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.

Postings to the AMS website. Articles are posted to the AMS website individually after proof is returned from authors and before appearing in an issue.

Subscription information. Transactions of the American Mathematical Society is published monthly. Beginning in January 1996 Transactions is accessible from www.ams.org/journals/. Subscription prices for Volume 357 (2005) are as follows: for paper delivery, US$1628 list, US$1302 institutional member, US$1465 corporate member; for electronic delivery, US$1465 list, US$1172 institutional member, US$1319 corporate member. Upon request, subscribers to paper delivery of this journal are also entitled to receive electronic delivery. If ordering the paper version, add US$39 for surface delivery outside the United States and India; US$50 to India. Expedited delivery to destinations in North America is US$48; elsewhere US$144. 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 www.ams.org/bookstore.

Subscriptions and orders should be addressed to the American Mathematical Society, P.O. Box 845904, Boston, MA 02284-5904 USA. All orders must be accompanied by payment. Other correspondence should be addressed to 201 Charles Street, Providence, RI 02904-2294 USA.

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 Acquisitions Department, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294 USA. 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 02904-2294 USA. Periodicals postage is paid at Providence, Rhode Island. Postmaster: Send address changes to Transactions, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294 USA.

© 2005 by the American Mathematical Society. All rights reserved.

This journal is indexed in Mathematical Reviews, Zentralblatt MATH, Science Citation Index®, Science Citation IndexSM–Expanded, ISI Alerting ServicesSM, 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.
Andrew Bakan, Frank Deutsch, and Wu Li, Strong CHIP, normality, and linear regularity of convex sets ........................................ 3831
Vassilis Kanellopoulos, Ramsey families of subtrees of the dyadic tree .................................................. 3865
Chan Woo Yang, \( L^p \) improving estimates for some classes of Radon transforms ......................................................... 3887
Roger W. Barnard, Petros Hadjicostas, and Alexander Yu. Solynin, The Poincaré metric and isoperimetric inequalities for hyperbolic polygons ................................................................. 3905
Marcus Tressl, The uniform companion for large differential fields of characteristic 0 .................................................. 3933
Wei-Ming Ni and Moxun Tang, Turing patterns in the Lengyel-Epstein system for the CIMA reaction .................. 3953
M.-L. Labbi, Double forms, curvature structures and the \((p, q)\)-curvatures ................................................................. 3971
Matt DeVos, Luis Goddyn, Bojan Mohar, Dirk Vertigan, and Xuding Zhu, Coloring-flow duality of embedded graphs .... 3993
Daniel Goldstein, Robert M. Guralnick, and I. M. Isaacs, Inequalities for finite group permutation modules .................. 4017
S. M. Malamud, Inverse spectral problem for normal matrices and the Gauss-Lucas theorem .................................. 4043
Nguyễn H. V. Hùng, The cohomology of the Steenrod algebra and representations of the general linear groups .......... 4065
M. A. Bertolim, M. P. Mello, and K. A. de Rezende, Poincaré-Hopf inequalities .......................................................... 4091
Wilmer J. Colmenaréz Rodríguez, Nonuniform hyperbolicity for singular hyperbolic attractors ..................................... 4131
W. J. Blok and C. J. van Alten, On the finite embeddability property for residuated ordered groupoids ......................... 4141
Adalberto P. Bergamasco and Sérgio Luís Zani, Prescribing analytic singularities for solutions of a class of vector fields on the torus ...... 4159
Antonio Breda d’Azevedo, Roman Nedela, and Jozef Širáň, Classification of regular maps of negative prime Euler characteristic .......................... 4175
Monika Ludwig, Minkowski valuations .................................................. 4191
Florin Diacu, Ernesto Pérez-Chavela, and Manuele Santoprete, Saari’s conjecture for the collinear \( n \)-body problem .................. 4215
Abdelhamid Meziani, Elliptic planar vector fields with degeneracies .... 4225
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 \texttt{AMSTeX} or \texttt{AMS-LaTeX}.

Information on the backlog for this journal can be found on the AMS website starting from http://www.ams.org/tran.

In an effort to make articles available as quickly as possible, articles are posted to the AMS website individually after proof is returned from authors and before appearing in an 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. If an editor is agreeable, an electronic manuscript prepared in TeX or \texttt{LATEX} may be submitted by pointing to an appropriate URL on a preprint or e-print server.

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 should be the 2000 Mathematics Subject Classification representing the primary and secondary subjects of the article. The classifications are accessible from www.ams.org/msc/. The list of classifications is also available in print starting with the 1999 annual index of Mathematical Reviews. The Mathematics Subject Classification footnote may be followed by a list of key words and phrases describing the subject matter of the article and taken from it. Journal abbreviations used in bibliographies are listed in the latest Mathematical Reviews annual index. The series abbreviations are also accessible from www.ams.org/publications/. To help in preparing and verifying references, the AMS offers MR Lookup, a Reference Tool for Linking, at www.ams.org/mrlookup/. 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 \texttt{AMSTeX}. To this end, the Society has prepared \texttt{AMSTeX} 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 \texttt{AMSTeX} style file and the \texttt{\LaTeX} commands automatically enable extensive intra-document linking to the bibliography and other elements of the article for searching electronically on the Web. Because linking must often be added manually to electronically prepared manuscripts in other forms of \texttt{TeX}, using \texttt{AMSTeX} 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. \texttt{AMSTeX} papers also move more efficiently through the production stream, helping to minimize publishing costs.
AMS-LATEX is the highly preferred format of TEX, but author packages are also available in AMS-TEX. 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 LATEX or plain TEX 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. LATEX users will find that AMS-LATEX is the same as LATEX with additional commands to simplify the typesetting of mathematics, and users of plain TEX should have the foundation for learning AMS-LATEX.

Authors may retrieve an author package from the AMS website starting from www.ams.org/tex/ or via FTP to ftp.ams.org (login as anonymous, enter username as password, and type cd pub/author-info). The AMS Author Handbook and the Instruction Manual are available in PDF format following the author packages link from www.ams.org/tex/. The author package can also be obtained free of charge by sending email to pub@ams.org (Internet) or from the Publication Division, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294 USA. When requesting an author package, please specify AMS-LATEX or AMS-TEX, 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 AMS-LATEX or AMS-TEX 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 submitted via the web at www.ams.org/submit-book-journal/, sent via email to pub-submit@ams.org (Internet), or sent on diskette to the Electronic Press Department, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294 USA. When sending a manuscript electronically via email or diskette, 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. Comprehensive instructions on preparing graphics are available starting from www.ams.org/jourhtml/authors.html. A few of the major requirements are given here.

Submit files for graphics as EPS (Encapsulated PostScript) files. This includes graphics originated via a graphics application as well as scanned photographs or other computer-generated images. If this is not possible, TIFF files are acceptable as long as they can be opened in Adobe Photoshop or Illustrator. 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. Variations of screens within a graphic should be no less than 10%.

AMS policy on making changes to articles after posting. Articles are posted to the AMS website individually after proof is returned from authors and before appearing in an issue. To preserve the integrity of electronically published articles, once an article is individually posted to the AMS website but not yet in an issue, changes cannot be made in place in the paper. However, an “Added after posting” section may be added to the paper right before the References when there is a critical error in the content of the paper. The “Added after posting” section gives the author an opportunity to correct this type
of critical error before the article is put into an issue for printing and before it is then reposted with the issue. The “Added after posting” section remains a permanent part of the paper. The AMS does not keep author-related information, such as affiliation, current address, and email address, up to date after a paper is initially posted.

Once the article is assigned to an issue, even if the issue has not yet been posted to the AMS website, corrections may be made to the paper by submitting a traditional errata article to the Editor. The errata article will appear in a future print issue and will link back and forth on the web to the original article online.

Secure manuscript tracking on the Web and via email. Authors can track their manuscripts through the AMS journal production process using the personal AMS ID and Article ID printed in the upper right-hand corner of the Consent to Publish form sent to each author who publishes in AMS journals. Access to the tracking system is available from www.ams.org/mstrack/ or via email sent to mstrack-query@ams.org. To access by email, on the subject line of the message simply enter the AMS ID and Article ID. To track more than one manuscript by email, choose one of the Article IDs and enter the AMS ID and the Article ID followed by the word all on the subject line. An explanation of each production step is provided on the web through links from the manuscript tracking screen. Questions can be sent to tran-query@ams.org.

\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 the AMS website, starting from 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 email to file-request@ams.org or by contacting the Electronic Prepress Department, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294 USA. 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 email, please include the email 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.

Inquiries. Any inquiries concerning a paper that has been accepted for publication that cannot be answered via the manuscript tracking system mentioned above should be sent to tran-query@ams.org or directly to the Electronic Prepress Department, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294 USA.
Editors

The traditional method of submitting a paper is to send two hard copies to the appropriate editor. Subjects, and the editors associated with them, are listed below.

In principle the Transactions welcomes electronic submissions, and some of the editors, those whose names appear below with an asterisk (*), have indicated that they prefer them. Editors reserve the right to request hard copies after papers have been submitted electronically. Authors are advised to make preliminary inquiries to editors as to whether they are likely to be able to handle submissions in a particular electronic form.

* Algebra, ALEXANDER KLESHCHEV, Department of Mathematics, University of Oregon, Eugene, OR 97403-1222 USA; e-mail: ams@cohoer.oregon.edu

Algebraic geometry, DAN ABRAMOVICH, Department of Mathematics, Brown University, Box 1917, Providence, RI 02912 USA; e-mail: amsend@math.brown.edu

Algebraic number theory, V. KUMAR MURTY, Department of Mathematics, University of Toronto, 100 St. George Street, Toronto, Ontario, Canada M5S 3G3; e-mail: murty@math.toronto.edu

* Algebraic topology, ALEJANDRO ADEM, Department of Mathematics, University of British Columbia, Room 121, 1984 Mathematics Road, Vancouver, British Columbia, Canada V6T 1Z2; e-mail: transactions@math.ubc.ca

* Combinatorics, SERGEY FOMIN, Department of Mathematics, East Hall, University of Michigan, Ann Arbor, MI 48109-1109 USA; e-mail: fomin@umich.edu

Complex analysis and harmonic analysis, ALEXANDER NAGEL, Department of Mathematics, University of Wisconsin, 480 Lincoln Drive, Madison, WI 53706-1313 USA; e-mail: nagel@math.wisc.edu

Differential geometry and global analysis, LISA C. JEFFREY, Department of Mathematics, University of Toronto, 100 St. George Street, Toronto, Ontario, Canada M5S 3G3; e-mail: jeffrey@math.toronto.edu

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

* Functional analysis and operator algebras, MARIUS DADARLAFT, Department of Mathematics, Purdue University, 150 N. University Street, West Lafayette, IN 47907-2067 USA; e-mail: mdd@math.purdue.edu

* Geometric analysis, TOBIAS COLDING, Courant Institute, New York University, 251 Mercer Street, New York, NY 10012 USA; e-mail: traneditor@cims.nyu.edu

* Geometric topology, MLADEN BESTVINA, Department of Mathematics, University of Utah, 155 South 1400 East, JWB 233, Salt Lake City, UT 84112-0090 USA; e-mail: bestvina@math.utah.edu

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

* Logic, STEFFEN LEMPPE, Department of Mathematics, University of Wisconsin, 480 Lincoln Drive, Madison, WI 53706-1388 USA; e-mail: lempp@math.wisc.edu

Number theory, HAROLD G. DIAMOND, Department of Mathematics, University of Illinois, 1409 West Green Street, Urbana, IL 61801-2917 USA; e-mail: diamond@math.uiuc.edu

* Ordinary differential equations, partial differential equations, and applied mathematics, PETER W. BATES, Department of Mathematics, Michigan State University, East Lansing, MI 48824-1027 USA; e-mail: bates@math.msu.edu

Partial differential equations, PATRICIA E. BAUMAN, Department of Mathematics, Purdue University, West Lafayette, IN 47907-1395 USA; e-mail: bauman@math.purdue.edu

* Probability and statistics, KRZYSZTOF BURDZY, Department of Mathematics, University of Washington, Box 354350, Seattle, WA 98195-4350 USA; e-mail: burdzy@math.washington.edu

* Real analysis and partial differential equations, DANIEL TATARU, Department of Mathematics, University of California, Berkeley, CA 94720 USA; e-mail: tataru@math.berkeley.edu

All other communications to the editors should be addressed to the Managing Editor, ROBERT GURALNICK, Department of Mathematics, University of Southern California, Los Angeles, CA 90089-1113 USA; e-mail: guralnic@math.usc.edu

MEMOIRS OF THE AMERICAN MATHEMATICAL SOCIETY

Memoirs is devoted to research in pure and applied mathematics of the same nature as Transactions. An issue consists of one or more separately bound research tracts for which the authors provide reproduction copy. Papers intended for Memoirs should normally be at least 80 pages in length. Memoirs has the same editorial committee as Transactions; so such papers should be addressed to one of the editors listed above.
TRANSACTIONS OF THE AMERICAN MATHEMATICAL SOCIETY

CONTENTS

Vol. 357, No. 10  Whole No. 845  October 2005

Andrew Bakan, Frank Deutsch, and Wu Li, Strong CHIP, normality, and linear regularity of convex sets .................................................. 3831
Vassilis Kanellopoulos, Ramsey families of subtrees of the dyadic tree ................................................................................................. 3865
Chan Woo Yang, \(L^p\) improving estimates for some classes of Radon transforms ......................................................................................... 3887
Roger W. Barnard, Petros Hadjicostas, and Alexander Yu. Solynin, The Poincaré metric and isoperimetric inequalities for hyperbolic polygons .................................................................................................................. 3905
Marcus Tressl, The uniform companion for large differential fields of characteristic 0 .......................................................... 3933
Wei-Ming Ni and Moxun Tang, Turing patterns in the Lengyel-Epstein system for the CIMA reaction .............................................. 3953
M.-L. Labbi, Double forms, curvature structures and the \((p,q)\)-curvatures ......................................................................................... 3971
Matt DeVos, Luis Goddyn, Bojan Mohar, Dirk Vertigan, and Xuding Zhu, Coloring-flow duality of embedded graphs .............. 3993
Daniel Goldstein, Robert M. Guralnick, and I. M. Isaacs, Inequalities for finite group permutation modules ............................................. 4017
S. M. Malamud, Inverse spectral problem for normal matrices and the Gauss-Lucas theorem .......................................................... 4043
Nguyễn H. V. Hùng, The cohomology of the Steenrod algebra and representations of the general linear groups .................................. 4065
M. A. Bertolim, M. P. Mello, and K. A. de Rezende, Poincaré-Hopf inequalities ...................................................................................... 4091
Wilmer J. Colmenárez Rodríguez, Nonuniform hyperbolicity for singular hyperbolic attractors ...................................................... 4131
W. J. Blok and C. J. van Alten, On the finite embeddability property for residuated ordered groupoids .................................................... 4141
Adalberto P. Bergamasco and Sérgio Luís Zani, Prescribing analytic singularities for solutions of a class of vector fields on the torus ...... 4159
Antonio Breda d’Azevedo, Roman Nedela, and Jozef Širáň, Classification of regular maps of negative prime Euler characteristic ........ 4175
Monika Ludwig, Minkowski valuations .................................................. 4191
Florin Diaconu, Ernesto Pérez-Chavela, and Manuele Santoprete, Saari’s conjecture for the collinear \(n\)-body problem ......................... 4215
Abdelhamid Meziani, Elliptic planar vector fields with degeneracies .... 4225