



## SPRINGER PROCEEDINGS IN PHYSICS

---

- 97 **Fields, Networks,  
Computational Methods and Systems  
in Modern Electrodynamics**  
A Tribute to Leopold B. Felsen  
Editors: P. Russer and M. Mongiardo
- 98 **Particle Physics and the Universe**  
Proceedings of the 9th Adriatic Meeting,  
Sept. 2003, Dubrovnik  
Editors: J. Trampetić and J. Wess
- 99 **Cosmic Explosions**  
On the 10th Anniversary of SN1993J  
(IAU Colloquium 192)  
Editors: J. M. Marcaide and K. W. Weiler
- 100 **Lasers in the Conservation of Artworks**  
LACONA V Proceedings,  
Osnabrück, Germany, Sept. 15–18, 2003  
Editors: K. Dickmann, C. Fotakis,  
and J.F. Asmus
- 101 **Progress in Turbulence**  
Editors: J. Peinke, A. Kittel, S. Barth,  
and M. Oberlack
- 102 **Adaptive Optics  
for Industry and Medicine**  
Proceedings  
of the 4th International Workshop  
Editor: U. Wittrock
- 103 **Computer Simulation Studies  
in Condensed-Matter Physics XVII**  
Editors: D.P. Landau, S.P. Lewis,  
and H.-B. Schüttler
- 104 **Complex Computing-Networks**  
Brain-like and Wave-oriented  
Electrodynamical Algorithms  
Editors: I.C. Gökner and L. Sevgi
- 105 **Computer Simulation Studies  
in Condensed-Matter Physics XVIII**  
Editors: D.P. Landau, S.P. Lewis,  
and H.-B. Schüttler
- 106 **Modern Trends in Geomechanics**  
Editors: W. Wu and H.S. Yu
- 107 **Microscopy of Semiconducting Materials**  
Proceedings of the 14th Conference,  
April 11–14, 2005, Oxford, UK  
Editors: A.G. Cullis and J.L. Hutchison
- 108 **Hadron Collider Physics 2005**  
Proceedings of the 1st Hadron  
Collider Physics Symposium,  
Les Diablerets, Switzerland,  
July 4–9, 2005  
Editors: M. Campanelli, A. Clark,  
and X. Wu
- 109 **Progress in Turbulence 2**  
Proceedings of the iTi Conference  
in Turbulence 2005  
Editors: M. Oberlack et al.
- 110 **Nonequilibrium Carrier Dynamics  
in Semiconductors**  
Proceedings  
of the 14th International Conference, July  
25–29, 2005, Chicago, USA  
Editors: M. Saraniti, U. Ravaioli
- 111 **Vibration Problems ICOVP 2005**  
Editors: E. Inan, A. Kiris
- 112 **Experimental Unsaturated  
Soil Mechanics**  
Editor: T. Schanz
- 113 **Theoretical and Numerical  
Unsaturated Soil Mechanics**  
Editor: T. Schanz
- 114 **Advances in Medical Engineering**  
Editor: M.T. Buzug
- 115 **X-Ray Lasers 2006**  
Proceedings  
of the 10th International Conference,  
August 20–25, 2006, Berlin, Germany  
Editors: P.V. Nickles and K.A. Janulewicz
- 116 **Lasers in the Conservation of Artworks**  
LACONA VI Proceedings, Vienna/Austria,  
Sept. 21–25, 2005  
Editors: J. Nimmrichter, W. Kautek,  
and M. Schreiner
- 117 **Advances in Turbulence XI**  
Proceedings of the 11th EUROMECH  
European Turbulence Conference  
Editors: J.M.L.M. Palma and A. Silva Lopes

---

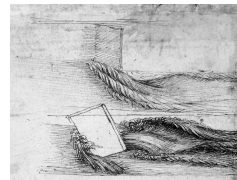
Volumes 71–96 are listed at the end of the book.

J. M. L. M. Palma  
A. Silva Lopes (Eds.)

# Advances in Turbulence XI

Proceedings of the 11th EUROMECH European  
Turbulence Conference, June 25-28, 2007  
Porto, Portugal

 Springer



J. M. L. M. Palma  
Faculdade de Engenharia  
da Universidade do Porto  
Rua Dr. Roberto Frias s/n  
4200-465 Porto  
Portugal  
jpalma@fe.up.pt

A. Silva Lopes  
Faculdade de Engenharia  
da Universidade do Porto  
Rua Dr. Roberto Frias s/n  
4200-465 Porto  
Portugal

Library of Congress Control Number: 2007928308

ISSN 0930-8989

ISBN 978-3-540-72603-6 Springer Berlin Heidelberg New York

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilm or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer. Violations are liable for prosecution under the German Copyright Law.

Springer is a part of Springer Science+Business Media  
springer.com

© Springer-Verlag Berlin Heidelberg 2007

The use of general descriptive names, registered names, trademarks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

Typesetting: Integra Software Services Pvt. Ltd., India  
Cover design: WMX Design, Heidelberg, Germany

Printed on acid-free paper SPIN: 11675709 45/3100/Integra 5 4 3 2 1 0



# Preface

This book comprises the written versions of all communications presented at ETC11, the 11<sup>th</sup> EUROMECH European Turbulence Conference, held at FEUP — Faculdade de Engenharia da Universidade do Porto, in Porto, Portugal, during June 25–28, 2007.

The history of the ETC conference series goes back to 1986, in Lyon, France. Latest editions were held in Barcelona (2000), Southampton (2002) and Trondheim (2004). The present edition is taking place after a three year gap, in order that, in the future, the two largest EUROMECH conferences in fluid mechanics and turbulence, EFMC and ETC, can occur in different years. During the last three years, there was time for announcing or losing the élan of previous editions of ETC11. The conference committee had many reasons to be apprehensive, but their concerns were put to rest by the large response of the community to the call of papers for ETC11. This also shows the need for a conference on turbulence along the lines of the previous edition of ETC and the establishment and appreciation of the conference by the research community in fluid mechanics and turbulence.

## Conference and Book Organisation

The book is organised as the conference programme. Chapters are called sessions and papers follow an order identical to their order of presentation within the session. A list of authors is provided at the end. In total, the book contains the written versions of 8 invited talks, 197 oral and 65 poster presentations.

## Paper Selection

A total of 443 abstracts, originating from 39 countries, were submitted for possible presentation at ETC11. Each abstract was scrutinised by three reviewers and marked on a scale of A to D. Considering the number of submissions and available space, only abstracts marked with a majority of A and Bs could be accepted. A total of 225 oral and 90 poster presentations were selected. Both the abstract submission and reviewing were carried out using web technologies, which facilitated much of the work and enabled us to inform the authors of the acceptance of their abstracts before the deadline. Final decisions and assessment of the reviewers' criteria were made at a meeting of the Conference Committee. Great care was put into the abstract selection, and we hope that this will be apparent during the four days of the conference from the quality of the presentations and from many fruitful meetings and discussions among the participants.

Turbulence is a topic of interest to a large community of researchers of different backgrounds. It is our hope that, apart from perpetuating the spirit of the ETC11, this book can also provide a source of knowledge and inspiration for some years to come.



# Acknowledgements

Several teams were put together in charge of aspects such as the conference web page, the electronic paper submission and evaluation, the conference registration, etc. Because it would be almost impossible to name them all, we express here our gratitude to those at different units within FEUP, namely the multimedia unit for producing all documents related to the conference announcements and graphic image, the computer centre for their support and assistance in the conference rooms and the economical and financial unit for taking care of all procedures required by the sponsors that also made possible the organisation of ETC11.

One person should be mentioned here to whom we are particularly grateful: our colleague João Correia Lopes, for his enthusiasm, availability at all times, support and experience in the use of Cyberchair, the web-based system used in electronic submission.

We are most grateful to the European Commission through the Marie Curie programme, by making possible the award of 162 grants that lowered the financial burden of many participants. The University of Porto (the Rector) and the Portuguese-American Foundation (FLAD) partly supported the expenses of some of the invited speakers.

Last but not least, we must thank all the authors for their contribution, which is the main purpose of the conference.

Porto, March 2007

José M. Laginha M. Palma  
Alexandre Silva Lopes

## Additional Reviewers

Jean-Pierre Bertoglio  
Fabien S. Godeferd  
Mikhael Gorokhovski  
Lionel Le Penven  
Benoit Pier

Frédéric Plaza  
Florence Raynal  
Liang Shao  
Serge Simoens



# Contents

## Invited Speaker I

Experimental Measurements of Lagrangian Statistics in Intense Turbulence ...1

*H. Xu, N.T. Ouellette, H. Nobach and E. Bodenschatz*

## Session 1.1: Lagrangian dynamics in turbulence/inertial particles (I)

Tracer Particles in Turbulent Superfluid Helium ..... 11

*Y.A. Sergeev, C.F. Barenghi and D. Kivotides*

Particle Dispersion in Stably Stratified Turbulence ..... 14

*M. van Aartrijk and H.J.H. Clercx*

Is It Possible to Study Euler (or Inviscid/Purely Inertial) Evolution  
in Low Reynolds Number Flows? ..... 17

*B. Galanti, D. Gendler-Fishman and A. Tsinober*

## Session 2.1: MHD turbulence (I)

Large Eddy Simulations of Compressible Magnetohydrodynamic  
Turbulence in Heat-Conducting Plasma ..... 20

*A.A. Chernyshov, K.V. Karelsky and A.S. Peretrosyan*

The Effect of a Finite Cascade Time on the  
Normalized Energy Dissipation ..... 23

*W. Bos, L. Shao and J.-P. Bertoglio*

Anisotropy in Three-Dimensional MHD Turbulence ..... 26

*B. Bigot, S. Galtier and H. Politano*

## Session 3.1: Instability and transition (I)

Receptivity to Roughness and Vortical Free-Stream Modes ..... 29

*L.-U. Schrader, L. Brandt and D.S. Henningson*

Secondary Instability in Variable-Density Round Jets ..... 32

*J.W. Nichols, J.-M. Chomaz and P.J. Schmid*

Axisymmetric Absolute Instability of Swirling Jets ..... 35

*J.J. Healey*

**Session 4.1: Wall bounded flows (I)**

Turbulent Boundary Layer Drag Reduction with Polymer Injection . . . . . 38  
*Y.X. Hou, V.S.R. Somandepalli and M.G. Mungal*

Characterisation of Marginally Turbulent Square Duct Flow . . . . . 41  
*M. Uhlmann, A. Pinelli, A. Sekimoto and G. Kawahara*

Turbulent Structure in Rough and Smooth Wall Boundary Layers . . . . . 44  
*R.J. Volino, M.P. Schultz and K.A. Flack*

**Invited Speaker II**

Wall-Layer Models for Large-Eddy Simulations of High-Reynolds Number  
 Non-Equilibrium Flows . . . . . 47  
*U. Piomelli, S. Radhakrishnan, L. Zhong and M. Li*

**Session 1.2: Lagrangian dynamics in turbulence/inertial particles (II)**

Trajectories of Solid Particles in a Tangle of Vortex-Filaments . . . . . 55  
*A.J. Mee, D. Kivotides, C.F. Barenghi and Y.A. Sergeev*

Quantifying Turbulent Dispersion by Means of Exit Times . . . . . 58  
*B.J. Devenish and D.J. Thomson*

Settling Velocity of Inertial Particles . . . . . 61  
*A. Celani, M. Martins Afonso and A. Mazzino*

Backwards/Forwards Dispersion and Inertial Range Stretching Rates . . . . 64  
*J. Berg*

**Session 2.2: MHD turbulence (II)**

Multiscale Analysis of Convective Magnetic Systems in a  
 Horizontal Layer . . . . . 67  
*M. Baptista, S.M.A. Gama and V.A. Zheligovsky*

Hall-MHD Turbulence in the Solar Wind . . . . . 70  
*S. Galtier and É. Buchlin*

Transition to Turbulence in Plane Channel Flow with Spanwise  
 Magnetic Field . . . . . 73  
*T. Boeck, D. Krasnov, M. Rossi and O. Zikanov*

Scaling Laws, Nonlocality and Structure in Isotropic  
Magnetohydrodynamic Turbulence ..... 76  
*T.A. Yousef, F. Rincon and A.A. Schekochihin*

**Session 3.2: Instability and transition (II)**

Absolute Instabilities and Transition to Turbulence in a Rotating Cavity.... 79  
*B. Viaud, E. Serre and J.M. Chomaz*

Recurrence of Travelling Waves in Transitional Pipe Flow ..... 82  
*R.R. Kerswell and O.R. Tutty*

Analysis of the Unsteady Flow Around a Wall-Mounted Finite Cylinder  
at Re=200 000 ..... 85  
*O. Frederich, M. Luchtenburg, E. Wassen and F. Thiele*

Transition in Plane Poiseuille Flow with a Stream-Wise Rotation ..... 88  
*M. Nagata and S. Masuda*

**Session 4.2: Wall bounded flows (II)**

DNS of Channel Flow with Pressure Gradient ..... 91  
*M. Marquillie, J.-P. Laval and R. Dolganov*

An Investigation into the Evolution of Sub-Layer Streaks in Two- and  
Three-Dimensional Turbulent Boundary Layers..... 94  
*K.L. Kudar, P.W. Carpenter and C. Davies*

Wall-Shear Stress Assessment in Zero-Pressure Gradient Turbulent Flow  
Using MPS<sup>3</sup> ..... 97  
*S. Große and W. Schröder*

Anomalous Turbulence in Rapidly Rotating Plane Couette Flow..... 100  
*M. Barri and H.I. Andersson*

**Session 1.3: Lagrangian dynamics in turbulence/inertial particles (III)**

Turbulent Clustering of Inertial Particles and Acceleration Field..... 103  
*S. Goto, J.C. Vassilicos and H. Yoshimoto*

Effect of the Reynolds Number and Initial Separation on Multi-Particle  
Sets Using Kinematic Simulation..... 106  
*A. Abou El-Azm Aly, F. Nicolleau and A. ElMaihy*

Lyapunov Exponents of Heavy Particles in Turbulent Flows ..... 109  
*J. Bec, L. Biferale, G. Boffetta, M. Cencini, S. Musacchio and F. Toschi*

Lagrangian Modeling and Alignment Trends of Vorticity with Pressure-Hessian Eigendirections in Turbulence..... 112  
*L. Chevillard and C. Meneveau*

Acceleration Statistics of Heavy Particles in Turbulent Flows ..... 115  
*A.S. Lanotte, J. Bec, L. Biferale, G. Boffetta, A. Celani, M. Cencini, S. Musacchio and F. Toschi*

**Session 2.3: MHD turbulence (III)**

Influence of large scale flow fluctuations on the dynamo threshold ..... 118  
*M. Peyrot, C. Fargant, F. Plunian, C. Normand and A. Courvoisier*

The Magnetoelliptic Instability in the Presence of Inertial Forces ..... 121  
*K. Mizerski and K. Bajer*

Instability and Transition to Turbulence in a Free Shear Layer Affected by a Parallel Magnetic Field ..... 124  
*A. Vorobei and O. Zikanov*

Kinetic Energy Repartition in MHD Turbulence..... 127  
*P. Burattini, M. Kinet, D. Carati and B. Knaepen*

**Session 3.3: Instability and transition (III)**

Critical (?) Behavior at the Turbulent-Laminar Transition in a Model of Plane Couette Flow ..... 130  
*P. Manneville and M. Lagha*

Interactions Between Finite-Length Streaks and Breakdown to Turbulence ..... 133  
*L. Brandt and H.C. de Lange*

Optimal Secondary Growth and Transition in a Plane Channel Flow ... 136  
*C. Cossu, M.P. Chevalier and D.S. Henningson*

Nonlinear Disturbance Evolution and Transition to Turbulence in a Compressible Swirling Mixing Layer..... 138  
*S.B. Müller and L. Kleiser*

Wake Influence on Boundary Layers Under Severe Adverse Pressure Gradients..... 141  
*M.P. Simens and J. Jiménez*



**Session 4.3: Wall bounded flows (III)**

Boundary Layer Structure in Highly Turbulent Convection ..... 144  
*R. du Puits, C. Resagk and A. Theiss*

Final States of Decaying 2D Turbulence in Different Geometries with  
 No-Slip Walls ..... 147  
*K. Schneider and M. Farge*

Near-Wall Measurements of Turbulence Statistics with Laser Doppler  
 Velocity Profile and Field Sensors ..... 150  
*K. Shirai, C. Bayer, A. Voigt, T. Pfister, L. Büttner and J. Czarske*

Detached Eddy Simulation of Flows Over Rough Surfaces ..... 153  
*A. Silva Lopes and J.M.L.M. Palma*

Theoretical Model of the Sub-Layer Streaks and the Cycle of Near-Wall  
 Turbulence for Application to Flow Control ..... 156  
*P.W. Carpenter, K.L. Kudar and P.K. Sen*

**Invited Speaker III**

Two-Dimensional Turbulence on a Confined Domain with No-Slip Walls... 159  
*G.J.F. van Heijst and H.J.H. Clercx*

**Session 1.4: Transport in quasi-2D-turbulence (I)**

Conformal Invariance in Two-Dimensional Turbulence ..... 164  
*G. Boffetta, D. Bernard, A. Celani and G. Falkovich*

Statistical Properties of 2D Turbulence on a Bounded Domain ..... 167  
*G.H. Keetels, H.J.H. Clercx and G.J.F. van Heijst*

Effect of Large Coherent Rings on Turbulent Field ..... 170  
*J.F. Krawczynski, L. Danaila, B. Renou and P.E. Dimotakis*

**Session 2.4: Instability and transition (IV)**

Quasi-Steady and Unsteady Goertler Vortices on Concave Wall:  
 Experiment and Theory. .... 173  
*A.V. Boiko, A.V. Ivanov, Y.S. Kachanov and D.A. Mischenko*

The Deterministic Wall Turbulence is Possible ..... 176  
*V.I. Borodulin, Y.S. Kachanov and A.P. Roschektayev*

The Effect of Free-Stream Turbulence on Growth and Breakdown of  
Tollmien-Schlichting Waves ..... 179  
*P. Schlatter, R. de Lange and L. Brandt*

**Session 3.4: Wall bounded flows (IV)**

Vortical Structures in Turbulent Plane Couette Flow ..... 182  
*A. Holstad, H.I. Andersson and B. Pettersen*

Wall Effects in Turbulent Rayleigh-Bénard Convection in a Long  
Rectangular Cell ..... 185  
*M. Kaczorowski, A. Shishkin and C. Wagner*

Master-Mode Set for 3D Turbulent Channel Flow ..... 188  
*S.I. Chernyshenko and M.E. Bondarenko*

**Session 4.4: Control of turbulent flows (I)**

Dilute Polymers in an Oscillating Grid Turbulent Flow ..... 191  
*A. Liberzon, U. Reiter, M. Holzner, M. Guala and W. Kinzelbach*

Transition Detection and Turbulence Measurements on Alinghi Yacht  
SUI-64 at Sea ..... 194  
*B. Tanguay, J. Bungener, F. Nivelletau and V. Nivelletau*

Numerical Analysis of the Excited Jets Using Large Eddy Simulation -  
Parametric Study ..... 197  
*A. Tyliczszak and A. Boguslawski*

**Session 1.5: Intermittency and scaling (I)**

Local Dissipation Scales in Turbulence ..... 200  
*J. Schumacher, K.R. Sreenivasan and V. Yakhot*

Intermittency via Self-Similarity in New Variables ..... 203  
*M.V. Melander*

Mixing of a Passive Scalar Emitted from a Random-in-Time  
Point Source ..... 206  
*A. Celani, M. Martins Afonso and A. Mazzino*

The Coupled LES - Subgrid Stochastic Acceleration Model  
(LES-SSAM) of a High Reynolds Number Flows ..... 209  
*V. Sabel'nikov, A. Chtab and M. Gorokhovski*

**Session 2.5: Instability and transition (V)**

Stereo-PIV of Sinuous and Varicose Breakdown ..... 212  
*J. Mans, M. Brouwers and H.C. de Lange*

Direct Numerical Simulation of Turbulent Taylor-Couette Flow with  
 High Reynolds Number ..... 215  
*W. He, M. Tanahashi and T. Miyauchi*

Tollmien-Schlichting Wave Cancellation Using an Oscillating  
 Lorentz Force ..... 218  
*T. Albrecht, H. Metzkes, G. Mutschke, R. Grundmann  
 and G. Gerbeth*

Temporal Dynamics of Small Perturbations for a 2D Growing Wake .... 221  
*S. Scarsoglio, D. Tordella and W.O. Criminale*

Mean Flow and Modeling of Turbulent-Laminar Patterns  
 in Plane Couette Flow ..... 224  
*L.S. Tuckerman and D. Barkley*

**Session 3.5: Wall bounded flows (V)**

Streamwise Velocity Fields in Fully Developed Turbulent Pipe and  
 Channel Flows Obtained Experimentally ..... 227  
*J.P. Monty, J.A. Stewart, R.C. Williams and M.S. Chong*

The Effect of the Sweep Angle on the Turbulent Separation Bubble  
 on a Flate Plate..... 230  
*A.H. Herbst, L. Brandt and D.S. Henningson*

Effects of the Streamwise Computational Domain Size on DNS of a  
 Turbulent Channel Flow at High Reynolds Number ..... 233  
*H. Abe, H. Kawamura, S. Toh and T. Itano*

On the Use of Taylor’s Hypothesis in Constructing Long Structures in  
 Wall-Bounded Turbulent Flow ..... 236  
*D.J.C. Dennis and T.B. Nickels*

Flow Development in Boundary Layers with Pressure Gradient ..... 239  
*K.A. Chauhan, H.M. Nagib and P.A. Monkewitz*

**Session 4.5: Vortex dynamics and structure formation (I)**

Dynamic Behaviour of a HALE Wing ..... 242  
*W.F.J. Olsman, R.R. Trieling, A. Hirschberg and G.J.F. van Heijst*

POD Analysis of Large-Scale Structures Through DNS of Turbulent Plane Couette Flow ..... 245  
*T. Tsukahara, K. Iwamoto and H. Kawamura*

Analysis of a Bursting Vortex Using Continuous and Orthogonal Wavelets ..... 248  
*J.E. Ruppert-Felsot, M. Farge and P. Petitjeans*

Flow Structure in a Bi-Axially Rotating Sphere: a Compact Turbulence Generator ..... 251  
*S. Kida, K. Nakayama and S. Goto*

PIV Study on the Turbulent Wake Behind Tapered Cylinders ..... 254  
*J. Visscher, B. Pettersen and H.I. Andersson*

**Invited Speaker IV**

Turbulence of Drag-Reducing Polymer Solutions..... 257  
*R. Piva, C.M. Casciola and E. De Angelis*

**Session 1.6: Transport in quasi-2D-turbulence (II)**

Stereoscopic-PIV Study of a Dipole in a Shallow Fluid Layer ..... 265  
*R.A.D. Akkermans, A.R. Cieslik, L.P.J. Kamp, H.J.H. Clercx and G.J.F. van Heijst*

Three-Dimensional Structures During a Dipole-Wall Collision in Shallow Flows ..... 268  
*A.R. Cieslik, R.A.D. Akkermans, L.P.J. Kamp, H.J.H. Clercx and G.J.F. van Heijst*

The Enstrophy Cascade in Bounded Two-Dimensional Turbulence..... 271  
*W. Kramer, H.J.H. Clercx and G.J.F. van Heijst*

Spectra of Quasi-2D Turbulence in Plasma and Fluid During Spectral Condensation ..... 274  
*M.G. Shats, H. Xia and H. Punzmann*

**Session 2.6: Turbulence in multiphase and non-Newtonian flows (I)**

Heat Transfer During Growth of a Boiling Bubble on the Wall in Turbulent Channel Flow ..... 277  
*J.G.M. Kuerten, C.W.M. van der Geld and B.P.M. van Esch*

Elastic Turbulence in 2D Viscoelastic Flows .....	280
<i>S. Berti, A. Bistagnino, G. Boffetta, A. Celani and S. Musacchio</i>	
Experimental Verification of a Theoretical Model for the Influence of Particle Inertia and Gravity on Decaying Turbulence in a Particle-Laden Flow .....	283
<i>G. Ooms, C. Poelma, M.J.B.M. Pourquie, J. Westerweel and P. Poesio Italy</i>	
Stationary States, Fluctuation-Dissipation Theorem and Effective Temperature in a Turbulent von Karman Flow .....	286
<i>R. Monchaux, P. Diribarne, P.-H. Chavanis, P. Diribarne, A. Chiffaudel, F. Daviaud and B. Dubrulle</i>	
<b>Session 3.6: Wall bounded flows (VI)</b>	
The Influence of External Turbulence on a Wall-Bounded Jet .....	289
<i>C. Poelma, F. Beati, J. Westerweel and J.C.R. Hunt</i>	
Comparison of Tensor Representations of Velocity-Pressure-Gradient, Pressure-Strain, and Pressure-Velocity Correlations with Plane Channel Flow DNS Data .....	292
<i>G.A. Gerolymos, D. S��n��chal, I. Vallet and B.A. Younis</i>	
Near Wall Measurements in Rough Surface Turbulent Boundary Layers .....	295
<i>B. Brzek, R.B. Cal, G. Johansson and L. Castillo</i>	
Reynolds Number Scaling of Particle Preferential Concentration in Turbulent Channel Flow .....	298
<i>C. Marchioli and A. Soldati</i>	
<b>Session 4.6: Vortex dynamics and structure formation (II)</b>	
Dissipative Structure in Multi Mode Stretched-Spiral Vortex .....	301
<i>K. Horiuti and T. Fujisawa</i>	
Modeling of a Turbulent Vortex Ring .....	304
<i>F. Kaplanski and Y. Rudi</i>	
Experimental Study of Longitudinal Horizontal Roll Vortices in a Convective Flow in Rectangular Box .....	307
<i>V. Batalov, P. Frick and A. Sukhanovsky</i>	
Nonlinear Evolution of Disturbed Vortex Rings .....	310
<i>Y. Hattori and Y. Fukumoto</i>	

**Session 1.7: Large eddy simulation and related techniques (I)**

LES of Turbulent Mixing in a Confined Coaxial Jet with 0.8 Velocity Ratio .....	313
<i>P.M. Areal and J.M.L.M. Palma</i>	
Turbulence and Energy Balance in an Axisymmetric Jet Computed by Large Eddy Simulation .....	316
<i>C. Bogey and C. Bailly</i>	
Shear-Improved Smagorinsky Model .....	319
<i>F. Toschi, E. L�ev�eque, L. Shao and J.-P. Bertoglio</i>	
Hybrid Two Level and Large-Eddy Simulation of Wall Bounded Turbulent Flows .....	322
<i>A.G. Gungor, M. Sanchez-Rocha and S. Menon</i>	
Finite Dimensional Models for Perturbed Self-Similar Turbulent Flows .....	325
<i>S.L. Woodruff and R. Rubinstein</i>	

**Session 2.7: Turbulence in multiphase and non-Newtonian flows (II)**

Turbulent Flow of Viscoelastic Shear-Thinning Liquids Through a Rectangular Duct .....	328
<i>M.P. Escudier, A.K. Nickson and R.J. Poole</i>	
Experimental Studies of Liquid-Liquid Dispersion in a Turbulent Shear Flow .....	331
<i>F. Ravelet, R. Delfos and J. Westerweel</i>	
Study on Flow Characteristics of Micro-Bubble Two-Phase Flow .....	334
<i>Z. Kawara, H. Yanagisawa, T. Kunugi and A. Serizawa</i>	
Velocity Statistics in Microbubble-Laden Turbulent Boundary Layer .....	337
<i>B. Jacob, A. Olivieri, M. Miozzi, E.F. Campana and R. Piva</i>	
Drag Reduction by Non-Brownian Rodlike Particles in a Channel Flow .....	340
<i>E. De Angelis and E.S.C. Ching</i>	

**Session 3.7: Wall bounded flows (VII)**

Use of Dual Plane PIV to Assess Scale-by-Scale Energy Budgets  
in Wall Turbulence ..... 343  
*N. Saikrishnan, E.K. Longmire, I. Marusic, N. Marati,  
C.M. Casciola and R. Piva*

Highly Time- and Space-Resolved Experiment on a High  
Reynolds Number Turbulent Boundary Layer ..... 346  
*M. Tutkun, P.B.V. Johansson, W.K. George, J. Kostas,  
S. Couderc, J.-M. Foucaut, M. Stanislas, C. Fourment, J. Delville*

Fully Mapped Energy Spectra in a High Reynolds Number Turbulent  
Boundary Layer ..... 349  
*N. Hutchins, I. Marusic and M.S. Chong*

Torque Scaling in Taylor-Couette Flow ..... 352  
*B. Eckhardt, S. Grossmann and D. Lohse*

Turbulent Shear Flows on a Sparse Grid ..... 355  
*F. De Lillo and B. Eckhardt*

**Session 4.7: Vortex dynamics and structure formation (III)**

Vortex Flows within Circular Cavities ..... 358  
*R. Savelsberg and I.P. Castro*

New Criteria for the Eduction of Three-Dimensional  
Turbulent Structures ..... 361  
*L. Larchevêque and M. Larchevêque*

Structure of a Tornado-Like Vortex ..... 364  
*K. Sassa, K. Yamashita and S. Takemura*

Self-Similar Structure Formation Process in Thermal Turbulence ..... 367  
*H. Yatou, T. Ogasawara, T. Matsumoto and S. Toh*

Vortex Dynamics in the Reattaching Flow of Separation Bubbles  
with Variable Aspect Ratio ..... 370  
*S. Courtine, A. Spohn and J.-P. Bonnet*

**Invited Speaker V**

LES of Compressible Inert and Reacting Turbulent Shear Flows ..... 373  
*R. Friedrich, S. Ghosh and I. Mahle*

**Session 1.8: Reacting and compressible turbulence**

- Coriolis Induced Compressibility Effects in Rotating Shear Layers ..... 383  
*B.J. Geurts, D.D. Holm and A.K. Kuczaj*
- DNS of the Interaction Between a Shock Wave and a Turbulent  
 Shear Flow ..... 386  
*M. Crespo, S. Jamme and P. Chassaing*
- Effects of Compressibility and Heat Release on the  
 Turbulent Mixing Layer Boundaries ..... 389  
*I. Mahle, J. Mathew and R. Friedrich*

**Session 2.8: Acoustic of turbulent flows**

- Dual-Time PIV Investigation of the Sound Producing region of the  
 Controlled and Uncontrolled High-Speed Jet ..... 392  
*J. Pinier and M. Glauser*
- Investigation of the Behavior of Noise Sources in Heated Jets ..... 395  
*P. Moore, H. Slot and B.J. Boersma*

**Session 3.8: Transport and mixing (I)**

- Dynamics of Spheres in Turbulent Channel Flow ..... 398  
*P.H. Mortensen, H.I. Andersson, J.J.J. Gillissen  
 and B.J. Boersma*
- Stereoscopic PIV Measurements in Electromagnetically Forced  
 Rotating Turbulence ..... 401  
*L.J.A. van Bokhoven, H.J.H. Clercx, G.J.F. van Heijst  
 and R.R. Trieling*
- Intermittency in the Miscible Rayleigh-Taylor Turbulence ..... 404  
*A. Celani, A. Mazzino and L. Vozella*

**Session 4.8: Large eddy simulation and related techniques (II)**

- Highly-Resolved Simulation of Flow Over a Three-dimensional Hill ..... 407  
*N. Li and M.A. Leschziner*
- A New Class of Symmetry Preserving and Thermodynamically  
 Consistent SGS Models ..... 410  
*D. Razafindralandy, A. Hamdouni and M. Oberlack*



A Turbulent-Energy Based Mesh Refinement Procedure for Large Eddy Simulation ..... 413  
*A. Naudin, L. Vervisch and P. Domingo*

**Session 1.9: Lagrangian dynamics in turbulence/inertial particles (IV)**

Bubbly Drag Reduction in Turbulent Taylor-Couette Flow ..... 416  
*D. Lohse, T.H. van den Berg, D.P.M. van Gils and D.P. Lathrop*

Concentration and Segregation of Particles and Bubbles by Turbulence ..... 418  
*E. Calzavarini, M. Cencini, D. Lohse and F. Toschi*

Clustering of Heavy Particles in Turbulent Flows ..... 421  
*J. Bec, L. Biferale, M. Cencini, A. Lanotte, S. Musacchio and F. Toschi*

Experimental Investigation of Turbulent Transport of Material Particles ..... 424  
*N. Qureshi, M. Bourgoïn, C. Baudet, A. Cartellier and Y. Gagne*

Shear Effect on Lagrangian Acceleration in High-Reynolds Number Turbulence ..... 427  
*Y. Tsuji*

**Session 2.9: Geophysical and astrophysical turbulence (I)**

The Fluid Mechanics of Gravitational Structure Formation ..... 429  
*C.H. Gibson*

DNS of Structural Vacillation in the Transition to Geostrophic Turbulence ..... 432  
*W.-G. Früh, P. Maubert, P.L. Read and A. Randriamampianina*

Stereo-PIV Measurements in Turbulent Rotating Convection ..... 435  
*R.P.J. Kunnen, B.J. Geurts and H.J.H. Clercx*

Lagrangian Statistics in Rotating Turbulence Through Particle Tracking Experiments ..... 438  
*L.D. Castello, H.J.H. Clercx, R.R. Trieling and L.J.A. van Bokhoven*

Turbulent Thermal Convection in a Vertical Channel - Correlation Length and Turbulent Momentum Exchanges ..... 441  
*M. Gibert, F. Chillà and B. Castaing*

**Session 3.9: Transport and mixing (II)**

Momentum and Heat Transfer in Turbulent Boundary Layers with External Grid Turbulence .....	444
<i>K. Nagata, Y. Sakai and S. Komori</i>	
Study on Jet Mixing Rate Based on Controlled Jets .....	447
<i>K. Tsujimoto, S. Kariya, T. Shakouchi and T. Ando</i>	
Mixing Study of a Jet in Crossflow Using Accurate Thermal Anemometry Techniques .....	450
<i>J.-P. Moro, P. Fougairolle and Y. Gagne</i>	
Experimental Study of Turbulent Transport of Particles in Non-Isothermal Flows and Formation of Large-Scale Structures .....	453
<i>A. Eidelman, T. Elperin, N. Kleorin, I. Rogachevskii and I. Sapir-Katiraie</i>	
A Theory of Relative Dispersion in Homogeneous Turbulence .....	456
<i>P. Franzese and M. Cassiani</i>	

**Session 4.9: Atmospheric turbulence (I)**

Experimental Study of Hysteresis Phenomenon in Turbulent Convection .....	459
<i>A. Eidelman, T. Elperin, N. Kleorin, I. Rogachevskii and I. Sapir-Katiraie</i>	
Velocity and Temperature Derivatives in High Reynolds Number Turbulent Flows in the Atmospheric Surface Layer .....	462
<i>G. Gulitski, M. Kholmyansky, W. Kinzelbach, B. Lüthi, A. Tsinober and S. Yorish</i>	
Role of Turbulence for Droplet Condensation .....	465
<i>A. Celani, A. Mazzino, A. Seminara and M. Tizzi</i>	
Kinematic Simulation and Rapid Distortion Theory, Analyses of One and Two-Particle Diffusion in Stably Stratified and Rotating Turbulence .....	468
<i>F. Nicolleau and G. Yu</i>	
Turbulent Flow Structure in the Similarity Region of a Swirling Jet ....	471
<i>A. Shiri, S. Toutiaei and W.K. George</i>	

**Invited Speaker VI**

Turbulent Modification of Upward Bubbly  
Channel Flow with Surfactant..... 474  
*T. Ogasawara, S. Takagi and Y. Matsumoto*

**Session 1.10: Lagrangian dynamics in turbulence/inertial particles (V)**

Turbulent Clustering of Inertial Particles in the Presence of Gravity .... 482  
*E. Hascoët and J.C. Vassilicos*

Acceleration Measurements in Turbulent-Like Flows..... 485  
*S. Ferrari, L. Rossi and J.C. Vassilicos*

Lagrangian Measurement Using Instrumented Particles  
in Rayleigh-Bénard Convection..... 488  
*W.L. Shew, Y. Gasteuil, J.-F. Pinton, R. Volk, M. Gibert,  
F. Chillá and B. Castaing*

Simultaneous Lagrangian and Eulerian Velocity Measurements  
in a Round Jet..... 491  
*P. Gervais, M. Bourgoïn, C. Baudet and Y. Gagne*

**Session 2.10: Intermittency and scaling (II)**

Stochastic Analysis and New Insights into Turbulence ..... 494  
*J. Peinke, A. Nawroth, S. Lüeck, M. Siefert and R. Friedrich*

On the Deficiency of Structure Functions as Inertial Range Diagnostics. 497  
*P.A. Davidson and P.-Å. Krogstad*

**Session 3.10: Transport and mixing (III)**

Isotropy of the Temperature Field Downstream of a Line  
Source in Turbulent Channel Flow ..... 500  
*L. Mydlarski, L. Danaïla and R.A. Lavertu*

One-Particle Dispersion in Turbulent Convection ..... 503  
*A. Bistagnino, G. Boffetta and A. Mazzino*

Spatial Distribution of the Heat Transport in Turbulent  
Rayleigh-Bénard Convection..... 506  
*O. Shishkina and C. Wagner*

Non-Oberbeck-Boussinesq Effects in Turbulent  
Rayleigh-Bénard Convection ..... 509  
*F.F. Araujo, S. Grossmann and D. Lohse*

**Session 4.10: Atmospheric turbulence (II)**

Wall Shear Stress Measurements in the Atmospheric Surface Layer ..... 511  
*I. Marusic, J.P. Monty, N. Hutchins and M.S. Chong*

Point (Sonic Anemometer) Measurements in a Gusty Wind Over  
Complex Terrain ..... 514  
*L.M.F. Ribeiro and J.M.L.M. Palma*

Atmospheric Surface Layer Turbulence Over Water Surfaces  
and Sub-Grid Scale Physics ..... 517  
*E. Bou-Zeid, H. Huwald, U. Lemmin, J.S. Selker, C. Meneveau  
and M.B. Parlange*

SNOHATS: Stratified Atmospheric Turbulence Over Snow Surfaces ..... 520  
*M.B. Parlange, E. Bou-Zeid, H. Huwald, M. Chamecki  
and C. Meneveau*

**Session 1.11: Lagrangian dynamics in turbulence/inertial particles (VI)**

The Effect of Persistent Separation in Turbulent Relative Dispersion:  
Self-Similar Telegraph Equation ..... 523  
*K. Kanatani, T. Ogasawara and S. Toh*

Statistics of Acceleration Field Motions in 2D Inverse-Cascading  
Turbulence ..... 526  
*F. Schwander, E. Hascoët and J.C. Vassilicos*

Probability Density Function (PDF) and Filtered Density  
Function (FDF) Methods for Turbulent Scalar Dispersion in  
Incompressible Flows ..... 529  
*M. Cassiani, J.D. Albertson and P. Franzese*

**Session 2.11: Intermittency and scaling (III)**

Probing Vortex Density Fluctuations in Superfluid Turbulence ..... 532  
*P.-E. Roche, B. Chabaud, O. Français, L. Rousseau  
and H. Willaime*

Contribution of Coherent and Incoherent Vorticity Fields to High Reynolds Number Homogeneous Isotropic Turbulence: a Wavelet Viewpoint..... 535  
*K. Yoshimatsu, N. Okamoto, K. Schneider, M. Farge and Y. Kaneda*

The Effect of Shear on Anisotropic Fluctuations in a Homogeneous Shear Flow..... 538  
*P. Gualtieri, B. Jacob, C.M. Casciola and R. Piva*

**Session 3.11: Transport and mixing (IV)**

Azimuthal Velocity Correlations in an Axisymmetric Far Wake..... 541  
*M. Tutkun, P.B.V. Johansson and W.K. George*

Mixing Characteristics in Buoyancy-Driven, Variable Density Turbulence ..... 544  
*D. Livescu and J.R. Ristorcelli*

Turbulent Von Kármán Swirling Flows ..... 547  
*S. Poncet, R. Schiestel and R. Monchoux*

**Session 4.11: Stability and flow control**

On the Global Linear Stability of the Boundary Layer on Rotating Bodies ..... 550  
*S.J. Garrett and N. Peake*

The Modulated Dissipation Rate in Periodically Forced Turbulence..... 553  
*R. Rubinstein and W. Bos*

Lifetime of Turbulence in Pipe Flow..... 556  
*B. Hof, W. Tax and J. Westerweel*

Dynamics at the Edge of Chaos in Pipe Flow..... 559  
*T.M. Schneider and B. Eckhardt*

**Invited Speaker VII**

Transition and Transition Control in a Square Cavity ..... 562  
*P.J. Schmid*

**Session 1.12: Turbulence in multiphase and non-Newtonian flows (III)**

DNS on Drag Reduction by the Injection of Dilute Polymer Solution into a Buffer Region in Turbulent Water Channel Flow ..... 570

*S. Tatsumi and Y. Hagiwara*

Velocity-Gradient Modification in Particle-Laden Turbulent Channel Flows ..... 573

*M.J. Bijlard and L.M. Portela*

DNS of Drag Reduction by Dilute Polymer Solutions in a Turbulent Channel Flow ..... 576

*R. Akhavan and D.H. Lee*

**Session 2.12: Atmospheric turbulence (III)**

Turbulent Mixing in the Atmospheric Boundary Layer: from Flat Terrain to Narrow Valley ..... 579

*C. Chemel and J.-P. Chollet*

GCM Representation of Turbulence on Jupiter ..... 582

*L.C. Zuchowski, Y.H. Yamazaki and P.L. Read*

Vorticity and Divergence Spectra in the Upper Troposphere and Lower Stratosphere ..... 585

*E. Lindborg*

**Session 3.12: Transport and mixing (V)**

On the Accuracy of Velocity and Velocity Gradient Turbulence Statistics Measured with Multi-Sensor Hot-Wire Probes .... 588

*P.V. Vukoslavčević, N. Beratlis, E. Balaras and J.M. Wallace*

A Stochastic SGS Model with Application to Turbulent Channel Flow with a Passive Scalar ..... 591

*L. Marstorp, G. Brethouwer and A.V. Johansson*

Heat Transfer Across the Air-Water Interface in Wind-Driven Turbulence ..... 594

*S. Ohtsubo, K. Tanno and S. Komori*

**Session 4.12: Wall bounded flows (VIII)**

Attenuation of Turbulent Flow Separation on a Wavy Wall by a Compliant Surface ..... 597

*H. Zhang, N. Yoshitake and Y. Hagiwara*

Turbulent Flow in Eccentric Annular Pipe..... 600  
*N. Nikitin*

Quasi-Normal Hypothesis Revised..... 603  
*A. Maurizi*

**Session 1.13: Geophysical and astrophysical turbulence (II)**

Coherent Large-Scale Flow Structures in Turbulent Convection ..... 606  
*C. Resagk, R. du Puits, E. Lobutova, A. Maystrenko and A. Thess*

Large-Scale Behaviour of Turbulent Convection Governed by  
 Low-Dimensional Fixed-Points ..... 609  
*M.K. Verma, J.J. Niemela, K. Kumar, S. Paul and D. Carati*

Structure Formation in Homogeneous Rotating Turbulence..... 612  
*P.J. Staplehurst, P.A. Davidson and S.B. Dalziel*

Differential Diffusion in Double-Diffusive Stratified Turbulence ..... 615  
*H. Hanazaki and K. Konishi*

Generation of Waves by Shear Turbulence at an Air-Water Interface ... 618  
*M. Teixeira and S. Belcher*

**Session 2.13: Large eddy simulation and related techniques (III)**

Modeling of Multipoint Correlations in Turbulent Flows..... 621  
*H. Chang, A. Bhattacharya, S.C. Kassinos and R.D. Moser*

Over-Prediction of Energy Back-Scatter Due to Misaligned  
 Eigen-Frame of SGS Tensor ..... 624  
*B. Lüthi, S. Ott, J. Berg and J. Mann*

Large Eddy Simulation of Turbulent Separated Flow Over a  
 Three-Dimensional Hill..... 627  
*M. García-Villalba, T. Stoesser, D. von Terzi, J.G. Wissink,  
 J. Fröhlich and W. Rodi*

Large Eddy Simulations of Passive-Scalar Mixing Using a  
 Tensorial Eddy Diffusivity-Based SGS-Modeling ..... 630  
*Y. Huai, B. Kniesner, A. Sadiki and S. Jakirlić*

Near-Wake Decaying Turbulence Behind a Cross-Bar ..... 633  
*L. Djenidi and P. Lavoie*

**Session 3.13: Transport and mixing (VI)**

- Penetrative Convection in Stratified Fluids: Velocity Measurements  
by Image Analysis Techniques ..... 636  
*A. Cenedese, V. Dore and M. Moroni*
- Enstrophy, Strain and Scalar Gradient Dynamics Across the  
Turbulent-Nonturbulent Interface in Jets ..... 639  
*C.B. da Silva and J.C.F. Pereira*
- Numerical Study of Non-Oberbeck-Boussinesq Effects on the  
Heat Transport in Turbulent Rayleigh-Bénard Convection in Liquids ... 642  
*K. Sugiyama, E. Calzavarini and D. Lohse*
- Ultimate Regime of Convection: Search for a  
Hidden Triggering Parameter ..... 645  
*F. Gauthier, B. Hébral, J. Muzellier and P.-E. Roche*
- Scalar Diffusion of Horizontally Released Heated Plume into  
a Turbulent Shear Flow ..... 648  
*Y. Ito and S. Komori*

**Session 4.13: Control of turbulent flows (II)**

- Estimation Techniques in a Turbulent Flow Field ..... 650  
*J. Ausseur, J. Pinier and M. Glauser*
- Turbulence Generated by Fractal Grids in the Wind Tunnel ..... 653  
*R.E.E. Seoud and J.C. Vassilicos*
- Large Eddy Simulations of Electromagnetically Driven Vortical Flows .. 656  
*S. Kenjereš, J. Verdoold, A. Wibowo, C.R. Kleijn and K. Hanjalić*
- Skin-Friction Drag Reduction via Steady Streamwise Oscillations of  
Spanwise Velocity ..... 659  
*M. Quadrio, C. Viotti and P. Luchini*
- Direct Numerical Simulation on Turbulent Flow Around a Regularly  
Deforming Film ..... 662  
*K. Takashima, S. Koyama and Y. Hagiwara*

**Invited Speaker VIII**

- Progress in Large Eddy Simulation Modeling of Temporally and Spatially  
Complex Land-Atmosphere Interactions ..... 665  
*C. Meneveau, V. Kumar, S. Chester and M.B. Parlange*



**Session 1.14: Geophysical and astrophysical turbulence (III)**

Two-Dimensional Polar Beta Plane Turbulence..... 673  
*G.F. Carnevale, A. Cenedese, S. Espa and M. Mariani*

Laboratory Study of Gravity Wave Turbulence..... 676  
*P. Denissenko, S. Lukaschuk and S. Nazarenko*

Quantification of the Discretization Effects in the Representation  
of Key Inertial-wave Interactions in Rotating Turbulence..... 679  
*L. Bourouiba*

Anisotropy and Universality in Solar Wind Turbulence.  
Ulysses Spacecraft Data..... 682  
*A. Bigazzi, L. Biferale, S.M.A. Gama and M. Velli*

**Session 2.14: Atmospheric turbulence (IV)**

Turbulence Budgets in the Wind Flow Over Homogeneous Forests..... 685  
*J.C. Lopes da Costa, F.A. Castro, A.S. Lopes and J.M.L.M. Palma*

Laser Based Measurements of Profiles of Wind and Momentum  
Flux Over a Canopy..... 688  
*J. Mann, F. Bingöl, E. Dellwik and O. Rathmann*

Anomalous One- and Two-Particle Dispersion in  
Anisotropic Turbulence..... 691  
*F.S. Godeferd, L. Liechtenstein and C. Cambon*

Effects of Local Conditions on Smagorinsky and Dynamic  
Coefficients for LES of Atmospheric Turbulence..... 694  
*M. Chamecki, C. Meneveau and M.B. Parlange*

**Session 3.14: Transport and mixing (VII)**

Asymptotic Behaviour of the Shearless Turbulent Kinetic  
Energy Mixing..... 697  
*D. Tordella, M. Iovieno and P.R. Bailey*

Turbulence in the System of Two Immiscible Liquids..... 700  
*P. Denissenko and S. Lukaschuk*

Diffusion in Time-Dependent Laminar Flows with Multi-Scale Eulerian  
Flow Topology..... 703  
*P. Kewcharoenwong, L. Rossi and J.C. Vassilicos*

Dynamics of Scalar Injection in Freestream Turbulence ..... 706  
*E. Sanz, C. Nicot, R. Point and F. Plaza*

**Session 4.14: Control of turbulent flows (III)**

Direct Numerical Simulation of Pulsating Turbulent Channel Flow  
for Drag Reduction ..... 709  
*K. Iwamoto, N. Sasou and H. Kawamura*

Numerical Simulations of the Bursting of a Laminar Separation  
Bubble and its Relation to Airfoil Stall ..... 712  
*O. Marxen, D. You and P. Moin*

Fluctuations in the Bluff Body Wake – Modelling an Ultrafast  
Aircraft Thermometer ..... 715  
*K. Bajer, B. Rosa, K.E. Haman and T.S. Szoplík*

**Posters I: Acoustics of turbulent flows**

Velocity and Wall Pressure Correlations Over a Forward Facing Step ... 718  
*G. Aloisio, R. Camussi, A. Ciarravano, F. Di Felice,  
A. Di Marco, M. Felli, E. Fiorentini and F. Pereira*

**Posters II: Atmospheric turbulence**

Time Evolution of Thorpe Profiles Corresponding  
to Atmospheric Soundings ..... 719  
*J.L. Cano Marchante and P. López González-Nieto*

Divergent and Rotational Modes in Stratified Flows ..... 720  
*G. Brethouwer and E. Lindborg*

On the Secondary Kelvin-Helmholtz Instability in a 3D Stably  
Stratified Mixing Layer ..... 721  
*D.M.V. Martinez, E.B.C. Schettini and J.H. Silvestrini*

**Posters III: Control of turbulent flows**

Aerodynamic Flow Control of a Free Airfoil ..... 722  
*D.P. Brzozowski, J.R. Culp and A. Glezer*

Performance of Reynolds-Averaged Turbulence Models for Unsteady  
Separated Flows with Periodic Blowing and Suction ..... 723  
*M. Yoshio and K. Abe*

Turbulent Dissipation in Drag Reduced Flows ..... 724  
*B. Frohnapfel, J. Jovanović and A. Delgado*

**Posters IV: Instability and transition**

Instabilities of a Barotropic Rotating Shear Layer ..... 725  
*A. Aguiar and P.L. Read*

Nonlinear Development of Klebanoff Modes in a  
 Laminar Boundary Layer ..... 726  
*P. Ricco and X. Wu*

Primary Instability of a Rotating Spherical Couette Flow with a  
 Radial Stratification and a Radial Buoyancy ..... 727  
*M. Jenny and B. Nsom*

Onset of Turbulence in T-Jet Mixers ..... 728  
*E. Erkoç, R.J. Santos and J.C.B. Lopes*

Transitional Flow in Annular Rotating Cavity ..... 729  
*E. Tuluszka-Sznitko and A. Zielinski*

Nonlinear Evolution of the Zigzag Instability in a Stratified Fluid ..... 730  
*A. Deloncle, P. Billant and J.-M. Chomaz*

Compressibility Effects in the Rayleigh-Taylor Instability for  
 Miscible Fluids ..... 731  
*M.-A. Lafay, B. Le Creurer and S. Gauthier*

**Posters V: Intermittency and scaling**

Instanton Theory of Turbulent Vorticity Fluctuations ..... 732  
*L. Moriconi*

Closure for Anisotropic Homogeneous Turbulence as the Problem of  
 Analytical and Scaling Properties of Spectral Tensors ..... 733  
*S.R. Bogdanov*

**Posters VI: Large eddy simulation and related techniques**

On the Modelling of Subgrid-Scale Enstrophy Transfer in Turbulent  
 Channel Flows ..... 734  
*G. Hauët, C.B. da Silva and J.C.F. Pereira*

Group-Theoretical Model of Developed Turbulence and Renormalization of the Navier-Stokes Equation ..... 735  
*V.L. Saveliev and M. Gorokhovski*

Scaling Properties of Subgrid-Scale Energy Dissipation in Large Eddy Simulation ..... 736  
*S.G. Chumakov*

On Restraining the Convective Subgrid-Scale Production in Burgers' Equation ..... 737  
*J. Helder and R. Verstappen*

A LES-Langevin Model for Turbulence ..... 738  
*R. Dolganov, B. Dubrulle and J.-P. Laval*

Quality Assessment of Inlet Boundary Conditions and Domain Size for Fully Compressible LES of Wall-Jet Turbulent Mixing ..... 739  
*G. Lodato, P. Domingo and L. Vervisch*

Parametric Study of LES Subgrid Terms in Turbulent Phase Separation Flows ..... 740  
*J. Larocque, S. Vincent, D. Lacanette, P. Lubin, J.P. Caltagirone and P. Sagaut*

CVS of Turbulent Compressible Mixing Layers Using Adaptive Multiresolution Methods ..... 741  
*O. Roussel and K. Schneider*

URANS and Seamless Hybrid URANS/LES : The Forced Turbulent Temporal Mixing Layer ..... 742  
*S. Carpy and R. Manceau*

Thermal Boundary Layers Simulations Under Adverse Pressure Gradients ..... 743  
*G. Araya, K. Jansen and L. Castillo*

A Multi-Scale, Multi-Domain Approach to Wall-Modelling for LES of High Reynolds Number Wall-Bounded Turbulence ..... 744  
*R. Akhavan and M. Haliloglu*

**Posters VII: MHD turbulence**

RANS Modelling of Turbulent Flows Driven by a Travelling Magnetic Field ..... 745  
*P.A. Nikrityuk, K. Eckert and R. Grundmann*

Direct Numerical Simulation of Turbulent Flow in Travelling  
Magnetic Fields ..... 746  
*K. Koal, J. Stiller and R. Grundmann*

Turbulent Pipe Flow in a Transverse Magnetic Field: A Comparison  
Between PIV Measurement and DNS ..... 747  
*J. Takeuchi, S. Satake, T. Kunugi, T. Yokomine, N.B. Morley and  
M.A. Abdou*

Direct Numerical Simulations of the Turbulent Hartmann Flow in  
Cylindrical Ducts ..... 748  
*I.E. Sarris, Y. Detandt, C. Toniolo, A. Viré, M. Kinet,  
D. Carati, G. Degrez and B. Knaepen*

Numerical Simulation of a Longitudinal Lorentz Force Flowmeter for  
Turbulent Flows in a Circular Pipe ..... 749  
*B. Knaepen, A. Thess, E. Votyakov and O. Zikanov*

Experimental Investigation of Time-Dependent Flow Driven by a  
Travelling Magnetic Field ..... 750  
*A. Cramer, J. Pal, C. Zhang, S. Eckert and G. Gerbeth*

A Non Local Shell Model for MHD Turbulence ..... 751  
*R. Stepanov and F. Plunian*

**Posters VIII: Reacting and compressible turbulence**

Compressibility Effects on the Return to Isotropy of Homogeneous  
Anisotropic Turbulence ..... 752  
*M. Crespo, S. Jamme and P. Chassaing*

Large Eddy Simulation of a Tunnel Fire Using Two Step Combustion  
Chemistry ..... 753  
*R.J.A. Howard, N. Peres, D. Toporov and A.C.M. Sousa*

On Fast Chemical Reactions and Singular Vortices Advecting  
Multi-Scale Concentration Fields ..... 754  
*D. Martinand*

Front Surfaces in Turbulent Premixed Flames ..... 755  
*G. Troiani, M. Marrocco and C.M. Casciola*

**Posters IX: Transport and mixing**

Dispersion of Heavy Spheroidal Particles in 3D Turbulent-Like Flows ... 756  
*A. Domínguez, P. Chhabra and H.J.H. Clercx*

The Route Towards Isotropy in a Turbulent Jet ..... 757  
*M. Falchi and G.P. Romano*

Experimental Study of Turbulence in a Counter-Rotating Flow ..... 758  
*R. Morris and T.B. Nickels*

**Posters X: Turbulence in multiphase and non-Newtonian flows**

Stability of Upward and Downward Dusty-gas Flows  
in a Vertical Channel ..... 759  
*S.A. Boronin and A.N. Osipov*

Effect of Cationic Surfactant, Linear Polymer Chain, and Their  
Complexes on Turbulent Wall Shear Stress ..... 760  
*A. Sirivat and S. Suksamranchit*

Direct Computation of Liquid Sheets in a Compressible Gas Medium ... 761  
*X. Jiang, G.A. Siamas and L. Wrobel*

Effect of Bubbles on the Turbulence Modification in a Downward  
Gas-Liquid Pipe Flow ..... 762  
*O. Kashinsky, P. Lobanov, M. Pakhomov, V. Randin  
and V. Terekhov*

One Equation Model for Turbulence Pipe Flow with Second Order  
Viscoelastic Corrections ..... 763  
*B. Sadanandan, R. Sureshkumar and F.T. Pinho*

**Posters XI: Vortex dynamics and structure formation**

Formulation of the Settling Velocity of Small Particles Initially  
Situating Inside a Vortex ..... 764  
*U. Sánchez and M.J. Moreno-López*

Transition Turbulence in a Laboratory Model of the Left Ventricle ..... 765  
*S. Fortini, G. Querzoli, M. Marchetti and A. Cenedese*

Experimental Study of Wake Structure Associated with Reduced  
Base Drag Using POD and LSE ..... 766  
*V. Durgesh and J.W. Naughton*

On Vorticity, Vortices and Material Lines in Turbulent Channel Flow ... 767  
*A. Helgeland, B. A. Pettersson Reif, O. Andreassen  
and C.E. Wasberg*

Orthonormal Divergence-Free Wavelet Analysis of  
 Cascading/Backscattering Process Around Coherent Structures..... 768  
*K. Araki and H. Miura*

Experimental Investigation of Forced and Unforced Instabilities  
 on the Cold Flow of a Swirl Burner ..... 769  
*A. Lacarelle, C.O. Paschereit, D. Greenblatt and E.J. Gutmark*

Quantifying Anisotropy in Stratified and Rotating Turbulence Using  
 Orthogonal Wavelets..... 770  
*L. Liechtenstein, W.J.T. Bos and K. Schneider*

Variable Density Vortex Rings ..... 771  
*S. Benteboula and I. Danaila*

Behavior of Flow Structures Inside a Round Buoyant Jet ..... 772  
*N. Sekishita and H. Makita*

**Posters XII: Wall bounded flows**

High Spatial Resolution MCCDPIV in a Zero Pressure Gradient  
 Turbulent Boundary Layer ..... 773  
*C.Y. Wong and J. Soria*

Interaction of Quasi Two Dimensional Flow Field with Turbulent  
 Boundary Layer as a Method of Investigating Drag Reduction of  
 Polymer Additives ..... 774  
*G.D. Roumbas, E.G. Kastrinakis and S.G. Nychas*

Structure and Mean-Velocity Profile of Pipeflow..... 775  
*M.H. Buschmann and M. Gad-el-Hak*

Detection of Streamwise Vortices in a Turbulent Boundary Layer ..... 776  
*J. Lin, J.-P. Laval, J.-M. Foucaut and M. Stanislas*

Upstream Condition Effects on the Anisotropy of Rough Favorable  
 Pressure Gradient Turbulent Boundary Layers ..... 777  
*R.B. Cal, B. Brzek, G. Johansson and L. Castillo*

Near-Wall Modeling of Compressible Turbulent Boundary Layers with  
 Separation ..... 778  
*M.P. Boiarciuc, C. Brun and M. Manhart*

Numerical Investigation of Turbulent Boundary Layer  
 Relaminarisation..... 779  
*A.D.S. Borges, A. Silva Lopes and J.M.L.M. Palma*

XXXVI Contents

Turbulent Flow Over Different Groups of Cubical Obstacles .....	780
<i>S. Leonardi, I.P. Castro and P. Orlandi</i>	
LES of Transient Turbulent Flow in a Pipe .....	781
<i>S.Y. Jung and Y.M. Chung</i>	
Investigation of a Tripped Turbulent Boundary Layer Flow Using Time-Resolved Tomographic PIV .....	782
<i>A. Schröder, R. Geisler and D. Michaelis</i>	
Author Index .....	783



## SPRINGER PROCEEDINGS IN PHYSICS

---

- 71 **Amorphous and Crystalline Silicon Carbide IV**  
Editors: C.Y. Yang, M.M. Rahman, and G.L. Harris
- 72 **Computer Simulation Studies in Condensed-Matter Physics IV**  
Editors: D.P. Landau, K.K. Mon, and H.-B. Schüttler
- 73 **Surface Science**  
Principles and Applications  
Editors: R.F. Howe, R.N. Lamb, and K. Wandelt
- 74 **Time-Resolved Vibrational Spectroscopy VI**  
Editors: A. Lau, F. Siebert, and W. Werncke
- 75 **Computer Simulation Studies in Condensed-Matter Physics V**  
Editors: D.P. Landau, K.K. Mon, and H.-B. Schüttler
- 76 **Computer Simulation Studies in Condensed-Matter Physics VI**  
Editors: D.P. Landau, K.K. Mon, and H.-B. Schüttler
- 77 **Quantum Optics VI**  
Editors: D.F. Walls and J.D. Harvey
- 78 **Computer Simulation Studies in Condensed-Matter Physics VII**  
Editors: D.P. Landau, K.K. Mon, and H.-B. Schüttler
- 79 **Nonlinear Dynamics and Pattern Formation in Semiconductors and Devices**  
Editor: F.-J. Niedernostheide
- 80 **Computer Simulation Studies in Condensed-Matter Physics VIII**  
Editors: D.P. Landau, K.K. Mon, and H.-B. Schüttler
- 81 **Materials and Measurements in Molecular Electronics**  
Editors: K. Kajimura and S. Kuroda
- 82 **Computer Simulation Studies in Condensed-Matter Physics IX**  
Editors: D.P. Landau, K.K. Mon, and H.-B. Schüttler
- 83 **Computer Simulation Studies in Condensed-Matter Physics X**  
Editors: D.P. Landau, K.K. Mon, and H.-B. Schüttler
- 84 **Computer Simulation Studies in Condensed-Matter Physics XI**  
Editors: D.P. Landau and H.-B. Schüttler
- 85 **Computer Simulation Studies in Condensed-Matter Physics XII**  
Editors: D.P. Landau, S.P. Lewis, and H.-B. Schüttler
- 86 **Computer Simulation Studies in Condensed-Matter Physics XIII**  
Editors: D.P. Landau, S.P. Lewis, and H.-B. Schüttler
- 87 **Proceedings of the 25th International Conference on the Physics of Semiconductors**  
Editors: N. Miura and T. Ando
- 88 **Starburst Galaxies**  
Near and Far  
Editors: L. Tacconi and D. Lutz
- 89 **Computer Simulation Studies in Condensed-Matter Physics XIV**  
Editors: D.P. Landau, S.P. Lewis, and H.-B. Schüttler
- 90 **Computer Simulation Studies in Condensed-Matter Physics XV**  
Editors: D.P. Landau, S.P. Lewis, and H.-B. Schüttler
- 91 **The Dense Interstellar Medium in Galaxies**  
Editors: S. Pfalzner, C. Kramer, C. Straubmeier, and A. Heithausen
- 92 **Beyond the Standard Model 2003**  
Editor: H.V. Klapdor-Kleingrothaus
- 93 **ISSMGE**  
Experimental Studies  
Editor: T. Schanz
- 94 **ISSMGE**  
Numerical and Theoretical Approaches  
Editor: T. Schanz
- 95 **Computer Simulation Studies in Condensed-Matter Physics XVI**  
Editors: D.P. Landau, S.P. Lewis, and H.-B. Schüttler
- 96 **Electromagnetics in a Complex World**  
Editors: I.M. Pinto, V. Galdi, and L.B. Felsen
-