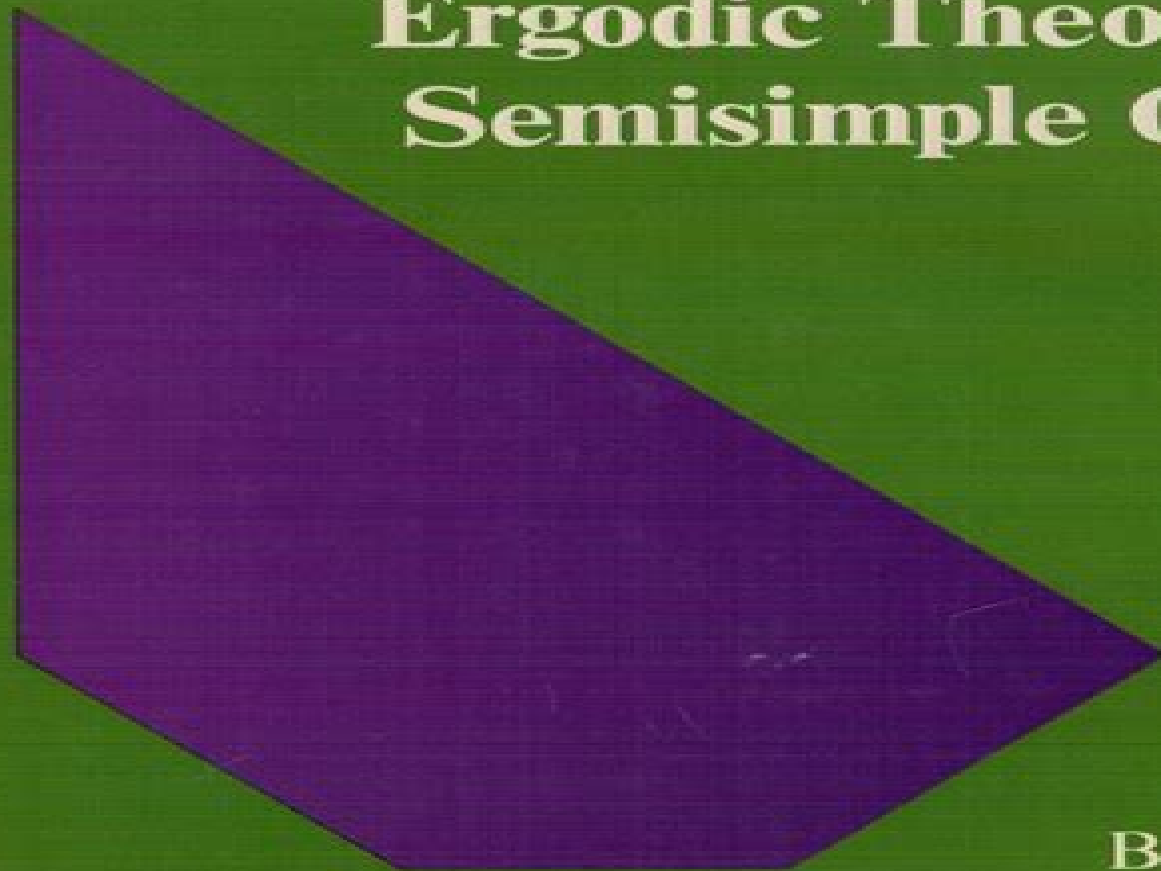


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Robert J. Zimmer

**Ergodic Theory and  
Semisimple Groups**



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# Ergodic Theory And Semisimple Groups

**Lizhen Ji**



## **Ergodic Theory And Semisimple Groups:**

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**Ergodic Theory and Semisimple Groups** R. J. Zimmer, 2013-03-14 This book is based on a course given at the University of Chicago in 1980-81. As with the course the main motivation of this work is to present an accessible treatment assuming minimal background of the profound work of G. A. Margulis concerning rigidity, arithmeticity and structure of lattices in semi-simple groups and related work of the author on the actions of semisimple groups and their lattice subgroups. In doing so we develop the necessary prerequisites from earlier work of Borel, Furstenberg, Kazhdan, Moore and others. One of the difficulties involved in an exposition of this material is the continuous interplay between ideas from the theory of algebraic groups on the one hand and ergodic theory on the other. This of course is not so much a mathematical difficulty as a cultural one as the number of persons comfortable in both areas has not traditionally been large. We hope this work will also serve as a contribution towards improving that situation. While there are a number of satisfactory introductory expositions of the ergodic theory of integer or real line actions there is no such exposition of the type of ergodic theoretic results with which we shall be dealing concerning actions of more general groups and hence we have assumed absolutely no knowledge of ergodic theory not even the definition of ergodic on the part of the reader. All results are developed in full detail. **Dynamical Systems and Semisimple Groups** Renato Feres, 1998-06-13

This 1998 book provides an introduction to dynamical systems and ergodic theory with an emphasis on smooth actions of noncompact Lie groups. The main goal is to serve as an entry into the literature on the ergodic theory of measure preserving actions of semisimple Lie groups. The author develops in a detailed and self-contained way the main results on Lie groups, Lie algebras and semisimple groups including basic facts on manifolds and Lie groups plus topics such as integration of

infinitesimal actions of Lie groups He then derives the basic structure theorems for the real semisimple Lie groups such as the Cartan and Iwasawa decompositions and gives an extensive exposition of the general facts and concepts from topological dynamics and ergodic theory including detailed proofs of the multiplicative ergodic theorem and Moore's ergodicity theorem This book should appeal to anyone interested in Lie theory differential geometry and dynamical systems

**Group Actions in Ergodic Theory, Geometry, and Topology** Robert J. Zimmer, 2019-12-23 Robert J Zimmer is best known in mathematics

for the highly influential conjectures and program that bear his name Group Actions in Ergodic Theory Geometry and Topology Selected Papers brings together some of the most significant writings by Zimmer which lay out his program and contextualize his work over the course of his career Zimmer's body of work is remarkable in that it involves methods from a variety of mathematical disciplines such as Lie theory differential geometry ergodic theory and dynamical systems arithmetic groups and topology and at the same time offers a unifying perspective After arriving at the University of Chicago in 1977 Zimmer extended his earlier research on ergodic group actions to prove his cocycle superrigidity theorem which proved to be a pivotal point in articulating and developing his program Zimmer's ideas opened the door to many others and they continue to be actively employed in many domains related to group actions in ergodic theory geometry and topology In addition to the selected papers themselves this volume opens with a foreword by David Fisher Alexander Lubotzky and Gregory Margulis as well as a substantial introductory essay by Zimmer recounting the course of his career in mathematics The volume closes with an afterword by Fisher on the most recent developments around the Zimmer program

**Group Representations, Ergodic Theory, and Mathematical Physics** Robert S. Doran, Calvin C. Moore, Robert J. Zimmer, 2008 George Mackey was an extraordinary mathematician of great power and vision His profound contributions to representation theory harmonic analysis ergodic theory and mathematical physics left a rich legacy for researchers that continues today This book is based on lectures presented at an AMS special session held in January 2007 in New Orleans dedicated to his memory The papers written especially for this volume by internationally known mathematicians and mathematical physicists range from expository and historical surveys to original high level research articles The influence of Mackey's fundamental ideas is apparent throughout The introductory article contains recollections from former students friends colleagues and family as well as a biography describing his distinguished career as a mathematician at Harvard where he held the Landon D Clay Professorship of Mathematics

**Ergodic Theory and Topological Dynamics of Group Actions on Homogeneous Spaces** M. Bachir Bekka, Matthias Mayer, 2000-05-11 This book first published in 2000 focuses on developments in the study of geodesic flows on homogeneous spaces

**Dynamics, Geometry, Number Theory** David Fisher, Dmitry Kleinbock, Gregory Soifer, 2022-02-07 This definitive synthesis of mathematician Gregory Margulis's research brings together leading experts to cover the breadth and diversity of disciplines Margulis's work touches upon This edited collection highlights the foundations and evolution of research by widely influential Fields Medalist Gregory Margulis Margulis is unusual in the degree to which

his solutions to particular problems have opened new vistas of mathematics his ideas were central for example to developments that led to the recent Fields Medals of Elon Lindenstrauss and Maryam Mirzakhani Dynamics Geometry Number Theory introduces these areas their development their use in current research and the connections between them Divided into four broad sections Arithmeticity Superrigidity Normal Subgroups Discrete Subgroups Expanders Representations Spectral Theory and Homogeneous Dynamics the chapters have all been written by the foremost experts on each topic with a view to making them accessible both to graduate students and to experts in other parts of mathematics This was no simple feat Margulis's work stands out in part because of its depth but also because it brings together ideas from different areas of mathematics Few can be experts in all of these fields and this diversity of ideas can make it challenging to enter Margulis's area of research Dynamics Geometry Number Theory provides one remedy to that challenge

*Combinatorial and Geometric Group Theory* Sean Cleary, 2002 This volume grew out of two AMS conferences held at Columbia University New York NY and the Stevens Institute of Technology Hoboken NJ and presents articles on a wide variety of topics in group theory Readers will find a variety of contributions including a collection of over 170 open problems in combinatorial group theory three excellent survey papers on boundaries of hyperbolic groups on fixed points of free group automorphisms and on groups of automorphisms of compact Riemann surfaces and several original research papers that represent the diversity of current trends in combinatorial and geometric group theory The book is an excellent reference source for graduate students and research mathematicians interested in various aspects of group theory **European**

**Congress of Mathematics** Ari Laptev, 2005 The European Congress of Mathematics held every four years has established itself as a major international mathematical event Following those in Paris 1992 Budapest 1996 and Barcelona 2000 the Fourth European Congress of Mathematics took place in Stockholm Sweden June 27 to July 2 2004 with 913 participants from 65 countries Apart from seven plenary and thirty three invited lectures there were six Science Lectures covering the most relevant aspects of mathematics in science and technology Moreover twelve projects of the EU Research Training Networks in Mathematics and Information Sciences as well as Programmes from the European Science Foundation in Physical and Engineering Sciences were presented Ten EMS Prizes were awarded to young European mathematicians who have made a particular contribution to the progress of mathematics Five of the prizewinners were independently chosen by the 4ECM Scientific Committee as plenary or invited speakers The other five prizewinners gave their lectures in parallel sessions Most of these contributions are now collected in this volume providing a permanent record of so much that is best in mathematics today **Arithmetic Groups and Their Generalizations** Lizhen Ji, 2008 In one guise or another many

mathematicians are familiar with certain arithmetic groups such as  $\mathbf{Z}$  or  $\mathrm{SL}_n(\mathbf{Z})$  Yet many applications of arithmetic groups and many connections to other subjects within mathematics are less well known Indeed arithmetic groups admit many natural and important generalizations The purpose of this expository book is to explain through some

brief and informal comments and extensive references what arithmetic groups and their generalizations are why they are important to study and how they can be understood and applied to many fields such as analysis geometry topology number theory representation theory and algebraic geometry It is hoped that such an overview will shed a light on the important role played by arithmetic groups in modern mathematics Titles in this series are co published with International Press Cambridge MA Table of Contents Introduction General comments on references Examples of basic arithmetic groups General arithmetic subgroups and locally symmetric spaces Discrete subgroups of Lie groups and arithmeticity of lattices in Lie groups Different completions of  $\mathbb{Q}$  and  $\mathbb{S}$  arithmetic groups over number fields Global fields and  $\mathbb{S}$  arithmetic groups over function fields Finiteness properties of arithmetic and  $\mathbb{S}$  arithmetic groups Symmetric spaces Bruhat Tits buildings and their arithmetic quotients Compactifications of locally symmetric spaces Rigidity of locally symmetric spaces Automorphic forms and automorphic representations for general arithmetic groups Cohomology of arithmetic groups  $K$  groups of rings of integers and  $K$  groups of group rings Locally homogeneous manifolds and period domains Non cofinite discrete groups geometrically finite groups Large scale geometry of discrete groups Tree lattices Hyperbolic groups Mapping class groups and outer automorphism groups of free groups Outer automorphism group of free groups and the outer spaces References Index Review from Mathematical Reviews the author deserves credit for having done the tremendous job of encompassing every aspect of arithmetic groups visible in today's mathematics in a systematic manner the book should be an important guide for some time to come AMSIP 43

**The Ergodic Theory of Lattice Subgroups (AM-172)** Alexander Gorodnik, Amos Nevo, 2010 The results established in this book constitute a new departure in ergodic theory and a significant expansion of its scope Traditional ergodic theorems focused on amenable groups and relied on the existence of an asymptotically invariant sequence in the group the resulting maximal inequalities based on covering arguments and the transference principle Here Alexander Gorodnik and Amos Nevo develop a systematic general approach to the proof of ergodic theorems for a large class of non amenable locally compact groups and their lattice subgroups Simple general conditions on the spectral theory of the group and the regularity of the averaging sets are formulated which suffice to guarantee convergence to the ergodic mean In particular this approach gives a complete solution to the problem of establishing mean and pointwise ergodic theorems for the natural averages on semisimple algebraic groups and on their discrete lattice subgroups Furthermore an explicit quantitative rate of convergence to the ergodic mean is established in many cases The topic of this volume lies at the intersection of several mathematical fields of fundamental importance These include ergodic theory and dynamics of non amenable groups harmonic analysis on semisimple algebraic groups and their homogeneous spaces quantitative non Euclidean lattice point counting problems and their application to number theory as well as equidistribution and non commutative Diophantine approximation Many examples and applications are provided in the text demonstrating the usefulness of the results established

**Geometry, Rigidity, and Group Actions** Robert J.

Zimmer, Benson Farb, David Fisher, 2011-04-15 The study of group actions is more than 100 years old but remains a widely studied topic in a variety of mathematic fields A central development in the last 50 years is the phenomenon of rigidity whereby one can classify actions of certain groups This book looks at rigidity      **Foliations: Geometry And Dynamics - Proceedings Of The Euroworkshop** Lawrence Conlon, Remi Langevin, Takashi Tsuboi, Pawel Walczak, 2002-02-01 This volume contains surveys and research articles regarding different aspects of the theory of foliation The main aspects concern the topology of foliations of low dimensional manifolds the geometry of foliated Riemannian manifolds and the dynamical properties of foliations Among the surveys are lecture notes devoted to the analysis of some operator algebras on foliated manifolds and the theory of confoliations objects defined recently by W Thurston and Y Eliashberg situated between foliations and contact structures Among the research articles one can find a detailed proof of an unpublished theorem due to Duminy concerning ends of leaves in exceptional minimal sets      *Proceedings of the Euroworkshop on Foliations Geometry and Dynamics, 29 May-9 June 2000, Warsaw, Poland* Pawe? Grzegorz Walczak, 2002 Contains surveys and research articles regarding different aspects of the theory of foliation      **Geometry of Nonpositively Curved Manifolds** Patrick Eberlein, 1996 Starting from the foundations the author presents an almost entirely self contained treatment of differentiable spaces of nonpositive curvature focusing on the symmetric spaces in which every geodesic lies in a flat Euclidean space of dimension at least two The book builds to a discussion of the Mostow Rigidity Theorem and its generalizations and concludes by exploring the relationship in nonpositively curved spaces between geometric and algebraic properties of the fundamental group This introduction to the geometry of symmetric spaces of non compact type will serve as an excellent guide for graduate students new to the material and will also be a useful reference text for mathematicians already familiar with the subject      Proceedings of the International Symposium/Workshop on Geometric Study of Foliations Tadayoshi Mizutani, 1994 This book covers recent topics in various aspects of foliation theory and its relation with other areas including dynamical systems C algebras index theory and low dimensional topology It contains survey articles by G Hector S Hurder and P Molino as well as more than 20 original papers by specialists who are currently most active in the field      **New Developments in Lie Theory and Geometry** Carolyn Gordon, 2009 This volume is an outgrowth of the Sixth Workshop on Lie Theory and Geometry held in the province of Cordoba Argentina in November 2007 The representation theory and structure theory of Lie groups play a pervasive role throughout mathematics and physics Lie groups are tightly intertwined with geometry and each stimulates developments in the other The aim of this volume is to bring to a larger audience the mutually beneficial interaction between Lie theorists and geometers that animated the workshop Two prominent themes of the representation theoretic articles are Gelfand pairs and the representation theory of real reductive Lie groups Among the more geometric articles are an exposition of major recent developments on noncompact homogeneous Einstein manifolds and aspects of inverse spectral geometry presented in settings accessible to readers new to the area      **Dynamical Systems IX**

D.V. Anosov, 2013-03-14 This volume is devoted to the hyperbolic theory of dynamical systems DS that is the theory of smooth DS s with hyperbolic behaviour of the tra jectories generally speaking not the individual trajectories but trajectories filling out more or less significant subsets in the phase space Hyperbolicity the property that under a small displacement of any of a trajectory consists in point of it to one side of the trajectory the change with time of the relative positions of the original and displaced points resulting from the action of the DS is reminiscent of the mot ion next to a saddle If there are sufficiently many such trajectories and the phase space is compact then although they tend to diverge from one another as it were they have nowhere to go and their behaviour acquires a complicated intricate character In the physical literature one often talks about chaos in such situations This type of be haviour would appear to be the opposite of the more customary and simple type of behaviour characterized by its own kind of stability and regularity of the motions these words are for the moment not being used as a strict ter 1 minology but rather as descriptive informal terms The ergodic properties of DS s with hyperbolic behaviour of trajectories Bunimovich et al 1985 have already been considered in Volume 2 of this series In this volume we therefore consider mainly the properties of a topological character see below 2 for further details

*Discrete Subgroups of Semisimple Lie Groups* Gregori A. Margulis, 1991-02-15 Discrete subgroups have played a central role throughout the development of numerous mathematical disciplines Discontinuous group actions and the study of fundamental regions are of utmost importance to modern geometry Flows and dynamical systems on homogeneous spaces have found a wide range of applications and of course number theory without discrete groups is unthinkable This book written by a master of the subject is primarily devoted to discrete subgroups of finite covolume in semi simple Lie groups Since the notion of Lie group is sufficiently general the author not only proves results in the classical geometry setting but also obtains theorems of an algebraic nature e g classification results on abstract homomorphisms of semi simple algebraic groups over global fields The treatise of course contains a presentation of the author s fundamental rigidity and arithmeticity theorems The work in this monograph requires the language and basic results from fields such as algebraic groups ergodic theory the theory of unitary representatons and the theory of amenable groups The author develops the necessary material from these subjects so that while the book is of obvious importance for researchers working in related areas it is essentially self contained and therefore is also of great interest for advanced students

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