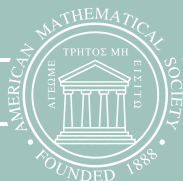

VOLUME 22 NUMBER 4



OCTOBER 2009

JOURNAL

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

Weinan E
Sergey Fomin
Gregory Lawler
John W. Morgan
Karl Rubin
Terence Tao

ASSOCIATE EDITORS

Noga Alon
Francis Bonahon
Alexei Borodin
Robert L. Bryant
Emmanuel Candes
Pavel I. Etingof
Mark Goresky
Christopher Hacon
Alexander S. Kechris
Peter Kronheimer
Elon Lindenstrauss
Jacob Lurie
Haynes R. Miller
Assaf Naor
Andrew M. Odlyzko
Bjorn Poonen
Sorin T. Popa
Victor S. Reiner
Freydoon Shahidi
Richard L. Taylor
Avi Wigderson
Lai-Sang Young

PROVIDENCE, RHODE ISLAND USA

ISSN 0894-0347

Available electronically at
www.ams.org/jams/

Journal of the American Mathematical Society

This journal is devoted to research articles of the highest quality in all areas of 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. The *Journal of the American Mathematical Society* is published quarterly. Beginning January 1996 the *Journal of the American Mathematical Society* is accessible from www.ams.org/journals/. Subscription prices for Volume 22 (2009) are as follows: for paper delivery, US\$313 list, US\$250 institutional member, US\$282 corporate member, US\$188 individual member; for electronic delivery, US\$282 list, US\$226 institutional member, US\$254 corporate member, US\$169 individual member. Upon request, subscribers to paper delivery of this journal are also entitled to receive electronic delivery. If ordering the paper version, add US\$18 for surface delivery outside the United States and India; US\$27 to India. Expedited delivery to destinations in North America is US\$30; elsewhere US\$55. 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.)

The *Journal of the American Mathematical Society* (ISSN 0894-0347) is published quarterly by the American Mathematical Society at 201 Charles Street, Providence, RI 02904-2294 USA and is mailed from Providence, Rhode Island. Periodicals postage is paid at Providence, Rhode Island. Postmaster: Send address changes to Journal of the AMS, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294 USA.

© 2009 by the American Mathematical Society. All rights reserved.

This journal is indexed in *Mathematical Reviews*, *Zentralblatt MATH*, *Science Citation Index*®, *Science Citation Index*™-Expanded, *ISI Alerting Services*™, *CompuMath Citation Index*®, and *Current Contents*®/*Physical, Chemical & Earth Sciences*. This journal is archived in *Portico*.

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.

JOURNAL OF THE AMERICAN MATHEMATICAL SOCIETY
CONTENTS

Vol. 22, No. 4

October 2009

E. Mukhin, V. Tarasov, and A. Varchenko , Schubert calculus and representations of the general linear group	909
Danny Calegari , Stable commutator length is rational in free groups	941
Manjul Bhargava , On P-orderings, rings of integer-valued polynomials, and ultrametric analysis	963
Julien Dubédat , SLE and the free field: Partition functions and couplings	995
Davesh Maulik and Alexei Oblomkov , Quantum cohomology of the Hilbert scheme of points on \mathcal{A}_n-resolutions	1055
Zeev Dvir , On the size of Kakeya sets in finite fields	1093
László Erdős, Benjamin Schlein, and Horng-Tzer Yau , Rigorous derivation of the Gross-Pitaevskii equation with a large interaction potential	1099
David Gabai, Robert Meyerhoff, and Peter Milley , Minimum volume cusped hyperbolic three-manifolds	1157

INDEX TO VOLUME 22 (2009)

- Alberti, Giovanni, Rustum Choksi, and Felix Otto. *Uniform energy distribution for an isoperimetric problem with long-range interactions*, 569
- Andersen, Kasper K. S., and Jesper Grodal. *The classification of 2-compact groups*, 387
- Beltrán, Carlos, and Luis Miguel Pardo. *Smale's 17th problem: Average polynomial time to compute affine and projective solutions*, 363
- Bhargava, Manjul. *On P -orderings, rings of integer-valued polynomials, and ultrametric analysis*, 963
- Bjerklov, Kristian, and Tobias Jäger. *Rotation numbers for quasiperiodically forced circle maps—mode-locking vs. strict monotonicity*, 353
- Borcea, Julius, Petter Brändén, and Thomas M. Liggett. *Negative dependence and the geometry of polynomials*, 521
- Brändén, Petter. *See* Borcea, Julius
- Brendle, Simon, and Richard Schoen. *Manifolds with $1/4$ -pinched curvature are space forms*, 287
- Calegari, Danny. *Stable commutator length is rational in free groups*, 941
- Chenevier, G., et L. Clozel. *Corps de nombres peu ramifiés et formes automorphes autoduales*, 467
- Chernov, N., and D. Dolgopyat. *The Galton board: Limit theorems and recurrence*, 821
- Choksi, Rustum. *See* Alberti, Giovanni
- Clozel, L. *See* Chenevier, G.
- Cohen, Albert, Wolfgang Dahmen, and Ronald DeVore. *Compressed sensing and best k -term approximation*, 211
- Dahmen, Wolfgang. *See* Cohen, Albert
- DeVore, Ronald. *See* Cohen, Albert
- Dolgopyat, D. *See* Chernov, N.
- Donoho, David L., and Jared Tanner. *Counting faces of randomly projected polytopes when the projection radically lowers dimension*, 1
- Dubédat, Julien. *SLE and the free field: Partition functions and couplings*, 995
- Dvir, Zeev. *On the size of Kakeya sets in finite fields*, 1093
- Eisenbud, David, and Frank-Olaf Schreyer. *Betti numbers of graded modules and cohomology of vector bundles*, 859
- Erdős, László, Benjamin Schlein, and Horng-Tzer Yau. *Rigorous derivation of the Gross-Pitaevskii equation with a large interaction potential*, 1099
- Eyssidieux, Philippe, Vincent Guedj, and Ahmed Zeriahi. *Singular Kähler-Einstein metrics*, 607
- Gabai, David, Robert Meyerhoff, and Peter Milley. *Minimum volume cusped hyperbolic three-manifolds*, 1157
- Giménez, Omer, and Marc Noy. *Asymptotic enumeration and limit laws of planar graphs*, 309
- Grodal, Jesper. *See* Andersen, Kasper K. S.
- Guedj, Vincent. *See* Eyssidieux, Philippe
- Hubbard, John, Dierk Schleicher, and Mitsuhiro Shishikura. *Exponential Thurston maps and limits of quadratic differentials*, 77
- Idziak, Paweł, Ralph McKenzie, and Matthew Valeriote. *The structure of locally finite varieties with polynomially many models*, 119
- Iwao, Y. *See* Lee, Y.-P.
- Jäger, Tobias. *See* Bjerklov, Kristian
- Kenig, C., D. Preiss, and T. Toro. *Boundary structure and size in terms of interior and exterior harmonic measures in higher dimensions*, 771
- Kisin, Mark. *The Fontaine-Mazur conjecture for GL_2* , 641
- Larsen, Michael, and Aner Shalev. *Word maps and Waring type problems*, 437
- Lee, Y.-P., with Appendix A by Y. Iwao and Y.-P. Lee. *Invariance of tautological equations II: Gromov-Witten theory*, 331
- Liggett, Thomas M. *See* Borcea, Julius
- Lusztig, G. *Study of a \mathbf{Z} -form of the coordinate ring of a reductive group*, 739
- Maulik, Daves, and Alexei Oblomkov. *Quantum cohomology of the Hilbert scheme of points on \mathcal{A}_n -resolutions*, 1055
- McKenzie, Ralph. *See* Idziak, Paweł
- Meyerhoff, Robert. *See* Gabai, David
- Milley, Peter. *See* Gabai, David

- Mukhin, E., V. Tarasov, and A. Varchenko. *Schubert calculus and representations of the general linear group*, 909
- Nadler, David, and Eric Zaslow. *Constructible sheaves and the Fukaya category*, 233
- Nolin, Pierre, and Wendelin Werner. *Asymmetry of near-critical percolation interfaces*, 797
- Noy, Marc. *See* Giménez, Omer
- Oblomkov, Alexei. *See* Maulik, Daves
- Otto, Felix. *See* Alberti, Giovanni
- Pardo, Luis Miguel. *See* Beltrán, Carlos
- Peres, Yuval, Oded Schramm, Scott Sheffield, and David B. Wilson. *Tug-of-war and the infinity Laplacian*, 167
- Preiss, D. *See* Kenig, C.
- Schleicher, Dierk. *See* Hubbard, John
- Schlein, Benjamin. *See* Erdős, László
- Schoen, Richard. *See* Brendle, Simon
- Schramm, Oded. *See* Peres, Yuval
- Schreyer, Frank-Olaf. *See* Eisenbud, David
- Segev, Yoav. *Proper Moufang sets with abelian root groups are special*, 889
- Shalev, Aner. *See* Larsen, Michael
- Sheffield, Scott. *See* Peres, Yuval
- Shishikura, Mitsuhiro. *See* Hubbard, John
- Tanner, Jared. *See* Donoho, David L.
- Tarasov, V. *See* Mukhin, E.
- Toro, T. *See* Kenig, C.
- Treil, Sergei, and Brett D. Wick. *Analytic projections, Corona problem and geometry of holomorphic vector bundles*, 55
- Valeriote, Matthew. *See* Idziak, Paweł
- Varchenko, A. *See* Mukhin, E.
- Werner, Wendelin. *See* Nolin, Pierre
- Wick, Brett D. *See* Treil, Sergei
- Wilson, David B. *See* Peres, Yuval
- Yau, Horng-Tzer. *See* Erdős, László
- Zaslow, Eric. *See* Nadler, David
- Zeriahi, Ahmed. *See* Eyssidieux, Philippe
- Zinger, Aleksey. *The reduced genus 1 Gromov-Witten invariants of Calabi-Yau hypersurfaces*, 691

VOLUME 22



2009

JOURNAL

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

Weinan E
Sergey Fomin
Gregory Lawler
John W. Morgan
Karl Rubin
Terence Tao

ASSOCIATE EDITORS

Noga Alon
Francis Bonahon
Alexei Borodin
Robert L. Bryant
Emmanuel Candes
Pavel I. Etingof
Mark Goresky
Christopher Hacon
Alexander S. Kechris
Peter Kronheimer
Elon Lindenstrauss
Jacob Lurie
Haynes R. Miller
Assaf Naor
Andrew M. Odlyzko
Bjorn Poonen
Sorin T. Popa
Victor S. Reiner
Freydoon Shahidi
Richard L. Taylor
Avi Wigderson
Lai-Sang Young

PROVIDENCE, RHODE ISLAND USA

ISSN 0894-0347

Journal of the American Mathematical Society

This journal is devoted to research articles of the highest quality in all areas of 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. The *Journal of the American Mathematical Society* is published quarterly. Beginning January 1996 the *Journal of the American Mathematical Society* is accessible from www.ams.org/journals/. Subscription prices for Volume 22 (2009) are as follows: for paper delivery, US\$313 list, US\$250 institutional member, US\$282 corporate member, US\$188 individual member; for electronic delivery, US\$282 list, US\$226 institutional member, US\$254 corporate member, US\$169 individual member. Upon request, subscribers to paper delivery of this journal are also entitled to receive electronic delivery. If ordering the paper version, add US\$18 for surface delivery outside the United States and India; US\$27 to India. Expedited delivery to destinations in North America is US\$30; elsewhere US\$55. 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.)

The *Journal of the American Mathematical Society* (ISSN 0894-0347) is published quarterly by the American Mathematical Society at 201 Charles Street, Providence, RI 02904-2294 USA and is mailed from Providence, Rhode Island. Periodicals postage is paid at Providence, Rhode Island. Postmaster: Send address changes to Journal of the AMS, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294 USA.

© 2009 by the American Mathematical Society. All rights reserved.

This journal is indexed in *Mathematical Reviews*, *Zentralblatt MATH*, *Science Citation Index*®, *Science Citation Index*™-Expanded, *ISI Alerting Services*™, *CompuMath Citation Index*®, and *Current Contents*®/*Physical, Chemical & Earth Sciences*. This journal is archived in *Portico*.

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.

JOURNAL OF THE AMERICAN MATHEMATICAL SOCIETY

CONTENTS

Vol. 22, No. 1

January 2009

David L. Donoho and Jared Tanner, Counting faces of randomly projected polytopes when the projection radically lowers dimension ...	1
Sergei Treil and Brett D. Wick, Analytic projections, Corona problem and geometry of holomorphic vector bundles	55
John Hubbard, Dierk Schleicher, and Mitsuhiro Shishikura, Exponential Thurston maps and limits of quadratic differentials	77
Paweł Idziak, Ralph McKenzie, and Matthew Valeriote, The structure of locally finite varieties with polynomially many models	119
Yuval Peres, Oded Schramm, Scott Sheffield, and David B. Wilson, Tug-of-war and the infinity Laplacian	167
Albert Cohen, Wolfgang Dahmen, and Ronald DeVore, Compressed sensing and best k-term approximation	211
David Nadler and Eric Zaslow, Constructible sheaves and the Fukaya category	233
Simon Brendle and Richard Schoen, Manifolds with $1/4$-pinched curvature are space forms	287

Vol. 22, No. 2

April 2009

Omer Giménez and Marc Noy, Asymptotic enumeration and limit laws of planar graphs	309
Y.-P. Lee, with Appendix A by Y. Iwao and Y.-P. Lee, Invariance of tautological equations II: Gromov–Witten theory	331
Kristian Bjerklöv and Tobias Jäger, Rotation numbers for quasiperiodically forced circle maps—mode-locking vs. strict monotonicity	353
Carlos Beltrán and Luis Miguel Pardo, Smale’s 17th problem: Average polynomial time to compute affine and projective solutions	363
Kasper K. S. Andersen and Jesper Grodal, The classification of 2–compact groups	387
Michael Larsen and Aner Shalev, Word maps and Waring type problems	437
G. Chenevier et L. Clozel, Corps de nombres peu ramifiés et formes automorphes autoduales	467
Julius Borcea, Petter Brändén, and Thomas M. Liggett, Negative dependence and the geometry of polynomials	521
Giovanni Alberti, Rustum Choksi, and Felix Otto, Uniform energy distribution for an isoperimetric problem with long-range interactions	569

Philippe Eyssidieux, Vincent Guedj, and Ahmed Zeriahi, Singular Kähler-Einstein metrics	607
Mark Kisin, The Fontaine-Mazur conjecture for GL_2	641
Aleksey Zinger, The reduced genus 1 Gromov-Witten invariants of Calabi-Yau hypersurfaces	691
G. Lusztig, Study of a \mathbf{Z}-form of the coordinate ring of a reductive group	739
C. Kenig, D. Preiss, and T. Toro, Boundary structure and size in terms of interior and exterior harmonic measures in higher dimensions	771
Pierre Nolin and Wendelin Werner, Asymmetry of near-critical percolation interfaces	797
N. Chernov and D. Dolgopyat, The Galton board: Limit theorems and recurrence	821
David Eisenbud and Frank-Olaf Schreyer, Betti numbers of graded modules and cohomology of vector bundles	859
Yoav Segev, Proper Moufang sets with abelian root groups are special ...	889

E. Mukhin, V. Tarasov, and A. Varchenko, Schubert calculus and representations of the general linear group	909
Danny Calegari, Stable commutator length is rational in free groups	941
Manjul Bhargava, On P-orderings, rings of integer-valued polynomials, and ultrametric analysis	963
Julien Dubédat, SLE and the free field: Partition functions and couplings	995
Davesh Maulik and Alexei Oblomkov, Quantum cohomology of the Hilbert scheme of points on \mathcal{A}_n-resolutions	1055
Zeev Dvir, On the size of Kakeya sets in finite fields	1093
László Erdős, Benjamin Schlein, and Horng-Tzer Yau, Rigorous derivation of the Gross-Pitaevskii equation with a large interaction potential	1099
David Gabai, Robert Meyerhoff, and Peter Milley, Minimum volume cusped hyperbolic three-manifolds	1157

Editors

Weinan E
Department of Mathematics
Fine Hall
Princeton University
Princeton, NJ 08544 USA
weinan@math.princeton.edu

Sergey Fomin
Department of Mathematics
University of Michigan
530 Church Street
Ann Arbor, MI 48109-1043 USA
fomin@umich.edu

Gregory Lawler
Department of Mathematics
University of Chicago
5734 S. University Avenue
Chicago, IL 60637 USA
lawler@math.uchicago.edu

John W. Morgan
Department of Mathematics
Columbia University
2990 Broadway
New York, NY 10027-0029 USA
jm@math.columbia.edu

Karl Rubin
Department of Mathematics
University of California, Irvine
Irvine, CA 92697-3875 USA
krubin@math.uci.edu

Terence Tao
Department of Mathematics
University of California, Los Angeles
405 Hilgard Avenue
Los Angeles, CA 90095-1555 USA
tao@math.ucla.edu

Associate Editors

Noga Alon, Tel Aviv University, Israel
Francis Bonahon, University of Southern California
Alexei Borodin, California Institute of Technology
Robert L. Bryant, Duke University
Emmanuel Candes, California Institute of Technology
Pavel I. Etingof, Massachusetts Institute of Technology
Mark Goresky, Institute for Advanced Study, Princeton
Christopher Hacon, University of Utah
Alexander S. Kechris, California Institute of Technology
Peter Kronheimer, Harvard University
Elon Lindenstrauss, Princeton University
Jacob Lurie, Massachusetts Institute of Technology
Haynes R. Miller, Massachusetts Institute of Technology
Assaf Naor, New York University, Courant Institute
Andrew M. Odlyzko, University of Minnesota
Bjorn Poonen, University of California, Berkeley
Sorin T. Popa, University of California, Los Angeles
Victor S. Reiner, University of Minnesota, Minneapolis
Freydoon Shahidi, Purdue University
Richard L. Taylor, Harvard University
Avi Wigderson, Institute for Advanced Study, Princeton
Lai-Sang Young, New York University–Courant Institute

Assistant to the Editorial Board

Cheryl A. Cantore
Princeton University
133 East Pyne
Princeton, NJ 08544 USA
cheryl@princeton.edu

Editorial Information

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

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 manuscript has not been submitted to nor is it under consideration for publication by another journal, conference proceedings, or similar publication.

Information for Authors

Initial submission. The AMS uses Centralized Manuscript Processing for initial submission. Authors should submit a PDF file using the Initial Manuscript Submission form found at www.ams.org/peer-review-submission or should send one copy of the manuscript to the following address: Centralized Manuscript Processing, JOURNAL OF THE AMS, 201 Charles Street, Providence, RI 02904-2294 USA. If a paper copy is being forwarded to the AMS, indicate that it is for the *Journal of the AMS* and include the name of the corresponding author, contact information such as email address or mailing address, and the name of an appropriate Editor to review the paper (see the list of Editors above).

The first page must contain a *descriptive title* that is short, but informative; useless or vague phrases such as “some remarks about” or “concerning” should be avoided. Although an abstract is not required upon initial submission, upon acceptance authors will be requested to supply an abstract for the electronic version of this journal. The AMS offers free worldwide access to the electronic abstracts. An abstract should be at least one complete sentence and at most 300 words. No abstracts appear in the printed journal starting in 1998. 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/msnhtml/serials.pdf. 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, 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. $\mathcal{A}\mathcal{M}\mathcal{S}\text{-}\mathcal{L}\mathcal{A}\mathcal{T}\mathcal{E}\mathcal{X}$ papers also move more efficiently through the production stream, helping to minimize publishing costs.

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

Authors may retrieve an author package for *Journal of the AMS* starting from www.ams.org/jams/jamsauthorpac.html 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 from the author package link. The author package can also be obtained free of charge by sending email to tech-support@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 $\mathcal{A}\mathcal{M}\mathcal{S}$ -L^AT_EX or $\mathcal{A}\mathcal{M}\mathcal{S}$ -T_EX and the publication in which your paper will appear. Please be sure to include your complete email address.

After acceptance. 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 to the Editor, who will forward a copy to the Providence office. Accepted 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 Prepress 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 from www.ams.org/authors/journals.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. 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. 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/. An explanation of each production step is provided on the Web through links from the manuscript tracking screen. Questions can be sent to jams-query@ams.org.

T_EX files available upon request. T_EX files are available upon request for authors 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 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 T_EX without errors. The AMS regrets that it cannot provide support to eliminate such errors in the author's T_EX 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 jams-query@ams.org or directly to the Electronic Prepress Department, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294 USA.

JOURNAL OF THE AMERICAN MATHEMATICAL SOCIETY

CONTENTS

Vol. 22, No. 4

October 2009

E. Mukhin, V. Tarasov, and A. Varchenko , Schubert calculus and representations of the general linear group	909
Danny Calegari , Stable commutator length is rational in free groups	941
Manjul Bhargava , On P -orderings, rings of integer-valued polynomials, and ultrametric analysis	963
Julien Dubédat , SLE and the free field: Partition functions and couplings	995
Davesh Maulik and Alexei Oblomkov , Quantum cohomology of the Hilbert scheme of points on \mathcal{A}_n -resolutions	1055
Zeev Dvir , On the size of Kakeya sets in finite fields	1093
László Erdős, Benjamin Schlein, and Horng-Tzer Yau , Rigorous derivation of the Gross-Pitaevskii equation with a large interaction potential	1099
David Gabai, Robert Meyerhoff, and Peter Milley , Minimum volume cusped hyperbolic three-manifolds	1157

Journal of the American Mathematical Society

VOLUME 22

NUMBER 4

PAGES 909–1216

OCTOBER 2009



0894-0347(200910)22:4*;1-E