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Christoph Egbers Gerd Pfister (Eds.)

Physics of Rotating Fluids

Selected Topics of the 11th International
Couette–Taylor Workshop
Held at Bremen, Germany, 20–23 July 1999



Springer

Editors

Christoph Egbers
Lehrstuhl Aerodynamik und Strömungslehre
Fakultät Maschinenbau, Elektrotechnik
und Wirtschaftsingenieurwesen
Brandenburgisch Technische Universität Cottbus
03013 Cottbus

Gerd Pfister
Institut für Experimentelle und Angewandte Physik
Universität Kiel
Olshausenstrasse 40
24098 Kiel, Germany

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Preface

“Lecture Notes in Physics”, having a strong publishing history in fundamental physics research, has devoted a special volume to recent developments in the field of physics of rotating fluids and related topics. The present volume will comprise 23 contributed papers on the different aspects of rotating fluids, i.e. Taylor–Couette flow, spherical Couette flow, plane Couette flow, as well as rotating annulus flow.

In the seminal paper by G.I. Taylor, a powerful combination of theory and experiment was brought to bear on the stability of flow between rotating cylinders, now referred to as Taylor–Couette flow. The significance of his work lies in the fact that here, for the first time, an experiment in fluid dynamics and the theory, using the Navier–Stokes equations, could be compared and led to excellent agreement. Since that time ideas associated with rotating flows have been extended and have resulted in classic texts such as Greenspan’s “The theory of rotating fluids”.

In this present book we report on modern developments in the field where new mathematical ideas have been applied to experimental observations on a variety of related flow fields.

The aim of this volume is to provide the reader with a comprehensive overview of the current state of the art and possible future directions of the Taylor–Couette community and to include related topics and applications.

The first part of this volume is devoted to several new results in the classical Taylor–Couette problem covering diverse theoretical, experimental and numerical works on bifurcation theory, the influence of boundary conditions, counter-rotating flows, spiral vortices, time-periodic flows, low dimensional dynamics, axial effects, secondary bifurcations, spatiotemporal intermittency, Taylor–Couette flows with axial and radial flow, Taylor vortices at different geometries and transport phenomena in magnetic fluids.

The second part of this volume focuses on spherical Couette flows, including isothermal flows, vortical structures, spiral and wavy vortices, the influence of throughflow, thermal convective motions, intermittency at the onset of convection, as well as magneto-hydrodynamics in spherical shells.

Further parts are devoted to Goertler vortices and flows along curved surfaces, rotating annulus flows, as well as superfluid Couette flows, tertiary and quarternary solutions for plane Couette flows with thermal stratification and rotating disk flows.

We hope that the readers will find this volume useful, giving an overview of the latest experimental and theoretical studies on the physics of rotating fluids.

It is a pleasure for us to thank all those who contributed to the conference “11th International Couette–Taylor Workshop” and, by the same token, to this volume. We would like to thank the Dipl. Phys. Oliver Meincke, Markus Junk, Arne Schulz and Jan Abshagen for their invaluable and indispensable help in editing this book.

Last, but not least, we are grateful to Dr. Christian Caron for offering to publish this volume in the Springer Series “Lecture Notes in Physics” and for the patient assistance of Mrs. Brigitte Reichel-Mayer.

Bremen, Kiel
August 2000

Christoph Egbers
Gerd Pfister

List of Contributors

Jan Abshagen

Universität Kiel
Institut für Experimentelle und
Angewandte Physik
Olshausenstrasse 40
24098 Kiel
Germany
jan@ang-physik.uni-kiel.de

Eberhard Bänsch

Zentrum für Technomathematik
Universität Bremen
Postfach 33 04 40
28334 Bremen
Germany
baensch@math.uni-bremen.de

Carlo F. Barenghi

Dept. of Mathematics and Statistics
The University of Newcastle Upon
Tyne
Newcastle Upon Tyne NE1 7RU
United Kingdom
C.F.Barenghi@newcastle.ac.uk

John H. Bolstad

Laurence Livermore National
Laboratory
L-23, University of California
POB 808
Livermore, CA 94550
USA
bolstad@l11-crg.llnl.gov

Friedrich Busse

Universität Bayreuth

Physikalisches Institut
95440 Bayreuth
Germany
busse@uni-bayreuth.de

Pascal Chossat

Université de Nice
Sophia Antipolis
I.N.L.N.
1361, route des lucioles
06560 Sophia Antipoli
France
chossat@inln.cnrs.fr

R.M. Clever

Institute of Geophysics and Planetary
Physics
University of California
Los Angeles
USA

Antonio Delgado

TU München
Lehrstuhl für Fluidmechanik und
Prozessautomation
Weihenstephaner Steig 23
85350 Freising
Germany
delgado@lfp.blm.tu-muenchen.de

Christoph Egbers

ZARM
Universität Bremen
Am Fallturm
28359 Bremen
Germany
egbers@zarm.uni-bremen.de

Afshin Goharzadeh
Université du Havre
Laboratoire de Mécanique
Groupe d’Énergétique et Mécanique
25, rue Philippe Lebon, B.P. 540
76058 Le Havre Cedex
France
goharzadeh@univ-lehavre.fr

Genrich R. Grek
Russian Academy of Sciences,
Siberian Division
Institute of Theoretical and Applied
Mechanics
630090 Novosibirsk
Russia
grek@itam.nsc.ru

Christoph Hartmann
TU München
Lehrstuhl für Fluidmechanik und
Prozessautomation
Weihenstephaner Steig 23
85350 Freising
Germany
hartmann@lfp.blm.tu-muenchen.de

Rainer Hollerbach
University of Glasgow
Department of Mathematics
15 University Gardens
Glasgow G12 8QW
United Kingdom
rainer@maths.gla.ac.uk

Markus Junk
ZARM
Universität Bremen
Am Fallturm
28359 Bremen
Germany
junk@zarm.uni-bremen.de

Victor V. Kozlov
Russian Academy of Sciences,
Siberian Division

Institute of Theoretical
and Applied Mechanics
630090 Novosibirsk
Russia
kozlov@itam.nsc.ru

Patrice Laure
Institut Non-Linéaire de Nice
UMR 129 CNRS-Université de Nice,
1361, route des Lucioles
06560 Valbonne
France
laure@inln.cnrs.fr

Ming Liu
ZARM
Universität Bremen
Am Fallturm
28359 Bremen
Germany
ming.liu@promis.com

Manfred Lücke
Institut für Theoretische Physik
Universität des Saarlandes
66041 Saarbrücken
Germany
luecke@lusi.uni-sb.de

Richard M. Lueptow
Northwestern University
Dept. of Mechanical Engineering
2145 Sheridan Road
Evanston, IL 60208-3111
USA
r-lueptow@nwu.edu

Francesc Marquès
Universitat Politècnica de Catalunya
Departament de Física Aplicada
Jordi Girona Salgado s/n
Mòdul B4 Campus Nord
08034 Barcelona, Spain
Spain
marques@chandra.upc.es

Oliver Meincke
 ZARM
 Universität Bremen
 Am Fallturm
 28359 Bremen
 Germany
 meincke@zarm.uni-bremen.de

Álvaro Meseguer
 Oxford University
 Computing Laboratory
 Numerical Analysis Group
 Wolfson Building, Parks Road
 Oxford OX1 3QD
 United Kingdom
 alvaro@comlab.ox.ac.uk

Rita Meyer-Spasche
 MPI für Plasmaphysik
 EURATOM-Association
 85748 Garching
 Germany
 meyer-spasche@ipp-garching.mpg.de

Innocent Mutabazi
 Université du Havre
 Laboratoire de Mécanique
 Groupe d'Energétique et Mécanique
 25, rue Philippe Lebon, B.P. 540
 76058 Le Havre Cedex
 France
 mutabazi@univ-lehavre.fr

Tom Mullin
 Department of Physics and Astronomy
 The University of Manchester
 Manchester M13 9PL
 United Kingdom
 tom@reynolds.ph.man.ac.uk

Koichi Nakabayashi
 Nagoya Institute of Technology
 Department of Mechanical
 Engineering
 Gokiso-Cho, Showa-Ku
 Nagoya, 466-8555

Japan
 nakabaya@cfm.mech.nitech.ac.jp

Christiane Normand
 C.E.A./Saclay,
 Service de Physique Théorique
 91191 Gif-sur-Yvette Cedex
 France
 normand@spht.saclay.cea.fr

Stefan Odenbach
 ZARM
 Universität Bremen
 Am Fallturm
 28359 Bremen
 Germany
 odenbach@zarm.uni-bremen.de

Gerd Pfister
 Universität Kiel
 Institut für Experimentelle und
 Angewandte Physik
 Olshausenstrasse 40
 24098 Kiel
 Germany
 pfister@ang-physik.uni-kiel.de

Frank Pohl
 MPI für Plasmaphysik
 EURATOM-Association
 85748 Garching
 Germany

Doug Satchwell
 Department of Physics and Astronomy
 The University of Manchester
 Manchester M13 9PL
 United Kingdom
 satch@reynolds.ph.man.ac.uk

Arne Schulz
 Universität Kiel
 Institut für Experimentelle
 und Angewandte Physik
 Olshausenstrasse 40
 24098 Kiel

XVIII List of Contributors

Germany
arne@ang-physik.uni-kiel.de

Nicoleta Dana Scurtu
Zentrum für Technomathematik
Universität Bremen
Postfach 33 04 40
28334 Bremen
Germany
scurtu@math.uni-bremen.de

Weiming Sha
Geophysical Institute
Graduate School of Science
Tohoku University
Aoba-Ku, Sendai, 980-8578
Japan
sha@wind.geophys.tohoku.ac.jp

Bernd Sitte
ZARM
Universität Bremen
Am Fallturm

28359 Bremen
Germany
sitte@zarm.uni-bremen.de

Yorinobu Toya
Nagano National College of
Technology
Department of Mechanical
Engineering
716 Tokuma
Nagano, 381-8550
Japan
toya@me.nagano-nct.ac.jp

Manfred Wimmer
Universität Karlsruhe
Fachgebiet Strömungsmaschinen
Kaiserstr. 12
76128 Karlsruhe
Germany
manfred.wimmer@mach.
uni-karlsruhe.de

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