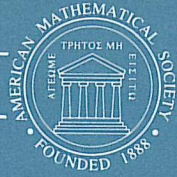

VOLUME 350 NUMBER 5



MAY 1998

WHOLE NUMBER 756

TRANSACTIONS

OF THE

AMERICAN MATHEMATICAL SOCIETY

EDITED BY

Rodrigo Bañuelos

William Beckner

Daniel M. Burns

Charles W. Curtis

Lawrence Ein

Philip J. Hanlon

Barbara Lee Keyfitz

John Luecke

John Mallet-Paret

Stewart Priddy

Peter Shalen, Managing Editor

Alice Silverberg

Theodore Slaman

Robert J. Stanton

Chuu-Lian Terng

Robert F. Williams

PROVIDENCE, RHODE ISLAND USA

ISSN 0002-9947

Transactions of the American Mathematical Society

This journal is devoted entirely to research in pure and applied mathematics.

Submission information. See **Information for Authors** at the end of this issue.

Publisher Item Identifier. The Publisher Item Identifier (PII) appears at the top of the first page of each article published in this journal. This alphanumeric string of characters uniquely identifies each article and can be used for future cataloging, searching, and electronic retrieval.

Subscription information. *Transactions of the American Mathematical Society* is published monthly. Beginning in January 1996 *Transactions* is accessible from e-MATH via the World Wide Web at the URL <http://www.ams.org/publications/>. Subscription prices for Volume 350 (1998) are as follows: for paper delivery, \$1156 list, \$925 institutional member, \$1040 corporate member; for electronic delivery, \$1040 list, \$832 institutional member, \$936 corporate member. Upon request, subscribers to paper delivery of this journal are also entitled to receive electronic delivery. If ordering the paper version, add \$27 for surface delivery outside the United States and India; \$50 to India. Expedited delivery to destinations in North America is \$45; elsewhere \$142. For paper delivery a late charge of 10% of the subscription price will be imposed upon orders received from nonmembers after January 1 of the subscription year.

Back number information. For back issues see the *AMS Catalog of Publications*.

Subscriptions and orders should be addressed to the American Mathematical Society, P.O. Box 5904, Boston, MA 02206-5904. *All orders must be accompanied by payment.* Other correspondence should be addressed to P.O. Box 6248, Providence, RI 02940-6248.

Copying and reprinting. Material in this journal may be reproduced by any means for educational and scientific purposes without fee or permission with the exception of reproduction by services that collect fees for delivery of documents and provided that the customary acknowledgment of the source is given. This consent does not extend to other kinds of copying for general distribution, for advertising or promotional purposes, or for resale. Requests for permission for commercial use of material should be addressed to the Assistant to the Publisher, American Mathematical Society, P. O. Box 6248, Providence, RI 02940-6248. Requests can also be made by e-mail to reprint-permission@ams.org.

Excluded from these provisions is material in articles for which the author holds copyright. In such cases, requests for permission to use or reprint should be addressed directly to the author(s). (Copyright ownership is indicated in the notice in the lower right-hand corner of the first page of each article.)

Transactions of the American Mathematical Society is published monthly by the American Mathematical Society at 201 Charles Street, Providence, RI 02904-2213. Periodicals postage is paid at Providence, Rhode Island. Postmaster: Send address changes to *Transactions*, American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248.

© 1998 by the American Mathematical Society. All rights reserved.

This journal is indexed in *Science Citation Index*[®], *SciSearch*[®],
Research Alert[®], *CompuMath Citation Index*[®], and
Current Contents[®]/*Physical, Chemical & Earth Sciences*.

Printed in the United States of America.

⊗ The paper used in this journal is acid-free and falls within the guidelines established to ensure permanence and durability.

10 9 8 7 6 5 4 3 2 1 03 02 01 00 99 98

Editorial Information

To be published in the *Transactions*, a paper must be correct, new, nontrivial, and significant. Further, it must be well written and of interest to a substantial number of mathematicians. Piecemeal results, such as an inconclusive step toward an unproved major theorem or a minor variation on a known result, are in general not acceptable for publication.

Papers submitted to the *Transactions* should exceed 10 published journal pages in length. Shorter papers may be submitted to the *Proceedings of the American Mathematical Society*. Published pages are the same size as those generated in the style files provided for $\mathcal{A}\mathcal{M}\mathcal{S}$ - $\mathcal{L}\mathcal{A}\mathcal{T}\mathcal{E}\mathcal{X}$ or $\mathcal{A}\mathcal{M}\mathcal{S}$ - $\mathcal{T}\mathcal{E}\mathcal{X}$.

As of December 31, 1997, the backlog for this journal was approximately 14 issues. This estimate is the result of dividing the number of manuscripts for this journal in the Providence office that have not yet gone to the printer on the above date by the average number of articles per issue over the previous twelve months, reduced by the number of issues published in four months (the time necessary for editing and composing a typical issue).

A Consent to Publish and Copyright Agreement is required before a paper will be published in this journal. After a paper is accepted for publication, the Providence office will send a Consent to Publish and Copyright Agreement to all authors of the paper. By submitting a paper to this journal, authors certify that the results have not been submitted to nor are they under consideration for publication by another journal, conference proceedings, or similar publication.

Information for Authors

Initial submission. Two copies of the paper should be sent directly to the appropriate Editor and the author should keep a copy.

The first page must consist of a *descriptive title*, followed by an *abstract* that summarizes the article in language suitable for workers in the general field (algebra, analysis, etc.). The *descriptive title* should be short, but informative; useless or vague phrases such as “some remarks about” or “concerning” should be avoided. The *abstract* should be at least one complete sentence, and at most 300 words. Included with the footnotes to the paper, there should be the 1991 *Mathematics Subject Classification* representing the primary and secondary subjects of the article. This may be followed by a list of *key words and phrases* describing the subject matter of the article and taken from it. A list of classifications may be found in the annual index of *Mathematical Reviews*, published with the December issue starting in 1990. Journal abbreviations used in bibliographies are also listed in the latest *Mathematical Reviews* annual index. The classifications and the journal abbreviations are accessible from e-MATH via the World Wide Web through the URL <http://www.ams.org/publications/>. When the manuscript is submitted, authors should supply the editor with electronic addresses if available. These will be printed after the postal address at the end of each article.

Electronically prepared manuscripts. The AMS encourages electronically prepared manuscripts, with a strong preference for $\mathcal{A}\mathcal{M}\mathcal{S}$ - $\mathcal{L}\mathcal{A}\mathcal{T}\mathcal{E}\mathcal{X}$. To this end, the Society has prepared $\mathcal{A}\mathcal{M}\mathcal{S}$ - $\mathcal{L}\mathcal{A}\mathcal{T}\mathcal{E}\mathcal{X}$ author packages for each AMS publication. Author packages include instructions for preparing electronic manuscripts, the *AMS Author Handbook*, samples, and a style file that generates the particular design specifications of that publication series. Articles properly prepared using the $\mathcal{A}\mathcal{M}\mathcal{S}$ - $\mathcal{L}\mathcal{A}\mathcal{T}\mathcal{E}\mathcal{X}$ style file automatically provide hypertext linking to the bibliography and other elements of the article for searching electronically on the World Wide Web. Because linking must often be added manually to electronically prepared manuscripts in

other forms of $\text{T}_{\text{E}}\text{X}$, using $\mathcal{A}\mathcal{M}\mathcal{S}\text{-L}\text{A}\text{T}_{\text{E}}\text{X}$ also reduces the amount of technical intervention once the files are received by the AMS. This results in fewer errors in processing and saves the author proofreading time. $\mathcal{A}\mathcal{M}\mathcal{S}\text{-L}\text{A}\text{T}_{\text{E}}\text{X}$ papers also move more efficiently through the production stream, helping to minimize publishing costs.

$\mathcal{A}\mathcal{M}\mathcal{S}\text{-L}\text{A}\text{T}_{\text{E}}\text{X}$ is the highly preferred format of $\text{T}_{\text{E}}\text{X}$, but author packages are also available in $\mathcal{A}\mathcal{M}\mathcal{S}\text{-T}_{\text{E}}\text{X}$. Those authors who make use of these style files from the beginning of the writing process will further reduce their own efforts. Manuscripts prepared electronically in $\text{L}\text{A}\text{T}_{\text{E}}\text{X}$ or plain $\text{T}_{\text{E}}\text{X}$ are normally not acceptable due to the high amount of technical time required to insure that the file will run properly through the AMS in-house production system. $\text{L}\text{A}\text{T}_{\text{E}}\text{X}$ users will find that $\mathcal{A}\mathcal{M}\mathcal{S}\text{-L}\text{A}\text{T}_{\text{E}}\text{X}$ is the same as $\text{L}\text{A}\text{T}_{\text{E}}\text{X}$ with additional commands to simplify the typesetting of mathematics, and users of plain $\text{T}_{\text{E}}\text{X}$ should have the foundation for learning $\mathcal{A}\mathcal{M}\mathcal{S}\text{-L}\text{A}\text{T}_{\text{E}}\text{X}$.

Authors may retrieve an author package from e-MATH via the World Wide Web through the URL <http://www.ams.org/tex/> or via FTP to <ftp.ams.org> (login as `anonymous` and enter username as password). The author package can also be obtained free of charge by sending e-mail to pub@ams.org (Internet) or from the Publication Division, American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248. When requesting an author package, please specify $\mathcal{A}\mathcal{M}\mathcal{S}\text{-L}\text{A}\text{T}_{\text{E}}\text{X}$ or $\mathcal{A}\mathcal{M}\mathcal{S}\text{-T}_{\text{E}}\text{X}$, Macintosh or IBM (3.5) format, and the publication in which your paper will appear. Please be sure to include your complete mailing address.

At the time of submission, authors should indicate if the paper has been prepared using $\mathcal{A}\mathcal{M}\mathcal{S}\text{-L}\text{A}\text{T}_{\text{E}}\text{X}$ or $\mathcal{A}\mathcal{M}\mathcal{S}\text{-T}_{\text{E}}\text{X}$ and provide the Editor with a paper manuscript that matches the electronic manuscript. The final version of the electronic manuscript should be sent to the Providence office immediately after the paper has been accepted for publication. The author should also send the final version of the paper manuscript to the Editor, who will forward a copy to the Providence office. Editors will require authors to send their electronically prepared manuscripts to the Providence office in a timely fashion. Electronically prepared manuscripts can be sent via e-mail to pub-submit@ams.org (Internet) or on diskette to the Electronic Prepress Department, American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248. When sending a manuscript electronically, please be sure to include a message indicating in which publication the paper has been accepted. No corrections will be accepted electronically. Authors must mark their changes on their proof copies and return them to the Providence office. Complete instructions on how to send files are included in the author package.

Electronic graphics. Figures may be sent to the AMS in an electronic format. The AMS recommends that graphics created electronically be saved in Encapsulated PostScript (EPS) format. This includes graphics originated via a graphics application as well as scanned photographs or other computer-generated images.

If the graphics package used does not support EPS output, the graphics file should be saved in one of the standard graphics formats—such as TIFF, PICT, GIF, etc.—rather than in an application-dependent format. Graphics files sent in an application-dependent format are not likely to be used. No matter what method was used to produce the graphic, it is necessary to provide a paper copy to the AMS.

Authors using graphics packages for the creation of electronic art should also avoid the use of any lines thinner than 0.5 points in width. Many graphics packages allow the user to specify a “hairline” for a very thin line. Hairlines often look acceptable when proofed on a typical laser printer. However, when produced on a

high-resolution laser imagesetter, hairlines become nearly invisible and will be lost entirely in the final printing process.

Screens should be set to values between 15% and 85%. Screens which fall outside of this range are too light or too dark to print correctly.

TEX files available. Beginning with the January 1992 issue of the *Bulletin* and the January 1996 issues of *Transactions*, *Proceedings*, *Mathematics of Computation*, and the *Journal of the AMS*, TEX files can be downloaded from e-MATH, starting from URL <http://www.ams.org/journals/>. Authors without Web access may request their files at the address given below after the article has been published. For *Bulletin* papers published in 1987 through 1991 and for *Transactions*, *Proceedings*, *Mathematics of Computation*, and the *Journal of the AMS* papers published in 1987 through 1995, TEX files are available upon request for authors without Web access by sending e-mail to file-request@ams.org or by contacting the Electronic Prepress Department, American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248. The request should include the title of the paper, the name(s) of the author(s), the name of the publication in which the paper has or will appear, and the volume and issue numbers if known. The TEX file will be sent to the author making the request after the article goes to the printer. If the requestor can receive Internet e-mail, please include the e-mail address to which the file should be sent. Otherwise please indicate a diskette format and postal address to which a disk should be mailed. **Note:** Because TEX production at the AMS sometimes requires extra fonts and macros that are not yet publicly available, TEX files cannot be guaranteed to run through the author's version of TEX without errors. The AMS regrets that it cannot provide support to eliminate such errors in the author's TEX environment.

Any inquiries concerning a paper that has been accepted for publication should be sent directly to the Electronic Prepress Department, American Mathematical Society, P. O. Box 6248, Providence, RI 02940-6248.

Editors

Two copies of papers intended for publication in *Transactions* or *Memoirs* should be addressed to the appropriate editor. Subjects, and the editors associated with them, follow.

Harmonic analysis, representation theory, and Lie theory, ROBERT J. STANTON, Department of Mathematics, Ohio State University, 231 West 18th Avenue, Columbus, OH 43210-1174; e-mail: stanton@math.ohio-state.edu

Ergodic theory and dynamical systems, ROBERT F. WILLIAMS, Department of Mathematics, University of Texas, Austin, TX 78712-1082; e-mail: bob@math.utexas.edu

Algebra, CHARLES W. CURTIS, Department of Mathematics, University of Oregon, Eugene, OR 97403-1222; e-mail: curtis@darkwing.uoregon.edu

Geometric topology, knot theory, hyperbolic geometry, and general topology, JOHN LUECKE, Department of Mathematics, University of Texas, Austin, TX 78712-1082; e-mail: luecke@math.utexas.edu

Algebraic topology and cohomology of groups, STEWART PRIDDY, Department of Mathematics, Northwestern University, 2033 Sheridan Road, Evanston, IL 60288-2730; e-mail: s_priddy@math.nwu.edu

Ordinary differential equations, partial differential equations, and applied mathematics, JOHN MALLET-PARET, Division of Applied Mathematics, Brown University, Providence, RI 02912-9000; e-mail: jmp@cfm.brown.edu

Differential geometry and global analysis, CHUU-LIAN TERNG, Department of Mathematics, Northeastern University, Boston, MA 02115-5096; e-mail: terng@neu.edu

Probability and statistics, RODRIGO BAÑUELOS, Department of Mathematics, Purdue University, West Lafayette, IN 47907; e-mail: banuelos@math.purdue.edu

Combinatorics and Lie theory, PHILIP J. HANLON, Department of Mathematics, University of Michigan, Ann Arbor, MI 48109-1003; e-mail: hanlon@math.lsa.umich.edu

Logic, THEODORE SLAMAN, Department of Mathematics, University of California, Berkeley, CA 94720-3840; e-mail: slaman@math.berkeley.edu

Number theory and arithmetic algebraic geometry, ALICE SILVERBERG, c/o Department of Mathematics, Harvard University, 1 Oxford St.-Science Center, Cambridge, MA 02138; e-mail: silver@math.ohio-state.edu

Complex analysis and complex geometry, DANIEL M. BURNS, Department of Mathematics, University of Michigan, Ann Arbor, MI 48109-1003; e-mail: dburns@math.lsa.umich.edu

Algebraic geometry and commutative algebra, LAWRENCE EIN, Department of Mathematics, University of Illinois, 851 S. Morgan (M/C 249), Chicago, IL 60607-7045; e-mail: ein@uic.edu

Real and harmonic analysis and geometric partial differential equations, WILLIAM BECKNER, Department of Mathematics, University of Texas, Austin, TX 78712-1082; e-mail: beckner@math.utexas.edu

Partial differential equations and applied mathematics, BARBARA LEE KEYFITZ, Department of Mathematics, University of Houston, 4800 Calhoun, Houston, TX 77204-3476; e-mail: keyfitz@uh.edu

All other communications to the editors should be addressed to the Managing Editor, PETER SHALEN, Department of Mathematics, Statistics and Computer Science (M/C 249), University of Illinois at Chicago, 851 S. Morgan Street, Chicago, IL 60607-7045; e-mail: shalen@math.uic.edu.

MEMOIRS OF THE AMERICAN MATHEMATICAL SOCIETY

This bimonthly journal is devoted to research in pure and applied mathematics of much the same nature as appears in *Transactions*. An issue consists of one or more separately bound research tracts for which the author(s) has provided reproduction copy. Prior to 1975 this was published as a monograph series. The editorial committee is identical with that for the *Transactions* so that papers intended for publication in this series should be addressed to one of the editors.

TRANSACTIONS OF THE AMERICAN MATHEMATICAL SOCIETY

CONTENTS

Vol. 350, No. 5

Whole No. 756

May 1998

C. McA. Gordon, Boundary slopes of punctured tori in 3-manifolds 1713

Michael Hutchings, Integration of singular braid invariants and graph cohomology 1791

Lin Zhou, Integral representation of continuous comonotonically additive functionals 1811

Peter Müller, Kronecker conjugacy of polynomials 1823

S. V. Ivanov and P. E. Schupp, On the hyperbolicity of small cancellation groups and one-relator groups 1851

K. L. Vaninsky, A convexity theorem in the scattering theory for the Dirac operator 1895

Mark R. Johnson, Linkage and sums of ideals 1913

Robert D. Thompson, The L_2 -localization of $W(n)$ 1931

André Boivin and Roman Dwilewicz, Extension and approximation of CR functions on tube manifolds 1945

Massimo Ferrarotti and Leslie C. Wilson, Generalized Hestenes' Lemma and extension of functions 1957

F. J. López, Hyperbolic complete minimal surfaces with arbitrary topology 1977

M. V. Clase, Prime and Semiprime Semigroup algebras of cancellative semigroups 1991

Maria Izabel Ramalho Martins, Composition factors of indecomposable modules 2009

Ajay Kumar and Allan M. Sinclair, Equivalence of norms on operator space tensor products of C^* -algebras 2033

Michael Brian Korey, Carleson conditions for asymptotic weights 2049

Charles J. K. Batty, Jan van Neerven, and Frank Rübiger, Local spectra and individual stability of uniformly bounded C_0 -semigroups . 2071

Charles J. K. Batty, Jan van Neerven, and Frank Rübiger, Tauberian theorems and stability of solutions of the Cauchy problem 2087

Ognyan Iv. Kounchev, Minimizing the Laplacian of a function squared with prescribed values on interior boundaries— Theory of polysplines 2105

Makoto Tamura, The average edge order of triangulations of 3-manifolds with boundary 2129



0002-9947(199805)350:5;1-P