

# BULLETIN BULLETIN SERIES)

of the

AMERICAN MATHEMATICAL SOCIETY

The AMS was founded in 1888

Сочинилъ

И. Лобачевскій.

Editors

Articles

Susan Friedlander Chief Editor

Book Reviews

Peter Kuchment

казань.

B'B YHUBEPCHTETCKOH THROFPAGIR,

**VOLUME 55** 

NUMBER 1

JANUARY 2018

1834.

Available electronically at www.ams.org/bull/

### Bulletin (New Series) of the American Mathematical Society

The *Bulletin* publishes expository articles on contemporary mathematical research written in a way that gives insight to mathematicians who may not be experts in the particular topic. The *Bulletin* publishes, by invitation only, reviews of selected books in mathematics and short articles in the "Mathematical Perspectives" section.

Submission information. See Information for Authors at the end of this issue. Publication on the AMS website. Articles are published on 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. It is available electronically from www.ams.org/journals/. For paper delivery, subscription prices for Volume 55 (2018) are US\$621 list, US\$496.80 institutional member, US\$372.60 individual member, US\$558.90 corporate member. The subscription price for members is included in the annual dues. Subscription renewals are subject to late fees. See www.ams.org/journal-faq for more journal subscription information. If ordering the paper version, add US\$5.25 for delivery within the United States; US\$10 for delivery outside the United States.

Back number information. For back issues see www.ams.org/backvols.

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 the American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294 USA.

Copying and reprinting. Individual readers of this publication, and nonprofit libraries acting for them, are permitted to make fair use of the material, such as to copy an article for use in teaching or research. Permission is granted to quote brief passages from this publication in reviews, provided the customary acknowledgment of the source is given. Republication, systematic copying, or multiple reproduction of any material in this publication is permitted only under license from the American Mathematical Society. Permissions to reuse portions of AMS publication content are now being handled by Copyright Clearance Center's RightsLink®service. For more information, please visit http://www.ams.org/rightslink.

Translation rights and licensed reprint requests should be sent to reprint-permission@ ams.org.

Excluded from these provisions is material for which the author holds copyright. In such cases, requests for permission to reuse 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 (ISSN 0273-0979 (print); ISSN 1088-9485 (online)) is published quarterly by the American Mathematical Society at 201 Charles Street, Providence, RI 02904-2294 USA. Periodicals postage is paid at Providence, Rhode Island, and additional mailing offices. POSTMASTER: Send address changes to Bulletin (New Series) of the American Mathematical Society, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294 USA.

© 2018 American Mathematical Society. All rights reserved.

This journal is indexed in Mathematical Reviews, Science Citation Index<sup>®</sup>, Science Citation Index<sup>TM</sup>—Expanded, ISI Alerting Services<sup>SM</sup>, CompuMath Citation Index<sup>®</sup>, and Current Contents<sup>®</sup>/Physical, Chemical & Earth Sciences. This journal is archived in Portico and in CLOCKSS.

Printed in the United States of America.

 $\otimes$  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 23 22 21 20 19 18

## BULLETIN OF THE AMERICAN MATHEMATICAL SOCIETY CONTENTS

Vol. 55, No. 1 January 2018 ARTICLES Lydia Bieri, Black hole formation and stability: A mathematical investigation ..... 1 Susan Holmes, Statistical proof? The problem of irreproducibility ...... 31 Matthew Baker, Hodge theory in combinatorics ..... 57 K. Soundararajan, Tao's resolution of the Erdős discrepancy problem ... 81 MATHEMATICAL PERSPECTIVES Gerald L. Alexanderson and Leonard F. Klosinski, About the cover: Are "old" mathematics books "collectible"? ..... 93 Selected Mathematical Reviews 97 BOOK REVIEWS Terence Tao (Reviewer), Polynomial methods in combinatorics, by Larry Guth ..... 103 Stanislav A. Molchanov (Reviewer), Geometric modeling in probability and statistics, by O. Calin and C. Udriste ..... 109 Jerome A. Goldstein (Reviewer), Semi-bounded differential operators, contractive semigroups, and beyond, by Alberto Cialdea and Vladimir Maz'ya ..... 113 Jacob Rubinstein (Reviewer), Singular perturbation in the physical sciences, by John Neu ..... 123 Eviatar B. Procaccia (Reviewer), Noise sensitivity of Boolean functions and percolation, by Christophe Garban and Jeffrey E. Steif ...... 131

#### **Editorial Board for Articles**

Emmanuel Candes Richard T. Durrett Daniel S. Freed Edward Frenkel Susan Friedlander, Chair Irene M. Gamba

Irene M. Gamba Mark Goresky Andrew J. Granville Robert M. Guralnick Bryna R. Kra
Barry C. Mazur
William P. Minicozzi II
Andrew Ranicki
Christoph M. Thiele
Burt Totaro

Burt Totaro Yuri Tschinkel Michael Wolf Maciej Zworski

#### Editorial Board for Book Reviews

David Cox Mark Embree Lisa Jeffrey Steven G. Krantz Peter Kuchment, Chair Ken Ono Philip E. Protter Israel Michael Sigal

#### Consultants to the Editors

Gerald L. Alexanderson Edward Dunne

Chief Editor: Susan Friedlander

#### **Editorial Information**

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

In an effort to make articles available as quickly as possible, articles are electronically published on the AMS website individually after proof is returned from authors and before appearing in an issue.

A Consent to Publish is required before we can begin processing your paper. After a paper is accepted for publication, the Providence office will send a Consent to Publish form 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

The *Bulletin* publishes expository articles on contemporary mathematical research written in a way that gives insight to mathematicians who may not be experts in the particular topic. All articles submitted to this journal are peer reviewed. The AMS has a single-blind peer-review process in which the reviewers know who the authors of the manuscripts are, but the authors do not have access to information on who the peer reviewers are.

The first page must consist of a short descriptive title, followed by an abstract that summarizes the article in language suitable for mathematicians in the general area. 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.

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.

Each paper should include a footnote with the 2010 Mathematics Subject Classification representing the primary and secondary subjects of the article. The classifications are accessible from www.ams.org/msc/. 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/. When the manuscript is submitted, authors should supply the Editor with electronic addresses if available.

Mathematicians giving AMS 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 using the guidelines for expository articles described above. Submissions will be reviewed by the Editorial Board for Articles, and authors will be notified of its decision.

Book Reviews are by invitation only. 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 2010 *Mathematics Subject Classification* representing the primary and secondary subjects of the book under review. The classifications are accessible from www.ams.org/msc/. To help in preparing and verifying references, the AMS offers MR Lookup, a Reference Tool for Linking, at www.ams.org/mrlookup/.

Initial submission. Authors of articles may submit manuscripts for consideration as PDF files at http://www.ams.org/peer-review/submission.pl. Manuscripts must be a single file with images embedded. Authors will have a chance to view the manuscript and data entered before releasing the manuscript into the system. Two-digit 2010 Mathematics Subject Classification numbers are included in a pull-down menu; classifications are accessible from http://www.ams.org/msc/. Complete author instructions are available at the site.

Authors who cannot supply a PDF file may submit a paper copy of their manuscript to *Bulletin/Peer-Review Manuscript Submissions*, 201 Charles Street, Providence, RI 02904-2294 USA. These submissions will be scanned into a PDF file and entered by AMS staff into the peer-review system. All the data required in the submission form must be provided to avoid delays in publishing the manuscript.

The Bulletin Chief Editor will be notified as new submissions arrive. The Editor will collect these submissions and assign them to subject area specialists. Queries concerning the status of submissions could be sent to the Editor at amsb@usc.edu.

Electronically prepared manuscripts. Manuscripts should be electronically prepared in  $\mathcal{A}_{\mathcal{M}}\mathcal{S}$ -IATEX. To this end, the Society has prepared  $\mathcal{A}_{\mathcal{M}}\mathcal{S}$ -IATEX 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  $\mathcal{A}_{\mathcal{M}}\mathcal{S}$ -IATEX 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.

Authors may retrieve an author package for the Bulletin of the AMS from www.ams.org/bull/bullauthorpac.html. The AMS Author Handbook is 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 or from the Publication Division, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294 USA. When requesting an author package, please specify the publication in which your paper will appear. Please be sure to include your complete email address.

After acceptance. The source files for the final version of the electronic manuscript should be sent to the Providence office immediately after the paper has been accepted for publication. Authors should indicate if the paper has been prepared using AMS-IATEX or AMS-TEX. Electronically prepared manuscripts can be submitted via the Web at www.ams.org/submit-book-journal/, sent via email to pub-submit@ams.org, or sent on CD to the Electronic Prepress Department, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294 USA. When sending a manuscript electronically via email or CD, please be sure to include a message indicating in which publication the paper has been accepted. Complete instructions on how to send files are included in the author package.

The final file of an accepted article should also be sent by email to both bulletin@math.uic.edu and susan@math.northwestern.edu.

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.

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 publication. Articles are published on 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 published to the AMS website, changes cannot be made in place in 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 electronically published.

Corrections of critical errors may be made to the paper by submitting an errata article to the Editor. The errata article will be published electronically, will appear in a future print issue, and will link back and forth on the Web with the original article.

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 may be sent to bull-query@ams.org.

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, 201 Charles Street, Providence, RI 02904-2294 USA.

## BULLETIN OF THE AMERICAN MATHEMATICAL SOCIETY CONTENTS

Vol. 55, No. 1 January 2018 ARTICLES Lydia Bieri, Black hole formation and stability: A mathematical 1 Susan Holmes, Statistical proof? The problem of irreproducibility ...... 31 Matthew Baker, Hodge theory in combinatorics ..... 57 K. Soundararajan, Tao's resolution of the Erdős discrepancy problem ... 81 MATHEMATICAL PERSPECTIVES Gerald L. Alexanderson and Leonard F. Klosinski, About the cover: Are "old" mathematics books "collectible"? ..... 93 Selected Mathematical Reviews ..... 97 BOOK REVIEWS Terence Tao (Reviewer), Polynomial methods in combinatorics, by Larry Guth ..... 103 Stanislav A. Molchanov (Reviewer), Geometric modeling in probability and statistics, by O. Calin and C. Udriste ..... 109 Jerome A. Goldstein (Reviewer), Semi-bounded differential operators, contractive semigroups, and beyond, by Alberto Cialdea and Vladimir Maz'ya ..... 113 Jacob Rubinstein (Reviewer), Singular perturbation in the physical sciences, by John Neu ..... 123 Eviatar B. Procaccia (Reviewer), Noise sensitivity of Boolean functions

and percolation, by Christophe Garban and Jeffrey E. Steif ......





131