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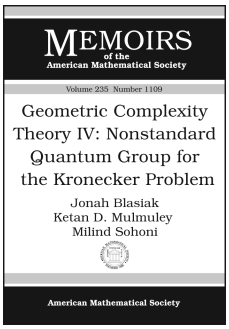
Algebra and Algebraic Geometry



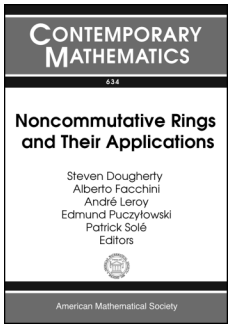
Geometric Complexity Theory IV: Nonstandard Quantum Group for the Kronecker Problem

Jonah Blasiak, *Drexel University, Philadelphia, PA*, **Ketan D. Mulmuley**, *University of Chicago, IL*, and **Milind Sohoni**, *Indian Institute of Technology, Mumbai, India*

Contents: Introduction; Basic concepts and notation; Hecke algebras and canonical bases; The quantum group $GL_q(V)$; Bases for $GL_q(V)$ modules; Quantum Schur-Weyl duality and canonical bases; Notation for $GL_q(V) \times GL_q(W)$; The nonstandard coordinate algebra $\mathcal{O}(M_q(\check{X}))$; Nonstandard determinant and minors; The nonstandard quantum groups $GL_q(\check{X})$ and $\mathsf{U}_q(\check{X})$; The nonstandard Hecke algebra $\check{\mathcal{H}}_r$; Nonstandard Schur-Weyl duality; Nonstandard representation theory in the two-row case; A canonical basis for $\check{Y}_\alpha$; A global crystal basis for two-row Kronecker coefficients; Straightened NST and semistandard tableaux; A Kronecker graphical calculus and applications; Explicit formulae for Kronecker coefficients; Future work; Appendix A. Reduction system for $\mathcal{O}(M_q(\check{X}))$; Appendix B. The Hopf algebra $\mathcal{O}_q^{\mathsf{T}}$; Bibliography.

Memoirs of the American Mathematical Society, Volume 235, Number 1109

May 2015, 160 pages, Softcover, ISBN: 978-1-4704-1011-7, LC 2014049957, 2010 *Mathematics Subject Classification:* 33D80, 20C30, 05E10; 16S80, 11Y16, **Individual member US$51.60**, List US$86, Institutional member US$68.80, Order code MEMO/235/1109



Noncommutative Rings and Their Applications

Steven Dougherty, *University of Scranton, PA*, **Alberto Facchini**, *Università di Padova, Italy*, **André Leroy**, *Université d'Artois, Lens, France*, **Edmund Puczyłowski**, *University of Warsaw, Poland*, and **Patrick Solé**, *CNRS/LTCI, Telecom ParisTech, France*, Editors

This volume contains the proceedings of an International Conference on Noncommutative Rings and Their Applications, held July 1–4, 2013, at the Université d'Artois, Lens, France. It presents recent developments in the theories of noncommutative rings and modules over such rings as well as applications of these to coding theory, enveloping algebras, and Leavitt path algebras.

Material from the course "Foundations of Algebraic Coding Theory", given by Steven Dougherty, is included and provides the reader with the history and background of coding theory as well as the interplay between coding theory and algebra. In module theory, many new results related to (almost) injective modules, injective hulls and automorphism-invariant modules are presented. Broad generalizations of classical projective covers are studied and category theory is used to describe the structure of some modules. In some papers related to more classical ring theory such as quasi duo rings or clean elements, new points of view on classical conjectures and standard open problems are given. Descriptions of codes over local commutative Frobenius rings are discussed, and a list of open problems in coding theory is presented within their context.

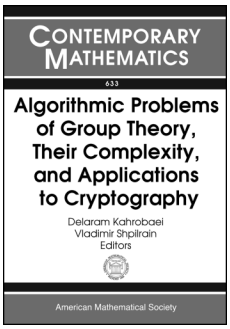
This item will also be of interest to those working in applications.

Contents: G. Abrams and **B. Schoonmaker**, Leavitt path algebras of Cayley graphs arising from cyclic groups; **A. Alahmadi**, **S. K. Jain**, and **S. Singh**, Characterizations of almost injective modules; **P. A. Guil Asensio** and **A. K. Srivastava**, Automorphism-invariant modules; **S. M. Buckley**, Distributive algebras, isoclinism, and invariant probabilities; **S. Catoiu**, Ideals of the enveloping algebra $U(sl_3)$; **S. Çeken** and **M. Alkan**, On second submodules; **S. T. Dougherty**, **J.-L. Kim**, and **P. Solé**, Open problems in coding theory; **S. T. Dougherty**, Foundations of algebraic coding theory; **S. T. Dougherty** and **E. Saltürk**, Counting $\mathbb{Z}_2\mathbb{Z}_4$-additive codes; **A. Facchini**, From endomorphism rings to some noteworthy ideals in categories of modules; **E. G. Goodaire** and **C. P. Milies**, Lie and Jordan properties in group algebras; **Y. Ibrahim** and **M. Yousif**, Rad-projective δ-covers;

M. Jastrzębska and **J. Krempa**, On lattices of annihilators; **P. Kanwar**, **A. Leroy**, and **J. Matczuk**, Clean elements in polynomial rings; **C. Lomp**, On the semiprime smash product question; **J. Matczuk**, Minimal prime ideals and derivations; **E. Martínez-Moro** and **S. Szabo**, On codes over local Frobenius non-chain rings of order 16; **E. R. Puczyłowski**, On quasi-duo rings; **H. Usefi**, Isomorphism invariants of enveloping algebras.

Contemporary Mathematics, Volume 634

April 2015, 265 pages, Softcover, ISBN: 978-1-4704-1032-2, LC 2014029564, 2010 *Mathematics Subject Classification:* 16N60, 16P60, 16S34, 16S99, 16U99, 17B35, 94B05, 94B15, 94B60, **AMS members US$84**, List US$105, Order code CONM/634



Algorithmic Problems of Group Theory, Their Complexity, and Applications to Cryptography

Delaram Kahrobaei, *City University of New York, NY*, and **Vladimir Shpilrain**, *City College of New York, NY*, Editors

This volume contains the proceedings of the AMS Special Session on Algorithmic Problems of Group Theory and Their Complexity, held January 9–10, 2013 in San Diego, CA and the AMS Special Session on Algorithmic Problems of Group Theory and Applications to Information Security, held April 6–7, 2013 at Boston College, Chestnut Hill, MA.

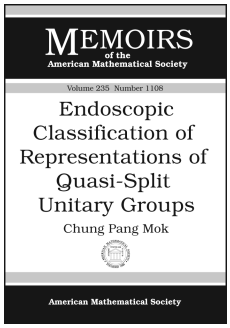
Over the past few years the field of group-based cryptography has attracted attention from both group theorists and cryptographers. The new techniques inspired by algorithmic problems in non-commutative group theory and their complexity have offered promising ideas for developing new cryptographic protocols. The papers in this volume cover algorithmic group theory and applications to cryptography.

This item will also be of interest to those working in applications.

Contents: **B. Cavallo** and **D. Kahrobaei**, Secret sharing using non-commutative groups and the shortlex order; **A. E. Clement**, An algorithm that decides conjugacy in a certain generalized free product; **B. Cooper** and **E. Rowland**, Classification of automorphic conjugacy classes in the free group on two generators; **B. Fine**, **A. Gaglione**, **G. Rosenberger**, and **D. Spellman**, On elementary free groups; **A. M. Gaglione**, **S. Lipschutz**, and **D. Spellman**, An application of a localized version of an axiom of Ian Chiswell; **A. M. Gaglione**, **S. Lipschutz**, and **D. Spellman**, A note on Stallings' pregroups; **D. Kahrobaei**, **C. Koupparis**, and **V. Shpilrain**, A CCA secure cryptosystem using matrices over group rings; **A. Mahalanobis**, The MOR cryptosystem and finite p-groups; **A. I. S. Moldenhauer**, A group theoretical ElGamal cryptosystem based on a semidirect product of groups and a proposal for a signature protocol; **B. Steinberg**, On some algorithmic properties of finite state automorphisms of rooted trees.

Contemporary Mathematics, Volume 633

April 2015, 123 pages, Softcover, ISBN: 978-0-8218-9859-8, LC 2014029814, 2010 *Mathematics Subject Classification:* 20-XX, 68-XX, **AMS members US$84**, List US$105, Order code CONM/633



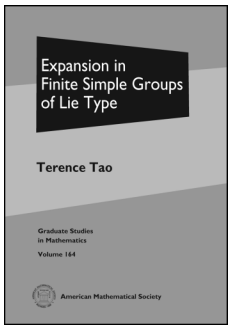
Endoscopic Classification of Representations of Quasi-Split Unitary Groups

Chung Pang Mok, *Morningside Center of Mathematics, Beijing, China, and Purdue University, Bloomington, IN*

Contents: Introduction; Statement of the main theorems; Local character identities and the intertwining relation; Trace formulas and their stabilization; The Standard model; Study of critical cases; Local classification; Nontempered representations; Global classification; Addendum; Bibliography.

Memoirs of the American Mathematical Society, Volume 235, Number 1108

May 2015, 250 pages, Softcover, ISBN: 978-1-4704-1041-4, LC 2014049955, 2010 *Mathematics Subject Classification:* 22E55, 22E50; 20G35, 11R42, **Individual member US$63**, List US$105, Institutional member US$84, Order code MEMO/235/1108



Expansion in Finite Simple Groups of Lie Type

Terence Tao, *University of California, Los Angeles, CA*

Expander graphs are an important tool in theoretical computer science, geometric group theory, probability, and number theory. Furthermore, the techniques used to rigorously establish the expansion property of a graph draw from such diverse areas of mathematics as representation theory, algebraic geometry, and arithmetic combinatorics. This text focuses on the latter topic in the important case of Cayley graphs on finite groups of Lie type, developing tools such as Kazhdan's property (T), quasirandomness, product estimates, escape from subvarieties, and the Balog–Szemerédi–Gowers lemma. Applications to the affine sieve of Bourgain, Gamburd, and Sarnak are also given. The material is largely self-contained, with additional sections on the general theory of expanders, spectral theory, Lie theory, and the Lang–Weil bound, as well as numerous exercises and other optional material.

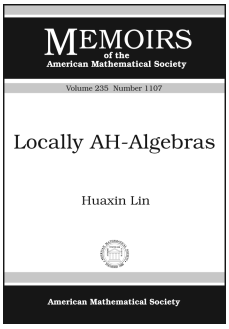
This item will also be of interest to those working in discrete mathematics and combinatorics.

Contents: *Expansion in Cayley graphs:* Expander graphs: Basic theory; Expansion in Cayley graphs, and Kazhdan's property (T); Quasirandom groups; The Balog-Szemerédi-Gowers lemma, and the Bourgain-Gamburd expansion machine; Product theorems, pivot arguments, and the Larsen-Pink non-concentration inequality; Non-concentration in subgroups; Sieving and expanders; *Related articles:* Cayley graphs the algebra of groups; The Lang-Weil bound; The spectral theorem and its converses for unbounded self-adjoint operators; Notes on Lie algebras; Notes on groups of Lie type; Bibliography; Index.

Graduate Studies in Mathematics, Volume 164

May 2015, approximately 307 pages, Hardcover, ISBN: 978-1-4704-2196-0, LC 2014049154, 2010 *Mathematics Subject Classification:* 05C81, 11B30, 20C33, 20D06, 20G40, **AMS members US$63.20**, List US$79, Order code GSM/164

Analysis



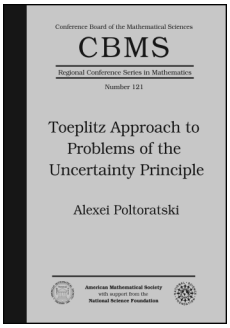
Locally AH-Algebras

Huaxin Lin, *University of Oregon, Eugene, OR, and The Research Center for Operator Algebras, East China Normal University, Shanghai, China*

Contents: Introduction; Preliminaries; Definition of C_g; C^*-algebras in C_g; Regularity of C^*-algebras in C_1; Traces; The unitary group; $\mathcal{Z}$-stability; General existence theorems; The uniqueness statement and the existence theorem for Bott map; The basic homotopy lemma; The proof of the uniqueness theorem **10.4**; The reduction; Appendix; Bibliography.

Memoirs of the American Mathematical Society, Volume 235, Number 1107

May 2015, 108 pages, Softcover, ISBN: 978-1-4704-1466-5, LC 2014049970, **Individual member US$48**, List US$80, Institutional member US$64, Order code MEMO/235/1107



Toeplitz Approach to Problems of the Uncertainty Principle

Alexei Poltoratski, *Texas A&M University, College Station, TX*

The Uncertainty Principle in Harmonic Analysis (UP) is a classical, yet rapidly developing, area of modern mathematics. Its first significant results and open problems date back to the work of Norbert Wiener, Andrei Kolmogorov, Mark Krein and Arne Beurling. At present, it encompasses a large part of mathematics, from Fourier analysis, frames and completeness problems for various systems of functions to spectral problems for differential operators and canonical systems.

These notes are devoted to the so-called Toeplitz approach to UP which recently brought solutions to some of the long-standing problems posed by the classics. After a short overview of the general area of UP the discussion turns to the outline of the new approach and its results. Among those are solutions to Beurling's Gap Problem in Fourier analysis, the Type Problem on completeness of exponential systems, a problem by Pólya and Levinson on sampling sets for entire functions, Bernstein's problem on uniform polynomial approximation, problems on asymptotics of Fourier integrals and a Toeplitz version of the Beurling–Malliavin theory. One of the main goals of the book is to present new directions for future research opened by the new approach to the experts and young analysts.

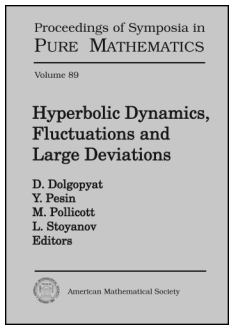
A co-publication of the AMS and CBMS.

Contents: Mathematical shapes of uncertainty; Gap theorems; A problem by Pólya and Levinson; Determinacy of measures and oscillations of high-pass signals; Beurling-Malliavin and Bernstein's problems; The type problem; Toeplitz approach to UP; Toeplitz version of the Beurling-Malliavin theory; Bibliography.

CBMS Regional Conference Series in Mathematics, Number 121

April 2015, 216 pages, Softcover, ISBN: 978-1-4704-2017-8, LC 2014043343, 2010 *Mathematics Subject Classification:* 30-XX, 33-XX, 34-XX, 42-XX, **AMS members US$39.20**, List US$49, Order code CBMS/121

Differential Equations



Hyperbolic Dynamics, Fluctuations and Large Deviations

D. Dolgopyat, *University of Maryland, College Park, MD*, **Y. Pesin**, *Pennsylvania State University, University Park, PA*, **M. Pollicott**, *University of Warwick, Coventry, United Kingdom*, and **L. Stoyanov**, *University of Western Australia, Crawley, Australia*, Editors

This volume contains the proceedings of the semester long special program on Hyperbolic Dynamics, Large Deviations and Fluctuations, which was held from January–June 2013, at the Centre Interfacultaire Bernoulli, École Polytechnique Fédérale de Lausanne, Switzerland.

The broad theme of the program was the long term behavior of dynamical systems and their statistical behavior. During the last 50 years, the statistical properties of dynamical systems of many different types have been the subject of extensive study in statistical mechanics and thermodynamics, ergodic and probability theories, and some areas of mathematical physics. The results of this study have had a profound effect on many different areas in mathematics, physics, engineering and biology.

The papers in this volume cover topics in large deviations and thermodynamics formalism and limit theorems for dynamic systems.

The material presented is primarily directed at researchers and graduate students in the very broad area of dynamical systems and ergodic theory, but will also be of interest to researchers in related areas such as statistical physics, spectral theory and some aspects of number theory and geometry.

This item will also be of interest to those working in mathematical physics.

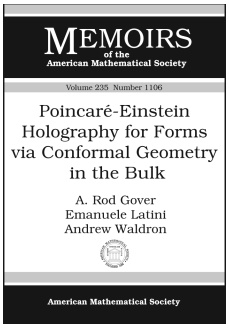
Contents: D. Dolgopyat, **Y. Pesin**, **M. Pollicott**, and **L. Stoyanov**, Hyperbolic dynamics, fluctuations and large deviations; *Large deviations and thermodynamical formalism:* **J. Buzzi**, The almost Borel structure of diffeomorphisms with some hyperbolicity; **Y. Kifer**, Lectures on large deviations in probability and dynamical systems; **O. M. Sarig**, Thermodynamic formalism for countable Markov shifts; *Limit theorems for dynamical systems:* **G. Forni**, Limit theorems for

horocycle flows; **S. Gouëzel**, Limit theorems in dynamical systems using the spectral method; **J. Marklof**, Kinetic limits of dynamical systems; *Additional topics:* **D. Dolgopyat** and **B. Fayad**, Limit theorems for toral translations; **Y. Guivarc'h**, Spectral gap properties and limit theorems for some random walks and dynamical systems; **J. De Simoi** and **C. Liverani**, The martingale approach after Varadhan and Dolgopyat.

Proceedings of Symposia in Pure Mathematics, Volume 89

April 2015, approximately 337 pages, Hardcover, ISBN: 978-1-4704-1112-1, LC 2014043353, 2010 *Mathematics Subject Classification:* 37D35, 37A60, 60F10, **AMS members US$96**, List US$120, Order code PSPUM/89

Geometry and Topology



Poincaré-Einstein Holography for Forms via Conformal Geometry in the Bulk

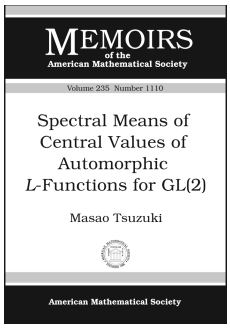
A. Rod Gover, *University of Auckland, New Zealand*, **Emanuele Latini**, *Laboratori Nazinali di Frascati LNF, Italy*, and **Andrew Waldron**, *University of California, Davis, CA*

Contents: Introduction; Bulk conformal geometry and extension problems; Tractor exterior calculus; The exterior calculus of scale; Higher form Proca equations; Obstructions, detours, gauge operators and Q-curvature; Appendx A. The ambient manifold; Appendix B. List of common symbols; Bibliography.

Memoirs of the American Mathematical Society, Volume 235, Number 1106

May 2015, 85 pages, Softcover, ISBN: 978-1-4704-1092-6, LC 2014050309, 2010 *Mathematics Subject Classification:* 53A30, 53B50, 53A55, 53B15, 22E46, **Individual member US$45.60**, List US$76, Institutional member US$60.80, Order code MEMO/235/1106

Number Theory



Spectral Means of Central Values of Automorphic L-Functions for GL(2)

Masao Tsuzuki, *Sophia University, Tokyo, Japan*

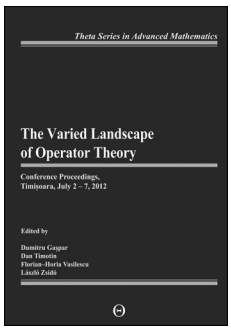
Contents: Introduction; Preliminaries; Preliminary analysis; Green's functions on $\mathrm{GL}(2,\mathbb{R})$; Green's functions on $\mathrm{GL}(2,F_v)$ with v a non archimedean place; Kernel functions; Regularized periods; Automorphic Green's functions; Automorphic smoothed kernels; Periods of regularized automorphic smoothed kernels: the spectral side; A geometric expression of automorphic smoothed kernels; Periods of regularized automorphic smoothed kernels: the geometric side; Asymptotic formulas; An error term estimate in the Weyl type asymptotic law; Appendix; Bibliography.

Memoirs of the American Mathematical Society, Volume 235, Number 1110

May 2015, 129 pages, Softcover, ISBN: 978-1-4704-1019-3, LC 2014049959, 2010 *Mathematics Subject Classification:* 11F72; 11F67, **Individual member US$48.60**, List US$81, Institutional member US$64.80, Order code MEMO/235/1110

New AMS-Distributed Publications

Analysis



The Varied Landscape of Operator Theory

Conference Proceedings, Timişoara, July 2–7, 2012

Dumitru Gaspar, *West University of Timişoara, Romania*, **Dan Timotin**, *Romanian Academy, Bucharest, Romania*, **Florian-Horia Vasilescu**, *University of Lille I, Villeneuve d'Ascq, France*, and **László Zsidó**, *University of Rome Tor Vergata, Italy*, Editors

The volume contains the proceedings of the 24th International Conference on Operator Theory, held in Timişoara from July 2–7,

2012. Leading experts in the field have contributed with several survey papers, covering the following subjects:

- amenability on coset spaces
- large orbits of operators and operator semigroups
- approximation numbers of composition operators
- commutators in the algebra of bounded operators on a Hilbert space
- interplay between algebraic groups, Lie algebras, and operator ideals
- free group factors and Hecke operators

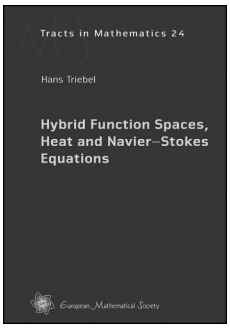
The remaining papers contain original research on different topics: single operator theory, C*-algebras, operators on functino spaces, quantum semigroups, moment problems, and semigroups on ordered Banach spaces.

A publication of the Theta Foundation. Distributed worldwide, except in Romania, by the AMS.

Contents: Z. Akkar and **E. Albrecht**, Spectral properties of Toeplitz operators on the unit ball and on the unit sphere; **C Anantharaman-Delaroche**, Approximation properties for coset spaces and their operator algebras; **M. Aukhadiev**, Pentagon equation and compact quantum semigroups; **D. Beltiţă**, **S. Patnaik**, and **G. Weiss**, $B(H)$-commutators: A historical survey II and recent advances on commutators of compact operators; **D. Beltiţă**, **S. Patnaik**, and **G. Weiss**, Interplay between algebraic groups, Lie algebras, and operator ideals; **V. Crismale** and **F. Fidaleo**, Symmetric states on the CAR algebra; **L. A. Fialkow**, The truncated moment problem on parallel lines; **S. A. Grigorian** and **A. Yu. Kuznetsova**, Torus action on a C^*-algebra generated by mapping; **T. A. Grigoryan**, **E. V. Lipacheva**, and **V. H. Tepoyan**, On the extension of the Toeplitz algebra by isometries; **A. Kishimoto**, Approximately inner and MF flows; **M. Mitkovski** and **B. D. Wick**, The essential norm of operators on $A^p(\mathbb{D}^n)$; **V. Müller**, Large orbits of operators and operator semigroups; **H. Queffélec**, Some recent results on approximation numbers of composition operators; **F. Radulescu**, Free group factors and Hecke operators; **N. Tiţa**, Remarks on some bounded and multilinear maps; **V. M. Ungureanu** and **V. Dragan**, Stability problems for positive evolution operators on ordered Banach spaces; **F.-H. Vasilescu**, Perturbations of quotient operators and applications.

International Book Series of Mathematical Texts

January 2015, 284 pages, Hardcover, ISBN: 978-606-8443-04-1, **AMS members US$59.20**, List US$74, Order code THETA/20



Hybrid Function Spaces, Heat and Navier–Stokes Equations

Hans Triebel, *Friedrich-Schiller University Jena, Germany*

This book is the continuation of *Local Function Spaces, Heat and Navier–Stokes Equations* (EMS Tracts in Mathematics, volume 20, 2013) by the author. A new approach is presented to exhibit relations between Sobolev spaces, Besov spaces, and Hölder–Zygmund spaces on the one hand and Morrey–Campanato spaces on the other. Morrey–Campanato spaces extend the notion of functions of bounded mean oscillation. These spaces play a crucial role in the theory of linear and nonlinear PDEs.

Chapter 1 (Introduction) describes the main motivations and intentions of this book. Chapter 2 is a self-contained introduction to Morrey spaces. Chapter 3 deals with hybrid smoothness spaces (which are between local and global spaces) in Euclidean n-space based on the Morrey–Campanato refinement of the Lebesgue spaces. The presented approach, which relies on wavelet decompositions, is applied in Chapter 4 to linear and nonlinear heat equations in global and hybrid spaces. The obtained assertions about function spaces and nonlinear heat equations are used in Chapters 5 and 6 to study Navier–Stokes equations in hybrid and global spaces.

This book is addressed to graduate students and mathematicians who have a working knowledge of basic elements of (global) function spaces and who are interested in applications to nonlinear PDEs with heat and Navier–Stokes equations as prototypes.

This item will also be of interest to those working in differential equations.

A publication of the European Mathematical Society (EMS). Distributed within the Americas by the American Mathematical Society.

Contents: Introduction; Morrey spaces; Hybrid spaces; Heat equations; Navier–Stokes equations in hybrid spaces; Navier–Stokes equations in global spaces; Bibliography; Symbols; Index.

EMS Tracts in Mathematics, Volume 22

January 2015, 196 pages, Hardcover, ISBN: 978-3-03719-150-7, 2010 *Mathematics Subject Classification:* 46-02, 46E35, 42B35, 42C40, 35K05, 35Q30, 76D03, 76D05, **AMS members US$51.20**, List US$64, Order code EMSTM/22