CONTEMPORARY MATHEMATICS

666

Recent Advances in Partial Differential Equations and Applications

International Conference in honor of Hugo Beirão de Veiga's 70th Birthday Recent Advances in PDEs and Applications February 17-21, 2014 Levico Terme (Trento), Italy

> Vicențiu D. Rădulescu Adélia Sequeira Vsevolod A. Solonnikov Editors



Recent Advances in Partial Differential Equations and Applications















CONTEMPORARY MATHEMATICS

666

Recent Advances in Partial Differential Equations and Applications

International Conference in honor of Hugo Beirão de Veiga's 70th Birthday Recent Advances in PDEs and Applications February 17-21, 2014 Levico Terme (Trento), Italy

> Vicenţiu D. Rădulescu Adélia Sequeira Vsevolod A. Solonnikov Editors



EDITORIAL COMMITTEE

Dennis DeTurck, Managing Editor

Michael Loss Kailash Misra Catherine Yan

2010 Mathematics Subject Classification. Primary 35-06, 76-06; Secondary 35A01, 35B40, 35J60, 35K55, 35L70, 65N06, 76D05.

Library of Congress Cataloging-in-Publication Data

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

DOI: http://dx.doi.org/10.1090/conm/666

Recent advances in partial differential equations and applications : international conference in honor of Hugo Beirão da Veiga's 70th birthday, February 17-21, 2014, Levico Terme (Trento), Italy / Vicenţiu D. Rădulescu, Adélia Sequeira, Vsevolod A. Solonnikov, editors.

pages cm.— (Contemporary mathematics; volume 666)

Includes bibliographical references.

ISBN 978-1-4704-1521-1 (alk. paper)

1. Differential equations, Partial-Congresses. I. Veiga, H. Beirão da (Hugo Beirão), 1943—II. Rădulescu, Vicențiu D., 1958— editor. III. Sequeira, A. (Adélia), editor. IV. Solonnikov, V. A. (Vsevolod Aleksevich), editor.

QA371.R34125 2016 515'.353-dc23

2015036428

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.

- © 2016 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/

 $10\; 9\; 8\; 7\; 6\; 5\; 4\; 3\; 2\; 1 \qquad \quad 21\; 20\; 19\; 18\; 17\; 16$

Contents

Preface	ix
Tributes to Hugo Beirão da Veiga Adélia Sequeira, João-Paulo Dias, Alberto Valli, Paolo Secchi Luigi Berselli, and Francesca Crispo	I, 1
Analyticity of the semi-group generated by the Stokes operator with Navier-type boundary conditions on L^p -spaces HIND AL BABA, CHÉRIF AMROUCHE, AND MIGUEL ESCOBEDO	23
Some results on systems for quantum fluids PAOLO ANTONELLI AND PIERANGELO MARCATI	41
Remarks on the inviscid limit for the compressible flows CLAUDE BARDOS AND TOAN T. NGUYEN	55
A generalization of Gauss' divergence theorem VIERI BENCI AND LORENZO LUPERI BAGLINI	69
Weak solutions to the Navier-Stokes equations constructed by semi-discretization are suitable LUIGI C. BERSELLI AND STEFANO SPIRITO	85
Existence theory for generalized Newtonian fluids D. Breit	99
The spectral drop problem GIUSEPPE BUTTAZZO AND BOZHIDAR VELICHKOV	111
On the vanishing theorems for the discretely self-similar solutions to the Hall equations $$	
Dongho Chae	137
A high regularity result of solutions to a modified p -Navier-Stokes system Francesca Crispo and Paolo Maremonti	151
General properties of the Helmholtz decomposition in spaces of L^q -type Reinhard Farwig, Christian Simader, Hermann Sohr, and Wern Varnhorn	ER 163
Conditional regularity of very weak solutions to the Navier-Stokes-Fourier system EDUARD FEIREISL AND YONGZHONG SUN	179
EDUARD FEIREISL AND YONGZHONG SUN	179

viii CONTENTS

Possible effect of noise on stretching mechanism Franco Flandoli	201
On the plane steady-state flow of a shear-thinning liquid past an obstacle in the singular case GIOVANNI P. GALDI AND CARLO R. GRISANTI	211
Sectorial Hamiltonians without zero resonance in one dimension VLADIMIR GEORGIEV AND ANNA RITA GIAMMETTA	225
Vortex stretching and anisotropic diffusion in the 3D Navier-Stokes equations Z. Grujić	239
On L^q estimates of planar flows up to the boundary P. Kaplický	253
Non equilibrium diffusion limit in a barotropic radiative flow Bernard Ducomet and Šárka Nečasová	265
Decomposition of the homogeneous space $\hat{W}^{1,2}$ with respect to the Dirichlet form $\langle \nabla u, \nabla v \rangle$ and applications R. RAUTMANN	279
Convection in ternary porous layers with depth-dependent permeability and viscosity SALVATORE RIONERO	289
On a variational inequality for incompressible non-Newtonian thick flows FERNANDO MIRANDA AND JOSÉ FRANCISCO RODRIGUES	305
On inhomogeneous p -Navier—Stokes systems E. Molitor and M. Růžička	317
On the global well-posedness of some free boundary problem for a compressible barotropic viscous fluid flow $$\operatorname{Yoshihiro}$$ Shibata	341
On a free boundary problem of magnetohydrodynamics for a viscous incompressible fluid not subjected to capillary forces V. A. SOLONNIKOV	357
Relative entropy and contraction for extremal shocks of conservation laws up to a shift ALEXIS F. VASSEUR	385

Preface

This volume contains the proceedings of the International Conference on Recent Advances in PDEs and Applications, held from February 17th to February 21st, 2014 in Levico Terme, Italy, in honor of Hugo Beirão da Veiga's 70th birthday.

The conference brought together leading experts and researchers in nonlinear partial differential equations to promote research and to stimulate interactions among the participants. The workshop program testified to the wide-ranging influence of Hugo Beirão da Veiga on the field of partial differential equations, in particular those related to fluid dynamics.

In his own work, Hugo Beirão da Veiga has been a seminal influence in many important areas: Navier-Stokes equations, Stokes systems, non-Newtonian fluids, Euler equations, regularity of solutions, perturbation theory, vorticity phenomena, and nonlinear potential theory, as well as various degenerate or singular models in mathematical physics. This same breadth is reflected in the mathematical papers included in this volume.

Researchers in nonlinear partial differential equations will find much of interest in this volume.

Vicenţiu D. Rădulescu Adélia Sequeira Vsevolod A. Solonnikov

Selected Published Titles in This Series

- 667 Mark L. Agranovsky, Matania Ben-Artzi, Greg Galloway, Lavi Karp, Dmitry Khavinson, Simeon Reich, Gilbert Weinstein, and Lawrence Zalcman, Editors, Complex Analysis and Dynamical Systems VI: Part 2: Complex Analysis, Quasiconformal Mappings, Complex Dynamics, 2016
- 666 Vicenţiu D. Rădulescu, Adélia Sequeira, and Vsevolod A. Solonnikov, Editors, Recent Advances in Partial Differential Equations and Applications, 2016
- 665 Helge Glöckner, Alain Escassut, and Khodr Shamseddine, Editors, Advances in Non-Archimedean Analysis, 2016
- 664 Dihua Jiang, Freydoon Shahidi, and David Soudry, Editors, Advances in the Theory of Automorphic Forms and Their L-functions, 2016
- 663 David Kohel and Igor Shparlinski, Editors, Frobenius Distributions: Lang-Trotter and Sato-Tate Conjectures, 2016
- 662 Zair Ibragimov, Norman Levenberg, Sergey Pinchuk, and Azimbay Sadullaev, Editors, Topics in Several Complex Variables, 2016
- 661 Douglas P. Hardin, Doron S. Lubinsky, and Brian Z. Simanek, Editors, Modern Trends in Constructive Function Theory, 2016
- 660 Habib Ammari, Yves Capdeboscq, Hyeonbae Kang, and Imbo Sim, Editors, Imaging, Multi-scale and High Contrast Partial Differential Equations, 2016
- 659 Boris S. Mordukhovich, Simeon Reich, and Alexander J. Zaslavski, Editors, Nonlinear Analysis and Optimization, 2016
- 658 Carlos M. da Fonseca, Dinh Van Huynh, Steve Kirkland, and Vu Kim Tuan, Editors, A Panorama of Mathematics: Pure and Applied, 2016
- 657 Noé Bárcenas, Fernando Galaz-García, and Mónica Moreno Rocha, Editors, Mexican Mathematicians Abroad, 2016
- 656 José A. de la Peña, J. Alfredo López-Mimbela, Miguel Nakamura, and Jimmy Petean, Editors, Mathematical Congress of the Americas, 2016
- 655 A. C. Cojocaru, C. David, and F. Pappalardi, Editors, SCHOLAR—a Scientific Celebration Highlighting Open Lines of Arithmetic Research, 2015
- 654 Carlo Gasbarri, Steven Lu, Mike Roth, and Yuri Tschinkel, Editors, Rational Points, Rational Curves, and Entire Holomorphic Curves on Projective Varieties, 2015
- 653 Mark L. Agranovsky, Matania Ben-Artzi, Greg Galloway, Lavi Karp, Dmitry Khavinson, Simeon Reich, Gilbert Weinstein, and Lawrence Zalcman, Editors, Complex Analysis and Dynamical Systems VI: Part 1: PDE, Differential Geometry, Radon Transform, 2015
- 652 Marina Avitabile, Jörg Feldvoss, and Thomas Weigel, Editors, Lie Algebras and Related Topics, 2015
- 651 Anton Dzhamay, Kenichi Maruno, and Christopher M. Ormerod, Editors, Algebraic and Analytic Aspects of Integrable Systems and Painlevé Equations, 2015
- 650 Jens G. Christensen, Susanna Dann, Azita Mayeli, and Gestur Ólafsson, Editors, Trends in Harmonic Analysis and Its Applications, 2015
- 649 Fernando Chamizo, Jordi Guàrdia, Antonio Rojas-León, and José María Tornero, Editors, Trends in Number Theory, 2015
- 648 Luis Álvarez-Cónsul, José Ignacio Burgos-Gil, and Kurusch Ebrahimi-Fard, Editors, Feynman Amplitudes, Periods and Motives, 2015
- 647 Gary Kennedy, Mirel Caibăr, Ana-Maria Castravet, and Emanuele Macrì, Editors, Hodge Theory and Classical Algebraic Geometry, 2015
- 646 Weiping Li and Shihshu Walter Wei, Editors, Geometry and Topology of Submanifolds and Currents, 2015
- 645 Krzysztof Jarosz, Editor, Function Spaces in Analysis, 2015

This volume contains the proceedings of the International Conference on Recent Advances in PDEs and Applications, in honor of Hugo Beirão da Veiga's 70th birthday, held from February 17–21, 2014, in Levico Terme, Italy.

The conference brought together leading experts and researchers in nonlinear partial differential equations to promote research and to stimulate interactions among the participants. The workshop program testified to the wide-ranging influence of Hugo Beirão da Veiga on the field of partial differential equations, in particular those related to fluid dynamics.

In his own work, da Veiga has been a seminal influence in many important areas: Navier-Stokes equations, Stokes systems, non-Newtonian fluids, Euler equations, regularity of solutions, perturbation theory, vorticity phenomena, and nonlinear potential theory, as well as various degenerate or singular models in mathematical physics. This same breadth is reflected in the mathematical papers included in this volume.

