

CONTEMPORARY MATHEMATICS

631

Recent Trends in Ergodic Theory and Dynamical Systems

International Conference in honor
of S. G. Dani's 65th Birthday
Recent Trends in Ergodic Theory and Dynamical Systems
December 26–29, 2012
Vadodara, India

Siddhartha Bhattacharya
Tarun Das
Anish Ghosh
Riddhi Shah
Editors



American Mathematical Society

Recent Trends in Ergodic Theory and Dynamical Systems



Photography courtesy TIFR Photography

S. G. Dani

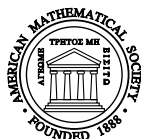
CONTEMPORARY MATHEMATICS

631

Recent Trends in Ergodic Theory and Dynamical Systems

International Conference in honor
of S. G. Dani's 65th Birthday
Recent Trends in Ergodic Theory and Dynamical Systems
December 26–29, 2012
Vadodara, India

Siddhartha Bhattacharya
Tarun Das
Anish Ghosh
Riddhi Shah
Editors



American Mathematical Society
Providence, Rhode Island

EDITORIAL COMMITTEE

Dennis DeTurck, Managing Editor

Michael Loss Kailash Misra Martin J. Strauss

2010 *Mathematics Subject Classification*. Primary 22D40, 28D20, 37A15, 37A17, 37A20, 37A30, 37A35, 37B05, 37E35, 60B15.

Library of Congress Cataloging-in-Publication Data

Recent trends in ergodic theory and dynamical systems : international conference in honor of S.G. Dani's 65th birthday, December 26–29, 2012, Vadodara, India / Siddhartha Bhattacharya, Tarun Das, Anish Ghosh, Riddhi Shah, editors.

pages cm. – (Contemporary mathematics ; volume 631)

Includes bibliographical references.

ISBN 978-1-4704-0931-9 (alk. paper)

1. Dani, S. G. 2. Differentiable dynamical systems—Congresses. 3. Ergodic theory—Congresses. 4. Mathematical analysis—Congresses. I. Bhattacharya, Siddhartha, 1971– II. Das, Tarun, 1964– III. Ghosh, Anish, 1979– IV. Shah, Riddhi.

QA614.8.R45 2014
515'.48—dc23

2014021630

Contemporary Mathematics ISSN: 0271-4132 (print); ISSN: 1098-3627 (online)

DOI: <http://dx.doi.org/10.1090/conm/631>

Copying and reprinting. Individual readers of this publication, and nonprofit libraries acting for them, are permitted to make fair use of the material, such as to copy select pages for use in teaching or research. Permission is granted to quote brief passages from this publication in reviews, provided the customary acknowledgment of the source is given.

Republication, systematic copying, or multiple reproduction of any material in this publication is permitted only under license from the American Mathematical Society. Permissions to reuse portions of AMS publication content are handled by Copyright Clearance Center's RightsLink® service. For more information, please visit: <http://www.ams.org/rightslink>.

Send requests for translation rights and licensed reprints to reprint-permission@ams.org.

Excluded from these provisions is material for which the author holds copyright. In such cases, requests for permission to reuse or reprint material should be addressed directly to the author(s). Copyright ownership is indicated on the copyright page, or on the lower right-hand corner of the first page of each article within proceedings volumes.

© 2015 by the American Mathematical Society. All rights reserved.

The American Mathematical Society retains all rights
except those granted to the United States Government.
Printed in the United States of America.

∞ The paper used in this book is acid-free and falls within the guidelines
established to ensure permanence and durability.
Visit the AMS home page at <http://www.ams.org/>

10 9 8 7 6 5 4 3 2 1 20 19 18 17 16 15

Dedicated to S. G. Dani on the occasion of his 65th birthday

Contents

Preface	ix
S. G. Dani as I have known him M. S. RAGHUNATHAN	1
Cubic averages and large intersections V. BERGELSON and A. LEIBMAN	5
Liouville property on G -spaces C. R. E. RAJA	21
A new connection between metric theory of Diophantine approximations and distribution of algebraic numbers V. BERNIK and F. GÖTZE	33
The gap distribution of slopes on the golden L JAYADEV S. ATHREYA, JON CHAIKA, and SAMUEL LELIÈVRE	47
Uniformly recurrent subgroups ELI GLASNER and BEJAMIN WEISS	63
Values of binary quadratic forms at integer points and Schmidt games DMITRY KLEINBOCK and BARAK WEISS	77
Conformal families of measures for general iterated function systems MANFRED DENKER and MICHIKO YURI	93
Dani's work on probability measures on groups FRANÇOIS LEDRAPPIER and RIDDHI SHAH	109
On the homogeneity at infinity of the stationary probability for an affine random walk Y. GUIVARC'H and E. LE PAGE	119
Dani's work on dynamical systems on homogeneous spaces DAVE WITTE MORRIS	131
Calculus of generalized Riesz products E. H. EL ABDALAOUI and M. G. NADKARNI	145
Diophantine approximation exponents on homogeneous varieties ANISH GHOSH, ALEXANDER GORODNIK, and AMOS NEVO	181
Ergodicity of principal algebraic group actions HANFENG LI, JESSE PETERSON, and KLAUS SCHMIDT	201

A note on three problems in metric Diophantine approximation VICTOR BERESNEVICH and SANJU VELANI	211
Dynamical invariants for group automorphisms RICHARD MILES, MATTHEW STAINES, and THOMAS WARD	231

Preface

A seven day instructional workshop followed by a four day discussion meeting were held, respectively, December 18–24 and 26–29, 2012, at the Maharaja Sayajirao University of Baroda, Vadodara, India, on the topic “Recent trends in ergodic theory and dynamical systems”. The organising committee comprised C. S. Aravinda, T. Das, R. Rao, N. Shah and R. Shah. Speakers in the discussion meeting included J. Aaronson, S. G. Dani, A. Gorodnik, E. Lindenstrauss, M. S. Raghunathan, B. Weiss and other leading mathematicians. At the inaugural session of the meeting, Professor S. G. Dani was felicitated on the occasion of his 65th birthday. Taking into account the rich academic content of the lectures, it was decided to publish the proceedings of the conference and the present editorial committee was set up. These proceedings are dedicated to S. G. Dani.

Dani is a leader in dynamical systems with interests spanning large parts of the modern theory of ergodic theory and dynamical systems as well as Diophantine approximation. Accordingly, the volume comprises original articles across the spectrum of the subject including homogeneous dynamics, Diophantine approximation, Teichmüller dynamics, ergodic theory, dynamics of iterated function systems, random walks and the ergodic theory of \mathbb{Z}^d actions. Additionally, the editors commissioned two surveys on Dani’s work. The survey by D. Morris discusses Dani’s many contributions to homogeneous dynamics while the survey by F. Ledrappier and R. Shah discusses his work on probability measures on groups. An invited article by M. S. Raghunathan, who was Dani’s PhD supervisor, contains some personal reminiscences.

It is a pleasure to thank the International Centre for Theoretical Sciences of the Tata Institute of Fundamental Research for providing financial support for the workshop and discussion meeting. It is also a pleasure to thank the Maharaja Sayajirao University for excellent local hospitality and especially the local organisers for their untiring efforts in making both the events an unqualified success.

Selected Published Titles in This Series

- 631 **Siddhartha Bhattacharya, Tarun Das, Anish Ghosh, and Riddhi Shah, Editors**, Recent Trends in Ergodic Theory and Dynamical Systems, 2015
- 630 **Pierre Albin, Dmitry Jakobson, and Frédéric Rochon, Editors**, Geometric and Spectral Analysis, 2014
- 629 **Milagros Izquierdo, S. Allen Broughton, Antonio F. Costa, and Rubí E. Rodríguez, Editors**, Riemann and Klein Surfaces, Automorphisms, Symmetries and Moduli Spaces, 2014
- 628 **Anita T. Layton and Sarah D. Olson, Editors**, Biological Fluid Dynamics: Modeling, Computations, and Applications, 2014
- 627 **Krishnaswami Alladi, Frank Garvan, and Ae Ja Yee, Editors**, Ramanujan 125, 2014
- 626 **Veronika Furst, Keri A. Kornelson, and Eric S. Weber, Editors**, Operator Methods in Wavelets, Tilings, and Frames, 2014
- 625 **Alexander Barg and Oleg R. Musin, Editors**, Discrete Geometry and Algebraic Combinatorics, 2014
- 624 **Karl-Dieter Crisman and Michael A. Jones, Editors**, The Mathematics of Decisions, Elections, and Games, 2014
- 623 **Pramod N. Achar, Dijana Jakelić, Kailash C. Misra, and Milen Yakimov, Editors**, Recent Advances in Representation Theory, Quantum Groups, Algebraic Geometry, and Related Topics, 2014
- 622 **S. Ejaz Ahmed, Editor**, Perspectives on Big Data Analysis, 2014
- 621 **Ludmil Katzarkov, Ernesto Lupercio, and Francisco J. Turrubiates, Editors**, The Influence of Solomon Lefschetz in Geometry and Topology, 2014
- 620 **Ulrike Tillmann, Søren Galatius, and Dev Sinha, Editors**, Algebraic Topology: Applications and New Directions, 2014
- 619 **Gershon Wolansky and Alexander J. Zaslavski, Editors**, Variational and Optimal Control Problems on Unbounded Domains, 2014
- 618 **Abba B. Gumel, Editor**, Mathematics of Continuous and Discrete Dynamical Systems, 2014
- 617 **Christian Ausoni, Kathryn Hess, Brenda Johnson, Wolfgang Lück, and Jérôme Scherer, Editors**, An Alpine Expedition through Algebraic Topology, 2014
- 616 **G. L. Litvinov and S. N. Sergeev, Editors**, Tropical and Idempotent Mathematics and Applications, 2014
- 615 **Plamen Stefanov, András Vasy, and Maciej Zworski, Editors**, Inverse Problems and Applications, 2014
- 614 **James W. Cogdell, Freydoon Shahidi, and David Soudry, Editors**, Automorphic Forms and Related Geometry, 2014
- 613 **Stephan Stolz, Editor**, Topology and Field Theories, 2014
- 612 **Patricio Cifuentes, José García-Cuerva, Gustavo Garrigós, Eugenio Hernández, José María Martell, Javier Parcet, Keith M. Rogers, Alberto Ruiz, Fernando Soria, and Ana Vargas, Editors**, Harmonic Analysis and Partial Differential Equations, 2014
- 611 **Robert Fitzgerald Morse, Daniela Nikolova-Popova, and Sarah Witherspoon, Editors**, Group Theory, Combinatorics, and Computing, 2014
- 610 **Pavel Etingof, Mikhail Khovanov, and Alistair Savage, Editors**, Perspectives in Representation Theory, 2014
- 609 **Dinh Van Huynh, S. K. Jain, Sergio R. López-Permouth, S. Tariq Rizvi, and Cosmin S. Roman, Editors**, Ring Theory and Its Applications, 2014

For a complete list of titles in this series, visit the
AMS Bookstore at www.ams.org/bookstore/conmseries/.

This volume contains the proceedings of the International Conference on Recent Trends in Ergodic Theory and Dynamical Systems, in honor of S. G. Dani's 65th Birthday, held December 26–29, 2012, in Vadodara, India.

This volume covers many topics of ergodic theory, dynamical systems, number theory and probability measures on groups. Included are papers on Teichmüller dynamics, Diophantine approximation, iterated function systems, random walks and algebraic dynamical systems, as well as two surveys on the work of S. G. Dani.

ISBN 978-1-4704-0931-9



9 781470 409319

CONM/631

AMS on the Web
www.ams.org