
VOLUME 39 NUMBER 1



JANUARY 2002

BULLETIN

(NEW SERIES)
OF THE

AMERICAN MATHEMATICAL SOCIETY

EDITORS

Bulletin Articles

Donald G. Saari
Chief Editor

Book Reviews

Bhama Srinivasan

PROVIDENCE, RHODE ISLAND USA

ISSN 0273-0979

Available electronically at
www.ams.org/bull/

Bulletin (New Series) of the American Mathematical Society

This journal is devoted to articles of the following types:

Bulletin Articles

Two types of articles will be included in this section: (1) papers that present a clear and insightful exposition of significant aspects of contemporary mathematical research, including Gibbs Lectures, Progress in Mathematics Lectures, and Retiring Presidential Addresses; and (2) brief, timely reports on important mathematical developments, which are normally solicited and often written by a disinterested expert.

Book Reviews

Book Reviews are accepted for publication by invitation only. Unsolicited manuscripts will not be considered.

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. *Bulletin (New Series) of the American Mathematical Society* is published quarterly. The *Bulletin* is also accessible electronically, starting with the January 1992 issue, from www.ams.org/publications/. For paper delivery, subscription prices for Volume 39 (2002) are \$337 list, \$270 institutional member, \$202 individual member. The subscription price for members is included in the annual dues. A late charge of 10% of the subscription price will be imposed upon orders received from nonmembers after January 1 of the subscription year. Subscribers outside the United States and India must pay a postage surcharge of \$8.00; subscribers in India must pay a postage surcharge of \$14.00. Expedited delivery to destinations in North America is \$12; elsewhere \$28.

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. *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.)

Bulletin (New Series) of the American Mathematical Society is published quarterly by the American Mathematical Society at 201 Charles Street, Providence, RI 02904-2294. Periodicals postage is paid at Providence, Rhode Island, and additional mailing offices. Postmaster: Send address changes to Bulletin, American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248.

© 2002 American Mathematical Society. All rights reserved.

This journal is indexed in *Mathematical Reviews*, *Science Citation Index*[®], *Science Citation Index*TM-*Expanded*, *ISI Alerting Services*SM, *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 07 06 05 04 03 02

Editorial Board for Bulletin Articles

| | |
|---------------------|--------------------------|
| John C. Baez | Haynes R. Miller |
| John M. Franks | Hugo Rossi |
| Eric M. Friedlander | Daniel Ruberman |
| Craig L. Huneke | Donald G. Saari, Chair |
| Douglas A. Lind | Panagiotis E. Souganidis |
| Barry Mazur | David A. Vogan |

Editorial Board for Book Reviews

| | |
|-------------------|-------------------------|
| L. Craig Evans | Bhama Srinivasan, Chair |
| Andy R. Magid | Audrey A. Terras |
| Philip E. Protter | Wolfgang Ziller |

Chief Editor: Donald G. Saari

Editorial Information

As of September 30, 2001, the backlog for this journal was approximately 1 issue. This estimate is the result of reducing 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 number of articles assigned to issues to be published in four months (the time necessary for editing and composing a typical issue). 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. *Bulletin* articles may be of two types: (1) reasonably broad expository surveys of a currently active area of mathematical research and (2) reports on a recent accomplishment in mathematical research. Three copies of the manuscript should be submitted to Professor Donald G. Saari, Department of Mathematics, Multipurpose Science and Technology Building, University of California, Irvine, Irvine, CA 92697-3875. Manuscripts may also be submitted to other members of the Editorial Board, with a copy of the cover letter and of the manuscript also sent to Professor Donald G. Saari. The author should keep one copy. *Bulletin* articles may also be submitted electronically in $\mathcal{A}\mathcal{M}\mathcal{S}$ - $\mathcal{L}\mathcal{A}\mathcal{T}\mathcal{E}\mathcal{X}$ or $\mathcal{A}\mathcal{M}\mathcal{S}$ - $\mathcal{T}\mathcal{E}\mathcal{X}$ to bams@math.uci.edu.

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 a brief technical description of the new material.

Both types of *Bulletin* articles should be written so as to be understandable by graduate students or mathematicians who are not experts in the subject matter of the article. A well-written expository article will include motivating problems and examples, some indication of the historical development of the subject, and of

course the results and open problems that make it an interesting and exciting area of mathematics. In most cases proofs should be at most briefly sketched, and there should be a good bibliography whose main aim is to help those wishing to pursue the subject further. Articles reporting on recent mathematical research should include an introductory section addressed to nonexperts describing the motivation, background, and significance of the results announced. Following the statement of results, there should be a sketch of proofs that may be addressed to experts, including elements of the proof which are novel. References should be given so that an interested reader can find the details.

Included with the footnotes in each 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.

Bulletin Articles are normally solicited by the Editorial Board, but unsolicited manuscripts will also be considered. In particular, those giving lectures (Gibbs Lectures, Colloquium Lectures, and Progress in Mathematics Lectures) or invited hour addresses at meetings of the Society are encouraged to write up their lectures in a manner that meets the requirements for expository articles described above and to submit their manuscripts for consideration by the Editorial Board for Bulletin Articles.

For Book Reviews the first page must include the title of the book being reviewed; the name(s) of the author(s); publisher; city of publication; year of publication; number of pages, including front matter; price if known; and ISBN. There should also be a footnote with the 2000 *Mathematics Subject Classification* representing the primary and secondary subjects of the book under review. The classifications are accessible from www.ams.org/msc/ and are also available in print starting with the 1999 annual index of *Mathematical Reviews*. To help in preparing and verifying references, the AMS offers MR Lookup, a Reference Tool for Linking, at www.ams.org/mrlookup/.

Electronically prepared manuscripts. The AMS encourages electronically prepared manuscripts, with a strong preference for $\mathcal{A}\mathcal{M}\mathcal{S}\text{-}\mathcal{L}\mathcal{A}\mathcal{T}\mathcal{E}\mathcal{X}$. To this end, the Society has prepared $\mathcal{A}\mathcal{M}\mathcal{S}\text{-}\mathcal{L}\mathcal{A}\mathcal{T}\mathcal{E}\mathcal{X}$ 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 $\mathcal{A}\mathcal{M}\mathcal{S}\text{-}\mathcal{L}\mathcal{A}\mathcal{T}\mathcal{E}\mathcal{X}$ style file and the `\label` and `\ref` 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 $\mathcal{T}\mathcal{E}\mathcal{X}$, using $\mathcal{A}\mathcal{M}\mathcal{S}\text{-}\mathcal{L}\mathcal{A}\mathcal{T}\mathcal{E}\mathcal{X}$ 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. $\mathcal{A}\mathcal{M}\mathcal{S}$ - $\mathcal{L}\mathcal{A}\mathcal{T}\mathcal{E}\mathcal{X}$ papers also move more efficiently through the production stream, helping to minimize publishing costs.

$\mathcal{A}\mathcal{M}\mathcal{S}$ - $\mathcal{L}\mathcal{A}\mathcal{T}\mathcal{E}\mathcal{X}$ is the highly preferred format of $\mathcal{T}\mathcal{E}\mathcal{X}$, but author packages are also available in $\mathcal{A}\mathcal{M}\mathcal{S}$ - $\mathcal{T}\mathcal{E}\mathcal{X}$. 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 $\mathcal{L}\mathcal{A}\mathcal{T}\mathcal{E}\mathcal{X}$ or plain $\mathcal{T}\mathcal{E}\mathcal{X}$ 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. $\mathcal{L}\mathcal{A}\mathcal{T}\mathcal{E}\mathcal{X}$ users will find that $\mathcal{A}\mathcal{M}\mathcal{S}$ - $\mathcal{L}\mathcal{A}\mathcal{T}\mathcal{E}\mathcal{X}$ is the same as $\mathcal{L}\mathcal{A}\mathcal{T}\mathcal{E}\mathcal{X}$ with additional commands to simplify the typesetting of mathematics, and users of plain $\mathcal{T}\mathcal{E}\mathcal{X}$ should have the foundation for learning $\mathcal{A}\mathcal{M}\mathcal{S}$ - $\mathcal{L}\mathcal{A}\mathcal{T}\mathcal{E}\mathcal{X}$.

Authors may retrieve an author package from the AMS website starting from www.ams.org/tex/ or via FTP to [ftp.ams.org](ftp://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, P.O. Box 6248, Providence, RI 02940-6248. When requesting an author package, please specify $\mathcal{A}\mathcal{M}\mathcal{S}$ - $\mathcal{L}\mathcal{A}\mathcal{T}\mathcal{E}\mathcal{X}$ or $\mathcal{A}\mathcal{M}\mathcal{S}$ - $\mathcal{T}\mathcal{E}\mathcal{X}$, 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 $\mathcal{A}\mathcal{M}\mathcal{S}$ - $\mathcal{L}\mathcal{A}\mathcal{T}\mathcal{E}\mathcal{X}$ or $\mathcal{A}\mathcal{M}\mathcal{S}$ - $\mathcal{T}\mathcal{E}\mathcal{X}$ 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 email 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. Comprehensive instructions on preparing graphics are available 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 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 bull-query@ams.org.

T_EX 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*, T_EX 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, T_EX 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, 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 T_EX 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 T_EX production at the AMS sometimes requires extra fonts and macros that are not yet publicly available, T_EX 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 bull-query@ams.org or directly to the Electronic Prepress Department, American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248.

Electronic Research Announcements

OF THE

AMERICAN MATHEMATICAL SOCIETY

Volume 7, 2001 (Most Recent Articles)

MANAGING EDITOR

Svetlana Katok

EDITORIAL BOARD

Stuart Antman
David Benson
Dmitri Burago
Mark Freidlin
Ronald Graham
Yitzhak Katznelson
David Kazhdan
Alexander Kechris
Alexandre Kirillov
Frances Kirwan
Krystyna Kuperberg
Robert Lazarsfeld
Gregory Margulis
Hugh Montgomery
Walter Neumann
Klaus Schmidt
Richard Schoen
Masamichi Takesaki
Michael Taylor
Guido Weiss
Zhihong (Jeff) Xia
Don Zagier
Efim Zelmanov

Vadim Yu. Kaloshin and Brian R. Hunt, *A stretched exponential bound on the rate of growth of the number of periodic points for prevalent diffeomorphisms I*

Vadim Yu. Kaloshin and Brian R. Hunt, *A stretched exponential bound on the rate of growth of the number of periodic points for prevalent diffeomorphisms II*

V. Balaji, I. Biswas, and D. S. Nagaraj, *Principal bundles with parabolic structure*

Robert Lauter and Victor Nistor, *On spectra of geometric operators on open manifolds and differentiable groupoids*

Stephen Doty and Anthony Giaquinto, *Generators and relations for Schur algebras*

A. Yu. Ol'shanskii and M. V. Sapir, *Non-amenable finitely presented torsion-by-cyclic groups*

Pablo Pedregal, *Fully explicit quasiconvexification of the mean-square deviation of the gradient of the state in optimal design*

The American Mathematical Society's electronic-only journal, *Electronic Research Announcements of the AMS (ERA-AMS)*, is available on the World Wide Web at www.ams.org/era.

ERA-AMS publishes high-quality research announcements of significant advances in all branches of mathematics. Authors may submit manuscripts to any editor. All papers are reviewed, and the entire Editorial Board must approve the acceptance of any paper. Papers are posted as soon as they are accepted and processed by the AMS.

ERA-AMS offers you ...

- decreased turn-around time from submission to publication
- fast access to your specific area of interest
- up-to-the-minute research information

For more information about this journal for authors, and subscription information, go to www.ams.org/journals/era.

For more information,
contact: cust-serv@ams.org
1-800-321-4267, 1-401-455-4000,
fax 1-401-455-4046



BULLETIN OF THE AMERICAN MATHEMATICAL SOCIETY
CONTENTS

Vol. 39, No. 1

January 2002

BULLETIN ARTICLES

| | |
|--|----|
| Felipe Cucker and Steve Smale , On the mathematical foundations of learning | 1 |
| Jason Fulman , Random matrix theory over finite fields | 51 |

BOOK REVIEWS

| | |
|---|-----|
| Anand Pillay (Reviewer), A course in model theory: An introduction to contemporary mathematical logic by Bruno Poizat | 87 |
| Fedor Bogomolov and Yuri Tschinkel (Reviewers), Alterations and resolution of singularities by H. Hauser, J. Lipman, F. Oort, and A. Quirós (eds.) | 95 |
| Fernando Q. Gouvêa (Reviewer), Cohomology of number fields by Jürgen Neukirch, Alexander Schmidt, and Kay Wingberg | 101 |
| Michael Cranston (Reviewer), From Brownian motion to Schrodinger's equation by Kai Lai Chung and Zhongxin Zhao | 109 |
| Noriko Yui (Reviewer), A course in p -adic analysis by Alain M. Robert .. | 113 |
| Stefan Richter (Reviewer), Theory of Bergman spaces by Haakan Hedenmalm, Boris Korenblum, and Kehe Zhu | 121 |
| Ira M. Gessel (Reviewer), Enumerative combinatorics, Volume 2 by Richard P. Stanley | 129 |
| Charles A. Weibel (Reviewer), Cycles, transfers, and motivic homology theories by Vladimir Voevodsky, Andrei Suslin, and Eric M. Friedlander | 137 |

The most recent articles of the AMS journal *Electronic Research Announcements* are listed at the back of this issue.



0273-0979(200201)39:1;1-X