

## INDEX TO VOLUME 22

July–October 1990

### RESEARCH-EXPOSITORY PAPERS

- Bercovici, Hari. *Notes on invariant subspaces*, 1  
Colombeau, J. F. *Multiplication of distributions*, 251  
Conder, Marston. *Hurwitz groups: a brief survey*, 359  
Katz, Nicholas M. *Exponential sums over finite fields and differential equations over the complex numbers: some interactions*, 269  
Lang, Serge. *Old and new conjectured diophantine inequalities*, 37  
McDuff, Dusa. *Elliptic methods in symplectic geometry*, 311

### RESEARCH ANNOUNCEMENTS

- Akbulut, Selman and King, Henry. *Some new results on the topology of nonsingular real algebraic sets*, 441  
Avramov, Luchezar L. and Foxby, Hans-Bjørn. *Gorenstein local homomorphisms*, 145  
Bloch, Anthony M., Brockett, Roger W., and Ratiu, Tudor S. *A new formulation of the generalized Toda lattice equations and their fixed point analysis via the momentum map*, 477  
Brockett, Roger W. *See* Bloch, Anthony M.  
Brooks, Robert and Gordon, Carolyn. *Isospectral families of conformally equivalent Riemannian metrics*, 433  
Brumer, Armand and McGuinness, Oisín. *The behavior of the Mordell-Weil group of elliptic curves*, 375  
Buttazzo, Giuseppe and Dal Maso, Gianni. *Shape optimization for Dirichlet problems: relaxed solutions and optimality conditions*, 531  
Caffisch, Russel E. *A simplified version of the abstract Cauchy-Kowalewski theorem with weak singularities*, 495  
Cochran, T. D. and Orr, K. E. *Not all links are concordant to boundary links*, 99  
Connell, Edwin and Zweibel, John. *Subgroups of polynomial automorphisms*, 401  
Conway, J. H. and Sloane, N. J. A. *A new upper bound for the minimum of an integral lattice of determinant 1*, 383  
Cooper, S. Barry. *The jump is definable in the structure of the degrees of unsolvability*, 151  
Dal Maso, Gianni. *See* Buttazzo, Giuseppe  
Fefferman, Charles L. and Seco, Luis A. *On the energy of a large atom*, 525  
Foxby, Hans-Bjørn. *See* Avramov, Luchezar L.  
Frohman, Charles and Meeks, III, William H. *The topology of complete one-ended minimal surfaces and Heegaard surfaces in  $\mathbf{R}^3$* , 417  
Garofalo, Nicola and Lanconelli, Ermanno. *Zero-order perturbations of the subelliptic Laplacian on the Heisenberg group and their uniqueness properties*, 501  
Gordon, Carolyn. *See* Brooks, Robert  
Hurder, Steven. *Deformation rigidity for subgroups of  $SL(n, \mathbf{Z})$  acting on the  $n$ -torus*, 107  
Iozzi, Alessandra. *A nonlinear extension of the Borel density theorem: Applications to invariance of geometric structures and to smooth orbit equivalence*, 115  
Johannson, Klaus. *Heegaard surfaces in Haken 3-manifolds*, 91  
Journé, J. L., Soffer, A., and Sogge, C. D.  *$L^p \rightarrow L^{p'}$  estimates for time-dependent Schrödinger operators*, 519  
Kamienny, S. *Torsion points on elliptic curves*, 371

## INDEX TO VOLUME 23

- Buell, D. A. *Binary quadratic forms, classical theory and applications*, reviewed by Lehmer, D. H., 604
- Davies, E. B. *Heat kernels and spectral theory*, reviewed by Strichartz, Robert S., 222
- Dozzi, M. *Stochastic processes with a multidimensional parameter*, reviewed by Merzbach, Ely, 228
- Dudley, R. M. *Real analysis and probability*, reviewed by Pinsky, Mark A., 575
- Dym, Harry. *J Contractive matrix functions, reproducing kernel Hilbert spaces and interpolation*, reviewed by Ball, Joseph A., 547
- Eastham, M. S. P. *The asymptotic solution of linear differential systems, applications of the Levinson theorem*, reviewed by Devinatz, Allen, 563
- Eberly, David. *See* Bebernes, Jerrold
- Fenchel, Werner. *Elementary geometry in hyperbolic space*, reviewed by Wilker, J. B., 589
- Fraïssé, R. *Theory of relations*, reviewed by Miller, Arnold W., 206
- Günther, Paul. *Huygens' principle and hyperbolic equations*, reviewed by Ørsted, Bent, 235
- Gangolli, R. and Varadarajan, V. S. *Harmonic analysis of spherical functions on real reductive groups*, reviewed by Barbasch, D., 598
- Golan, Jonathan S. and Simmons, Harold. *Derivatives, nuclei and dimensions on the frame of torsion theories*, reviewed by Johnstone, P. T., 178
- Guillemin, Victor. *Cosmology in (2+1)-dimensions, cyclic models, and deformations of  $M_{2,1}$* , reviewed by Beem, John K., 616
- Gupta, M. *See* Kamthan, P. K.
- Hahn, A. J. and O'Meara, O. T. *The classical groups and K-theory*, reviewed by Steinberg, Robert, 594
- Henkin, Gennadi M. and Leiterer, Jürgen. *Andreotti-Grauert theory by integral formulas*, reviewed by Range, R. Michael, 190
- Higman, Graham and Scott, Elizabeth. *Existentially closed groups*, reviewed by Hickin, Kenneth, 242
- Hubert, Jacqueline Sanchez and Palencia, Enrique Sanchez. *Vibration and coupling of continuous systems: asymptotic methods*, reviewed by Slemrod, M., 623
- Jorgensen, P. E. T. *Operators and representation theory: Canonical models for algebras of operators arising in quantum mechanics*, reviewed by Goodman, Roe, 551
- Kamthan, P. K. and Gupta, M. *Schauder bases: Behavior and stability*, reviewed by Retherford, J. R., 167
- Kreiss, Heinz-Otto and Lorenz, Jens. *Initial-boundary value problems and the Navier-Stokes equations*, reviewed by Constantin, Peter, 555
- Kulkarni, Ravi S. and Pinkall, Ulrich., eds. *Conformal geometry*, reviewed by Goldman, William M., 566
- Leiterer, Jürgen. *See* Henkin, Gennadi M.
- Lorenz, Jens. *See* Kreiss, Heinz-Otto
- Lyubich, Yu. I. *See* Belitskii, G. R.
- McConnell, J. C. and Robson, J. C. *Noncommutative Noetherian rings*, reviewed by Formanek, Edward, 579
- Mercier, Bertrand. *An introduction to the numerical analysis of spectral methods*, reviewed by Lustman, Levi, 626
- Molino, Pierre. *Riemannian foliations*, reviewed by Conlon, L., 583
- O'Meara, O. T. *See* Hahn, A. J.
- O'Rourke, Joseph. *Art gallery theorems and algorithms*, reviewed by Avis, David, 230
- Palencia, Enrique Sanchez. *See* Hubert, Jacqueline Sanchez
- Penrose, Roger. *The emperor's new mind*, reviewed by McCarthy, John, 606
- Pinkall, Ulrich. *See* Kulkarni, Ravi S.
- Popov, Vasil A. *See* Sendov, Blagovest

## INDEX TO VOLUME 23

- Kan, I. and Yorke, J. A. *Antimonotonicity: concurrent creation and annihilation of periodic orbits*, 469
- King, Henry. *See* Akbulut, Selman
- Kon, Mark A. and Novak, Erich. *The adaption problem for approximating linear operators*, 159
- Kraus, Jon. *The tensor product problem for reflexive algebras*, 455
- Lanconelli, Ermanno. *See* Garofalo, Nicola
- Li, Luen-Chau. *On the complete integrability of some Lax systems on  $GL(n, R) \times GL(n, R)$* , 487
- McGuinness, Oisín. *See* Brumer, Armand
- Meeks, III, William H. *See* Frohman, Charles
- Nagel, A., Ricci, F., and Stein, E. M. *Fundamental solutions and harmonic analysis on nilpotent groups*, 139
- Novak, Erich. *See* Kon, Mark A.
- Orr, John Lindsay. *Triangular algebras and ideals of nest algebras*, 461
- Orr, K. E. *See* Cochran, T. D.
- Piatetski-Shapiro, I., Rallis, S., and Schiffmann, G. *L functions for the group  $G_2$* , 389
- Pizer, Arnold K. *Ramanujan graphs and Hecke operators*, 127
- Rallis, S. *See* Piatetski-Shapiro, I.
- Ratiu, Tudor S. *See* Bloch, Anthony M.
- Ricci, F. *See* Nagel, A.
- Roe, John. *Exotic cohomology and index theory*, 447
- du Sautoy, Marcus P. F. *Finitely generated groups, p-adic analytic groups, and Poincaré series*, 121
- Schiffmann, G. *See* Piatetski-Shapiro, I.
- Seco, Luis A. *See* Fefferman, Charles L.
- Shi, Wan-Xiong. *Complete noncompact Kähler manifolds with positive holomorphic bisectional curvature*, 437
- Skora, Richard K. *Splittings of surfaces*, 85
- Sloane, N. J. A. *See* Conway, J. H.
- Soffer, A. *See* Journé, J. L.
- Sogge, C. D. *See* Journé, J. L.
- Stein, E. M. and Wainger, S. *Discrete analogues of singular radon transforms*, 537
- Stein, E. M. *See* Nagel, A.
- Stephenson, Kenneth. *Circle packings in the approximation of conformal mappings*, 407
- Stolz, Stephan. *Simply connected manifolds of positive scalar curvature*, 427
- Wainger, S. *See* Stein, E. M.
- Wilf, Herbert S. and Zeilberger, Doron. *Towards computerized proofs of identities*, 77
- Yorke, J. A. *See* Kan, I.
- Zeilberger, Doron. *See* Wilf, Herbert S.
- Zhao, Z. *Subcriticality, positivity, and gaugeability of the Schrödinger operator*, 513
- Zhu, Shun-Hui. *A finiteness theorem for Ricci curvature in dimension three*, 423
- Zweibel, John. *See* Connell, Edwin

## BOOK REVIEWS

- Baues, H. J. *Algebraic homotopy*, reviewed by Brown, Ronald, 182
- Bebernes, Jerrold and Eberly, David. *Mathematical problems from combustion theory*, reviewed by Kapila, A. K., 559
- Belitskii, G. R. and Lyubich, Yu. I. *Matrix norms and their applications*, reviewed by Fillmore, Peter A., 620
- Bennett, Colin and Sharpley, Robert. *Interpolation of operators*, reviewed by Sagher, Yoram, 198

## INDEX TO VOLUME 23

- Robson, J. C. *See* McConnell, J. C.
- Scott, Elizabeth. *See* Higman, Graham
- Sendov, Blagovest and Popov, Vasil A. *The averaged moduli of smoothness with applications in numerical methods and approximation*, reviewed by Nessel, R. J., 618
- Sharpley, Robert. *See* Bennett, Colin
- Simmons, Harold. *See* Golan, Jonathan S.
- Tondeur, Philippe. *Foliations on Riemannian manifolds*, reviewed by Conlon, L., 583
- Tsai-Han, Kiang. *The theory of fixed point classes*, reviewed by Smart, D. R., 630
- Valent, T. *Boundary value problems of finite elasticity*, reviewed by Ciarlet, Philippe G., 209
- Varadarajan, V. S. *See* Gangolli, R.
- Yudovich, V. I. *The linearization method in hydrodynamical stability theory*, reviewed by Sattinger, D. H., 545
- van Loon, P. M. *Continuous decoupling transformations for linear boundary value problems*, reviewed by Wasow, Wolfgang, 173

# JOURNALS PUBLISHED BY THE AMERICAN MATHEMATICAL SOCIETY

## TRANSLATION JOURNALS

**Soviet Mathematics–Doklady** is a bimonthly translation journal containing the entire pure mathematics section of the DOKLADY AKADEMII NAUK SSSR, the Reports of the Academy of Sciences in the USSR. DOKLADY publishes 500 articles a year, each about four pages long.

**Mathematics of the USSR–Izvestiya**, a bimonthly journal, is a cover-to-cover translation of IZVESTIYA AKADEMII NAUK SSSR SERIYA MATEMATICHESKAYA, published by the Academy of Sciences of the USSR. This is a journal of current research in all fields of pure mathematics.

**Mathematics of the USSR–Sbornik** is a bimonthly journal and is a cover-to-cover translation of MATEMATICHESKIĬ SBORNIK (NOVAYA SERIYA), published by the Moscow Mathematical Society and the Academy of Sciences of the USSR. This is a journal of current research in all fields of pure mathematics.

**Theory of Probability and Mathematical Statistics** is the cover-to-cover translation into English of the TEORIYA VEROYATNOSTEĬ I MATEMATICHESKAYA STATISTIKA published by Kiev University, beginning with the 1970 Soviet publication.

**Transactions of the Moscow Mathematical Society** is a translation into English of TRUDY MOSKOVSKOGO MATEMATICHESKOGO OBSHCHESTVA which contains the results of original research in pure mathematics.

**Proceedings of the Steklov Institute of Mathematics** is a translation of the AKADEMIYA NAUK SSSR TRUDY ORDENA LENINA MATEMATICHESKOGO INSTITUTA IMENI V. A. STEKLOVA. Issues contain book-length articles or collections of articles pertaining to the same topic.

**Leningrad Mathematical Journal** is a translation of ALGEBRA I ANALIZ.

## CONTENT AND SUBMISSION INFORMATION FOR RESEARCH JOURNALS

**Bulletin (New Series) of the American Mathematical Society** contains Research-Expository Papers, Research Announcements and Reviews of Books on Advanced Mathematics. See inside front cover for submission information.

**Journal of the American Mathematical Society** is devoted to research articles of the highest quality in all areas of pure and applied mathematics.

**Mathematics of Computation** is a quarterly journal devoted to original papers in numerical analysis, the application of numerical methods and high-speed calculator devices, the computation of mathematical tables, the theory of high-speed calculating devices, and other aids to computation. In addition, reviews and notes in these and related fields are published. Prospective publications should be sent to the Editor, WALTER GAUTSCHI, Computer Sciences Department, Purdue University, West Lafayette, Indiana 47907.

**Memoirs of the American Mathematical Society** is a bimonthly journal constituting a series of paperbound research tracts which are of the same general character as the papers published in the TRANSACTIONS. An issue of the MEMOIRS is made up of one or more numbers; a number contains either a single monograph or a group of cognate papers. Copy is supplied by the author; information on preparation of camera copy may be obtained by writing to the Editorial Department of the American Mathematical Society. Papers should be sent to the appropriate editor of TRANSACTIONS.

**Proceedings of the American Mathematical Society** is a monthly journal devoted entirely to research in pure and applied mathematics, principally to the publication of original papers of moderate length. A department called Shorter Notes was established for the purpose of publishing very short papers of an unusually elegant and polished character for which there is normally no other outlet. Send papers directly to one of the editors listed under the subject field of the paper. The numbers in parentheses are the first two digits of major classifications from the 1980 Mathematics Subject Classification (1985 Revision) and describe the fields being handled by the editor.

*Logic and foundations* (03 04) to ANDREAS R. BLASS, Department of Mathematics, University of Michigan, Ann Arbor, Michigan 48109-1003

*Combinatorics, computer science, and information theory* (05 15 68 94) to JEFFRY N. KAHN, Department of Mathematics, Rutgers University, New Brunswick, New Jersey 08903

*Commutative algebra* (06 12 13 14 15 18) to LOUIS J. RATLIFF, JR., Department of Mathematics, University of California, Riverside, California 92502

*Number theory* (11) to WILLIAM ADAMS, Department of Mathematics, University of Maryland, College Park, Maryland 20742

*General algebra* (16 17 18 08) to MAURICE AUSLANDER, Department of Mathematics, Brandeis University, P.O. Box 9110, Waltham, Massachusetts 02254-9110

*Group theory* (20) to WARREN J. WONG, Department of Mathematics, University of Notre Dame, Notre Dame, Indiana 46556

*Real variables* (26 28 40) to ANDREW M. BRUCKNER, Department of Mathematics, University of California, Santa Barbara, California 93106

*Complex variables* (30 31 32) to CLIFFORD J. EARLE JR., Cornell University, White Hall, Ithaca, New York 14853

*Ordinary differential equations and dynamical systems* (33 34 39 49 58) to KENNETH R. MEYER, Department of Mathematical Sciences, University of Cincinnati, Cincinnati, Ohio 45221-0025

*Partial differential equations* (35 49 53) to BARBARA L. KEYFITZ, Department of Mathematics, University of Houston, Houston, Texas 77204-3476

*General analysis* (31 41 42 43 44 45) to J. MARSHALL ASH, Department of Mathematics, DePaul University, Chicago, Illinois 60614

*Functional analysis and operator theory* (46 47) to PALLE E. T. JORGENSEN, University of Iowa, Iowa City, Iowa 52242

*Functional analysis and convexity* (46 52) to WILLIAM J. DAVIS, Department of Mathematics, Ohio State University, Columbus, Ohio 43210

*Complex variables, functional analysis, and operator theory* (30 46 47) to PAUL S. MUHLY, Department of Mathematics, University of Iowa, Iowa City, Iowa 52242

*Lie groups and geometry* (22 51 53) to JONATHAN M. ROSENBERG, Department of Mathematics, University of Maryland, College Park, Maryland 20742

*Set theoretic topology* (54) to FRANKLIN D. TALL, Department of Mathematics, University of Toronto, Ontario M5S 1A1, Canada

*Metric and geometric topology* (54 57) to HAMES E. WEST, Department of Mathematics, Cornell University, Ithaca, New York 14853

*Algebraic and differential topology* (55 58) to FREDERICK R. COHEN, Department of Mathematics, University of Rochester, Rochester, New York 14627

*Probability and certain other fields* (60–94 inclusive) to LAWRENCE F. GRAY, Department of Mathematics, University of Minnesota, Minneapolis, Minnesota 55455, or GEORGE C. PAPANICOLAOU, Applied Mathematics Division, New York University-Courant Institute, 251 Mercer Street, New York, New York 10012

All other communications should be addressed to the Managing Editor, WILLIAM J. DAVIS, at the above address.

**Transactions of the American Mathematical Society** is a monthly journal devoted entirely to research in pure and applied mathematics and, in general, includes longer papers than those in the PROCEEDINGS. Two copies of the manuscript should be submitted to one of the following editors.

*Harmonic analysis, representation theory, and Lie theory* to AVNER D. ASH, Department of Mathematics, The Ohio State University, 231 West 18th Avenue, Columbus, OH 43210

*Abstract analysis* to MASAMICHI TAKESAKI, Department of Mathematics, University of California, Los Angeles, CA 90024

*Classical analysis (including complex, real, and harmonic)* to EUGENE FABES, Department of Mathematics, University of Minnesota, Minneapolis, MN 55455

*Algebra and algebraic geometry* to JUDITH D. SALLY, Department of Mathematics, Northwestern University, Evanston, IL 60208

*Geometric topology and general topology* to JAMES W. CANNON, Department of Mathematics, Brigham Young University, Provo, UT 84602

*Algebraic topology and differential topology* to RALPH COHEN, Department of Mathematics, Stanford University, Stanford, CA 94305

*Ordinary differential equations, partial differential equations, and applied mathematics* to ROGER D. NUSSBAUM, Department of Mathematics, Rutgers University, New Brunswick, NJ 08903

*Global analysis and differential geometry* to JERRY L. KAZDAN, Department of Mathematics, University of Pennsylvania, E1, Philadelphia, PA 19104-6395

*Probability and statistics* to BURGESS DAVIS, Departments of Mathematics and Statistics, Purdue University, West Lafayette, IN 47907.

*Combinatorics and number theory* to CARL POMERANCE, Department of Mathematics, University of Georgia, Athens, GA 30602

*Logic, set theory, general topology, and universal algebra* to JAMES E. BAUMGARTNER, Department of Mathematics, Dartmouth College, Hanover, NH 37550

*Algebraic number theory, analytic number theory, and modular forms* to AUDREY TERRAS, Department of Mathematics, University of California at San Diego, La Jolla, CA 92093

All other communications to the editors should be addressed to the Managing Editor, DAVID J. SALTMAN, Department of Mathematics, University of Texas at Austin, Austin, TX 78713

## OTHER JOURNALS

**Abstracts of Papers Presented to the American Mathematical Society** contains abstracts of invited hour addresses, of papers presented in special sessions or in sessions for contributed papers, and of papers presented to the Society "by title".

**Current Mathematical Publications**, issued triweekly, contains a subject-classified index of papers and books being published currently in mathematics.

**Mathematical Reviews** is a monthly journal devoted to abstracts and reviews of the current mathematical literature of the world. Abstracts and reviews are grouped according to the 1980 Mathematics Subject Classification scheme (1985 Revision). The subscription includes an annual author and subject index.

**Notices of the American Mathematical Society**, published ten times a year, contains programs and reports of the meetings of the Society, reports on Society business, communications to the membership, and news items and information of interest to the mathematical community.

# BULLETIN (New Series) of the American Mathematical Society

## EDITORS

### EDITORIAL BOARD FOR RESEARCH-EXPOSITORY PAPERS

Persi Diaconis  
Jerry Kazdan  
Barry Mazur  
Richard S. Palais  
Chairman

David Vogan  
Alan Weinstein  
Guido L. Weiss

### EDITORIAL BOARD FOR RESEARCH ANNOUNCEMENTS

William B. Arveson  
Richard Askey  
Joseph Bernstein  
Gregory L. Cherlin  
Percy Alec Deift  
Michael D. Fried  
Ronald L. Graham

Victor W. Guillemin  
Roger E. Howe  
Chairman  
Robert Lazarsfeld  
Frank S. Quinn III  
Peter B. Shalen  
Nolan R. Wallach

BOOK REVIEWS EDITOR: Murray Protter

MANAGING EDITOR: Murray Protter

## MANUSCRIPT, PROOF, AND COPYING INFORMATION

### MANUSCRIPT

Articles submitted for publication should be typewritten and double-spaced. The *Manual for Authors*, available from the Society, should be consulted for symbols and style conventions. Authors should take the greatest possible care in preparing the original manuscript. Hand-drawn symbols are satisfactory if clearly done; special instructions for the typesetter, when necessary, should be included on a separate sheet.

For Research-Expository Articles and Research Announcements, the first footnote should include *subject classification numbers* representing the primary and secondary subjects of the article. The 1980 Mathematics Subject Classification (1985 Revision) can be found in the annual subject index volumes of *Mathematical Reviews*.

To encourage the submission of manuscripts in electronic form using  $\text{\TeX}$  and the  $\mathcal{A}\mathcal{M}\mathcal{S}$ - $\text{\TeX}$  macro package, the Executive Committee of the Council has adopted a policy that allows for accelerating the publication date of such manuscripts by as much as 20 weeks, which is approximately equal to the time normally needed by the Society for copyediting, typesetting, and proofreading an average manuscript.

### GALLEY PROOF

When a paper with more than one author has been accepted for publication, only one set of galley proof will be sent. Joint authors should, therefore, indicate which of them should receive galley proof in the event that the manuscript is accepted for publication.

### 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 an article 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 (including abstracts) is permitted only under license from the Amer-



ican Mathematical Society. Requests for such permission should be addressed to the Executive Director, American Mathematical Society, P.O. Box 6248, Providence, Rhode Island 02940.

The appearance of the code on the first page of an article in this journal indicates the copyright owner's consent for copying beyond that permitted by Sections 107 or 108 of the U.S. Copyright Law, provided that the fee of \$1.00 plus \$.25 per page for each copy be paid directly to Copyright Clearance Center, Inc., 27 Congress Street, Salem, Massachusetts 01970. This consent does not extend to other kinds of copying, such as copying for general distribution, for advertising or promotion purposes, for creating new collective works, or for resale.

## OFFPRINTS AND ADDRESS CHANGES

Any inquiries concerning a paper which has been accepted for publication, including information regarding reprints or changes of address for mailing proof, should be sent directly to the Editorial Department, American Mathematical Society, P.O. Box 6248, Providence, Rhode Island 02940.

## COPYRIGHT TRANSFER AGREEMENT

The signing of a Copyright Transfer Agreement is a requirement of publication in the BULLETIN. A copy of the agreement is sent to the author upon receipt of a manuscript in the Providence Office of the Society; in case of joint authors, a copy is sent to each author. Authors are urged to return the form immediately to prevent delays in processing and publishing the manuscript. The 1984 edition of the *Manual for Authors* has a description of Society policy concerning copyright and a copy of the agreement.

## PUBLICATION CHARGES

There are no page charges assessed on papers published in the BULLETIN.

## REMARKS ON RESEARCH ANNOUNCEMENTS

The BULLETIN of the American Mathematical Society is the only research mathematical journal received as a privilege of membership in the Society. Its circulation is larger, by an order of magnitude, than that of most journals, in particular specialized journals. Thus, a BULLETIN Research Announcement should contain results of sufficient depth and import to be of interest to a wide mathematical audience. And, consequently, beyond basic mathematical standards, Research Announcements should meet high standards for style.

Beyond general exhortations to write clearly and precisely, the following more specific suggestions are offered.

1. Keep in mind that you are writing for as wide an audience as possible. Avoid the shorthand and jargon of your area as much as you can. Carefully introduce the terminology needed to understand the main results. If space considerations prevent a full development of the concepts, delineate clearly what you are not explaining and provide references to it in the literature. Consider an Announcement an opportunity to explain your area of research to the world at large.

2. Do not confuse a graceful style with a sloppy style. Although a light touch or a colorful phrase can relieve the tedium of definitions, excessive breeziness and imprecision confuse readers who have only a casual knowledge of the subject. We say this not to encourage pedantic writing but to discourage obscure writing. Your results should be stated precisely with all important concepts and notations made clear.

3. Ask a colleague to review your manuscript before you submit it. Even better, ask two colleagues, one whose work is very close to yours, one whose work is farther away. (If you can't get two people you know to read your work before it is published, how many will want to read it after?) Ask for suggestions on how to improve the readability.

---

VOLUME 23



1990

---

# BULLETIN

( N E W S E R I E S )  
OF THE

---

A M E R I C A N M A T H E M A T I C A L S O C I E T Y

---

## EDITORS

Richard S. Palais, *Research Expository Papers*

Murray Protter, *Book Reviews*

Roger E. Howe, *Research Announcements*

## ASSOCIATE EDITORS

William B. Arveson

Richard Askey

Joseph Bernstein

Gregory Cherlin

Percy Alec Deift

Michael D. Fried

Ronald L. Graham

Victor W. Guillemin

Barry Mazur

Robert Lazarsfeld

Frank S. Quinn III

Peter B. Shalen

David Vogan

Nolan R. Wallach

Alan Weinstein

Guido L. Weiss

---

PROVIDENCE, RHODE ISLAND USA

---

ISSN 0273-0979

**COPYING AND REPRINTING.** Individual readers of this publication, and non-profit libraries acting for them, are permitted to make fair use of the material, such as to copy an article 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 (including abstracts) is permitted only under license from the American Mathematical Society. Requests for such permission should be addressed to the Executive Director, American Mathematical Society, P.O. Box 6248, Providence, Rhode Island 02940-6248.

The appearance of the code on the first page of an article in this book indicates the copyright owner's consent for copying beyond that permitted by Sections 107 or 108 of the U.S. Copyright Law, provided that the fee of \$1.00 plus \$.25 per page for each copy be paid directly to the Copyright Clearance Center, Inc., 27 Congress Street, Salem, Massachusetts 01970. This consent does not extend to other kinds of copying, such as copying for general distribution, for advertising or promotional purposes, for creating new collective works, or for resale.

Copyright ©1990 by the American Mathematical Society. All rights reserved.

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. ∞

**Research-Expository Papers**

Notes on invariant subspaces by *Hari Bercovici* ..... 1  
 Old and new conjectured diophantine inequalities by *Serge Lang* ..... 37

**Research Announcements**

Towards computerized proofs of identities by *Herbert S. Wilf and Doron Zeilberger* ..... 77  
 Splittings of surfaces by *Richard K. Skora* ..... 85  
 Heegaard surfaces in Haken 3-manifolds by *Klaus Johannson* ..... 91  
 Not all links are concordant to boundary links by *T. D. Cochran and K. E. Orr* ..... 99  
 Deformation rigidity for subgroups of  $SL(n, \mathbb{Z})$  acting on the  $n$ -torus by *Steven Hurder* ..... 107  
 A nonlinear extension of the Borel density theorem: Applications to invariance of geometric structures and to smooth orbit equivalence by *Alessandra Iozzi* ..... 115  
 Finitely generated groups,  $p$ -adic analytic groups, and Poincaré series by *Marcus P. F. du Sautoy* ..... 121  
 Ramanujan graphs and Hecke operators by *Arnold K. Pizer* ..... 127  
 Fundamental solutions and harmonic analysis on nilpotent groups by *A. Nagel, F. Ricci, and E. M. Stein* ..... 139  
 Gorenstein local homomorphisms by *Luchezar L. Avramov and Hans-Bjørn Foxby* ..... 145  
 The jump is definable in the structure of the degrees of unsolvability by *S. Barry Cooper* ..... 151  
 The adaption problem for approximating linear operators by *Mark A. Kon and Erich Novak* ..... 159

**Book Reviews**

Schander bases: Behavior and stability by *P. K. Kamthan and M. Gupta*—  
 Reviewed by *J. R. Retherford* ..... 167  
 Continuous decoupling transformations for linear boundary value problems  
 by *P. M. van Loon*—Reviewed by *Wolfgang Wasow* ..... 173  
 Derivatives, nuclei and dimensions on the frame of torsion theories by  
*Jonathan S. Golan and Harold Simmons*—Reviewed by *P. T. Johnstone* ..... 178  
 Algebraic homotopy by *H. J. Baues*—Reviewed by *Ronald Brown* ..... 182

<b>Andreotti-Grauert theory by integral formulas</b> by <i>Gennadi M. Henkin and Jürgen Leiterer</i> —Reviewed by <i>R. Michael Range</i> .....	190
<b>Interpolation of operators</b> by <i>Colin Bennett and Robert Sharpley</i> —Reviewed by <i>Yoram Sagher</i> .....	198
<b>Theory of relations</b> by <i>R. Fraïssé</i> —Reviewed by <i>Arnold W. Miller</i> .....	206
<b>Boundary value problems of finite elasticity</b> by <i>T. Valent</i> —Reviewed by <i>Philippe G. Ciarlet</i> .....	209
<b>Heat kernels and spectral theory</b> by <i>E. B. Davies</i> —Reviewed by <i>Robert S. Strichartz</i> .....	222
<b>Stochastic processes with a multidimensional parameter</b> by <i>M. Dozzi</i> —Reviewed by <i>Ely Merzbach</i> .....	228
<b>Art gallery theorems and algorithms</b> by <i>Joseph O'Rourke</i> —Reviewed by <i>David Avis</i> .....	230
<b>Huygens' principle and hyperbolic equations</b> by <i>Paul Günther</i> —Reviewed by <i>Bent Ørsted</i> .....	235
<b>Existentially closed groups</b> by <i>Graham Higman and Elizabeth Scott</i> —Reviewed by <i>Kenneth Hickin</i> .....	242

## CONTENTS

OCTOBER 1990

---

### Research-Expository Papers

<b>Multiplication of distributions</b> by <i>J. F. Colombeau</i> .....	251
<b>Exponential sums over finite fields and differential equations over the complex numbers: some interactions</b> by <i>Nicholas M. Katz</i> .....	269
<b>Elliptic methods in symplectic geometry</b> by <i>Dusa McDuff</i> .....	311
<b>Hurwitz groups: a brief survey</b> by <i>Marston Conder</i> .....	359

### Research Announcements

<b>Torsion points on elliptic curves</b> by <i>S. Kamienny</i> .....	371
<b>The behavior of the Mordell-Weil group of elliptic curves</b> by <i>Armand Brumer and Oisín McGuinness</i> .....	375
<b>A new upper bound for the minimum of an integral lattice of determinant 1</b> by <i>J. H. Conway and N. J. A. Sloane</i> .....	383
<b><math>L</math> functions for the group <math>G_2</math></b> by <i>I. Piatetski-Shapiro, S. Rallis, and G. Schiffmann</i> .....	389
<b>Subgroups of polynomial automorphisms</b> by <i>Edwin Connell and John Zweibel</i> .....	401
<b>Circle packings in the approximation of conformal mappings</b> by <i>Kenneth Stephenson</i> .....	407

<b>The topology of complete one-ended minimal surfaces and Heegaard surfaces in <math>\mathbb{R}^3</math></b> by <i>Charles Frohman and William H. Meeks III</i> . . . . .	417
<b>A finiteness theorem for Ricci curvature in dimension three</b> by <i>Shun-Hui Zhu</i> . . . . .	423
<b>Simply connected manifolds of positive scalar curvature</b> by <i>Stephan Stolz</i>	427
<b>Isospectral families of conformally equivalent Riemannian metrics</b> by <i>Robert Brooks and Carolyn Gordon</i> . . . . .	433
<b>Complete noncompact Kähler manifolds with positive holomorphic bisectional curvature</b> by <i>Wan-Xiong Shi</i> . . . . .	437
<b>Some new results on the topology of nonsingular real algebraic sets</b> by <i>Selman Akbulut and Henry King</i> . . . . .	441
<b>Exotic cohomology and index theory</b> by <i>John Roe</i> . . . . .	447
<b>The tensor product problem for reflexive algebras</b> by <i>Jon Kraus</i> . . . . .	455
<b>Triangular algebras and ideals of nest algebras</b> by <i>John Lindsay Orr</i> . . .	461
<b>Antimonotonicity: concurrent creation and annihilation of periodic orbits</b> by <i>I. Kan and J. A. Yorke</i> . . . . .	469
<b>A new formulation of the generalized Toda lattice equations and their fixed point analysis via the momentum map</b> by <i>Anthony M. Bloch, Roger W. Brockett, and Tudor S. Ratiu</i> . . . . .	477
<b>On the complete integrability of some lax systems on <math>GL(n, \mathbb{R}) \times GL(n, \mathbb{R})</math></b> by <i>Luen-Chau Li</i> . . . . .	487
<b>A simplified version of the abstract Cauchy-Kowalewski theorem with weak singularities</b> by <i>Russel E. Caflisch</i> . . . . .	495
<b>Zero-order perturbations of the subelliptic Laplacian on the Heisenberg group and their uniqueness properties</b> by <i>Nicola Garofalo and Ermanno Lanconelli</i> . . . . .	501
<b>Subcriticality, positivity, and gaugeability of the Schrödinger operator</b> by <i>Z. Zhao</i> . . . . .	513
<b><math>L^p \rightarrow L^{p'}</math> estimates for time-dependent Schrödinger operators</b> by <i>J. L. Journé, A. Soffer, and C. D. Sogge</i> . . . . .	519
<b>On the energy of a large atom</b> by <i>Charles L. Fefferman and Luis A. Seco</i>	525
<b>Shape optimization for Dirichlet problems: relaxed solutions and optimality conditions</b> by <i>Giuseppe Buttazzo and Gianni Dal Maso</i>	531
<b>Discrete analogues of singular radon transforms</b> by <i>E. M. Stein and S. Wainger</i> . . . . .	537
<b>Book Reviews</b>	
<b>The linearization method in hydrodynamical stability theory</b> by <i>V. I. Yudovich</i> —Reviewed by <i>D. H. Sattinger</i> . . . . .	545
<b><math>J</math> Contractive matrix functions, reproducing kernel Hilbert spaces and interpolation</b> by <i>Harry Dym</i> —Reviewed by <i>Joseph A. Ball</i> . . . . .	547

<b>Operators and representation theory: Canonical models for algebras of operators arising in quantum mechanics</b> by <i>P. E. T. Jorgensen</i> — Reviewed by <i>Roe Goodman</i> .....	551
<b>Initial-boundary value problems and the Navier-Stokes equations</b> by <i>Heinz-Otto Kreiss and Jens Lorenz</i> —Reviewed by <i>Peter Constantin</i>	555
<b>Mathematical problems from combustion theory</b> by <i>Jerrold Bebernes and David Eberly</i> —Reviewed by <i>A. K. Kapila</i> .....	559
<b>The asymptotic solution of linear differential systems, applications of the Levinson theorem</b> by <i>M. S. P. Eastham</i> —Reviewed by <i>Allen Devinatz</i> .....	563
<b>Conformal geometry</b> by <i>Ravi S. Kulkarni and Ulrich Pinkall, eds.</i> — Reviewed by <i>William M. Goldman</i> .....	566
<b>Real analysis and probability</b> by <i>R. M. Dudley</i> —Reviewed by <i>Mark A. Pinsky</i> .....	575
<b>Noncommutative Noetherian rings</b> by <i>J. C. McConnell and J. C. Robson</i> — Reviewed by <i>Edward Formanek</i> .....	579
<b>Foliations on Riemannian manifolds</b> by <i>Philippe Tondeur</i> ; <b>Riemannian foliations</b> by <i>Pierre Molino</i> —Reviewed by <i>L. Conlon</i> .....	583
<b>Elementary geometry in hyperbolic space</b> by <i>Werner Fenchel</i> —Reviewed by <i>J. B. Wilker</i> .....	589
<b>The classical groups and K-theory</b> by <i>A. J. Hahn and O. T. O'Meara</i> — Reviewed by <i>Robert Steinberg</i> .....	594
<b>Harmonic analysis of spherical functions on real reductive groups</b> by <i>R. Gangolli and V. S. Varadarajan</i> —Reviewed by <i>D. Barbasch</i> .....	598
<b>Binary quadratic forms, classical theory and applications</b> by <i>D. A. Buell</i> — Reviewed by <i>D. H. Lehmer</i> .....	604
<b>The emperor's new mind</b> by <i>Roger Penrose</i> —Reviewed by <i>John McCarthy</i>	606
<b>Cosmology in (2+1)-dimensions, cyclic models, and deformations of <math>M_{2,1}</math></b> by <i>Victor Guillemin</i> —Reviewed by <i>John K. Beem</i> .....	616
<b>The averaged moduli of smoothness with applications in numerical methods and approximation</b> by <i>Blagovest Sendov and Vasil A. Popov</i> — Reviewed by <i>R. J. Nessel</i> .....	618
<b>Matrix norms and their applications</b> by <i>G. R. Belitskii and Yu. I. Lyubich</i> —Reviewed by <i>Peter A. Fillmore</i> .....	620
<b>Vibration and coupling of continuous systems: asymptotic methods</b> by <i>Jacqueline Sanchez Hubert and Enrique Sanchez Palencia</i> — —Reviewed by <i>M. Slemrod</i> .....	623
<b>An introduction to the numerical analysis of spectral methods</b> by <i>Bertrand Mercier</i> —Reviewed by <i>Levi Lustman</i> .....	626
<b>The theory of fixed point classes</b> by <i>Kiang Tsai-Han</i> —Reviewed by <i>D. R. Smart</i> .....	630

(Continued from inside back cover)

<b>Elementary geometry in hyperbolic space</b> by <i>Werner Fenchel</i> —Reviewed by <i>J. B. Wilker</i> .....	589
<b>The classical groups and <math>K</math>-theory</b> by <i>A. J. Hahn and O. T. O'Meara</i> —Reviewed by <i>Robert Steinberg</i> .....	594
<b>Harmonic analysis of spherical functions on real reductive groups</b> by <i>R. Gangolli and V. S. Varadarajan</i> —Reviewed by <i>D. Barbasch</i> .....	598
<b>Binary quadratic forms, classical theory and applications</b> by <i>D. A. Buell</i> —Reviewed by <i>D. H. Lehmer</i> .....	604
<b>The emperor's new mind</b> by <i>Roger Penrose</i> —Reviewed by <i>John McCarthy</i>	606
<b>Cosmology in <math>(2+1)</math>-dimensions, cyclic models, and deformations of <math>M_{2,1}</math></b> by <i>Victor Guillemin</i> —Reviewed by <i>John K. Beem</i> .....	616
<b>The averaged moduli of smoothness with applications in numerical methods and approximation</b> by <i>Blagovest Sendov and Vasil A. Popov</i> —Reviewed by <i>R. J. Nessel</i> .....	618
<b>Matrix norms and their applications</b> by <i>G. R. Belitskii and Yu. I. Lyubich</i> —Reviewed by <i>Peter A. Fillmore</i> .....	620
<b>Vibration and coupling of continuous systems: asymptotic methods</b> by <i>Jacqueline Sanchez Hubert and Enrique Sanchez Palencia</i> —Reviewed by <i>M. Slemrod</i> .....	623
<b>An introduction to the numerical analysis of spectral methods</b> by <i>Bertrand Mercier</i> —Reviewed by <i>Levi Lustman</i> .....	626
<b>The theory of fixed point classes</b> by <i>Kiang Tsai-Han</i> —Reviewed by <i>D. R. Smart</i> .....	630





(Continued from back cover)

<b>On the complete integrability of some Lax systems on <math>GL(n, R) \times GL(n, R)</math></b> by <i>Luen-Chau Li</i> .....	487
<b>A simplified version of the abstract Cauchy-Kowalewski theorem with weak singularities</b> by <i>Russel E. Caflisch</i> .....	495
<b>Zero-order perturbations of the subelliptic Laplacian on the Heisenberg group and their uniqueness properties</b> by <i>Nicola Garofalo and Ermanno Lanconelli</i> .....	501
<b>Subcriticality, positivity, and gaugeability of the Schrödinger operator</b> by <i>Z. Zhao</i> .....	513
<b><math>L^p \rightarrow L^{p'}</math> estimates for time-dependent Schrödinger operators</b> by <i>J. L. Journé, A. Soffer, and C. D. Sogge</i> .....	519
<b>On the energy of a large atom</b> by <i>Charles L. Fefferman and Luis A. Seco</i>	525
<b>Shape optimization for Dirichlet problems: relaxed solutions and optimality conditions</b> by <i>Giuseppe Buttazzo and Gianni Dal Maso</i>	531
<b>Discrete analogues of singular radon transforms</b> by <i>E. M. Stein and S. Wainger</i> .....	537
<b>Book Reviews</b>	
<b>The linearization method in hydrodynamical stability theory</b> by <i>V. I. Yudovich</i> —Reviewed by <i>D. H. Sattinger</i> .....	545
<b><math>J</math> Contractive matrix functions, reproducing kernel Hilbert spaces and interpolation</b> by <i>Harry Dym</i> —Reviewed by <i>Joseph A. Ball</i> .....	547
<b>Operators and representation theory: Canonical models for algebras of operators arising in quantum mechanics</b> by <i>P. E. T. Jorgensen</i> —Reviewed by <i>Roe Goodman</i> .....	551
<b>Initial-boundary value problems and the Navier-Stokes equations</b> by <i>Heinz-Otto Kreiss and Jens Lorenz</i> —Reviewed by <i>Peter Constantin</i>	555
<b>Mathematical problems from combustion theory</b> by <i>Jerrold Bebernes and David Eberly</i> —Reviewed by <i>A. K. Kapila</i> .....	559
<b>The asymptotic solution of linear differential systems, applications of the Levinson theorem</b> by <i>M. S. P. Eastham</i> —Reviewed by <i>Allen Devinatz</i> .....	563
<b>Conformal geometry</b> by <i>Ravi S. Kulkarni and Ulrich Pinkall, eds.</i> —Reviewed by <i>William M. Goldman</i> .....	566
<b>Real analysis and probability</b> by <i>R. M. Dudley</i> —Reviewed by <i>Mark A. Pinsky</i> .....	575
<b>Noncommutative Noetherian rings</b> by <i>J. C. McConnell and J. C. Robson</i> —Reviewed by <i>Edward Formanek</i> .....	579
<b>Foliations on Riemannian manifolds</b> by <i>Philippe Tondeur, Riemannian foliations</i> by <i>Pierre Molino</i> —Reviewed by <i>L. Conlon</i> .....	583

(Continued on facing page)

**Research-Expository Papers**

**Multiplication of distributions** by *J. F. Colombeau* ..... 251

**Exponential sums over finite fields and differential equations over the complex numbers: some interactions** by *Nicholas M. Katz* ..... 269

**Elliptic methods in symplectic geometry** by *Dusa McDuff* ..... 311

**Hurwitz groups: a brief survey** by *Marston Conder* ..... 359

**Research Announcements**

**Torsion points on elliptic curves** by *S. Kamienny* ..... 371

**The behavior of the Mordell-Weil group of elliptic curves** by *Armand Brumer and Oisín McGuinness* ..... 375

**A new upper bound for the minimum of an integral lattice of determinant 1** by *J. H. Conway and N. J. A. Sloane* ..... 383

**$L$  functions for the group  $G_2$**  by *I. Piatetski-Shapiro, S. Rallis, and G. Schiffmann* ..... 389

**Subgroups of polynomial automorphisms** by *Edwin Connell and John Zweibel* ..... 401

**Circle packings in the approximation of conformal mappings** by *Kenneth Stephenson* ..... 407

**The topology of complete one-ended minimal surfaces and Heegaard surfaces in  $\mathbb{R}^3$**  by *Charles Frohman and William H. Meeks III* ..... 417

**A finiteness theorem for Ricci curvature in dimension three** by *Shun-Hui Zhu* ..... 423

**Simply connected manifolds of positive scalar curvature** by *Stephan Stolz* ..... 427

**Isospectral families of conformally equivalent Riemannian metrics** by *Robert Brooks and Carolyn Gordon* ..... 433

**Complete noncompact Kähler manifolds with positive holomorphic bisectional curvature** by *Wan-Xiong Shi* ..... 437

**Some new results on the topology of nonsingular real algebraic sets** by *Selman Akbulut and Henry King* ..... 441

**Exotic cohomology and index theory** by *John Roe* ..... 447

**The tensor product problem for reflexive algebras** by *Jon Kraus* ..... 455

**Triangular algebras and ideals of nest algebras** by *John Lindsay Orr* ... 461

**Antimonotonicity: concurrent creation and annihilation of periodic orbits** by *I. Kan and J. A. Yorke* ..... 469

**A new formulation of the generalized Toda lattice equations and their fixed point analysis via the momentum map** by *Anthony M. Bloch, Roger W. Brockett, and Tudor S. Ratiu* ..... 477

(Continued on inside back cover)