

**EDITOR IN CHIEF****Timothy W. Nilsen**

Case Western Reserve University

**DEPUTY EDITOR****Eric Phizicky**University of Rochester School  
of Medicine and Dentistry**REVIEWS EDITOR****Thomas R. Cech**

Howard Hughes Medical Institute

**EDITORS****Benjamin Blencowe**  
University of Toronto**Javier F. Caceres**  
MRC Human Genetics Unit**Maria Carmo-Fonseca**  
Instituto de Medicina Molecular,  
University of Lisbon**Ling-Ling Chen**  
Chinese Academy of Sciences**Elena Conti**  
Max Planck Institute of Biochemistry,  
Martinsried**Adrian R. Ferré-D'Amaré**  
National Heart, Lung and Blood Institute**Fátima Gebauer**  
Centre for Genomic Regulation (CRG)**Britt Glaunsinger**  
University of California, Berkeley**Marina V. Rodnina**  
Max Planck Institute for Biophysical  
Chemistry**Mikiko C. Siomi**  
The University of Tokyo**Erik Sontheimer**  
University of Massachusetts Medical School**Peter F. Stadler**  
Leipzig University**Jörg Vogel**  
University of Würzburg**Eric Westhof**  
CNRS, Strasbourg**John Woolford**  
Carnegie Mellon University**Mihaela Zavolan**  
Biozentrum, University of Basel**EDITORIAL BOARD****Manuel Ares**  
University of California, Santa Cruz**David P. Bartel**  
Massachusetts Institute of Technology**Brenda L. Bass**  
University of Utah**Philip C. Bevilacqua**  
Pennsylvania State University**Douglas L. Black**  
University of California, Los Angeles**Ronald R. Breaker**  
Yale University**Chris Burge**  
Massachusetts Institute of Technology**Witold Filipowicz**  
Friedrich Miescher Institute**Kurt Fredrick**  
The Ohio State University**Mariano A. Garcia-Blanco**  
Duke University**Wendy Gilbert**  
Yale University**Michelle Hastings**  
Rosaling Franklin University of Medicine  
and Science**Matthias W. Hentze**  
EMBL, Heidelberg**Daniel Herschlag**  
Stanford University**Jane E. Jackman**  
The Ohio State University**Allan Jacobson**  
University of Massachusetts Medical School**Martin Jinek**  
University of Zurich**Katrin Karbstein**  
Scripps Research**Magda Konarska**  
Warsaw University**Andrei Korostelev**  
University of Massachusetts  
Medical School**Adrian R. Krainer**  
Cold Spring Harbor Laboratory**Alain Laederach**  
UNC Chapel Hill**David M.J. Lilley**  
University of Dundee**Reinhard Lührmann**  
Max Planck Institute for Biophysical Chemistry,  
Göttingen**Kristen W. Lynch**  
University of Pennsylvania School  
of Medicine**James Manley**  
Columbia University**Lynne E. Maquat**  
University of Rochester**Gunter Meister**  
University of Regensburg**Harry F. Noller**  
University of California, Santa Cruz**Tao Pan**  
University of Chicago**Roy Parker**  
University of Colorado, Boulder**Lori Passmore**  
MRC Laboratory of Molecular Biology**Ramesh Pillai**  
University of Geneva**Anna Marie Pyle**  
Yale University**Donald Rio**  
University of California, Berkeley**Michael Rosbash**  
Brandeis University**Guido Sanguinetti**  
University of Edinburgh**Schraga Schwartz**  
Weizmann Institute of Science**Geraldine Seydoux**  
Johns Hopkins University**Phillip A. Sharp**  
Massachusetts Institute  
of Technology**Stewart Shuman**  
Memorial Sloan Kettering Cancer Center**Haruhiko Siomi**  
Keio University School of Medicine**Jonathan Staley**  
University of Chicago**Joan A. Steitz**  
Yale University**Gisela Storz**  
National Institute of Child Health  
and Human Development**David Tollervey**  
University of Edinburgh**Yukihide Tomari**  
The University of Tokyo**Jernej Ule**  
UCL Institute of Neurology**Juan Valcárcel**  
ICREA and Centre de Regulació  
Genòmica**Yanli Wang**  
Institute of Biophysics, Chinese Academy  
of Sciences**Marvin Wickens**  
University of Wisconsin, Madison**Sandra L. Wolin**  
National Cancer Institute**Sarah A. Woodson**  
Johns Hopkins University**Gene Yeo**  
University of California, San Diego**PRODUCTION MANAGER****Denise Weiss**  
Cold Spring Harbor Laboratory Press**PRODUCTION EDITOR****Marie Cotter**  
Cold Spring Harbor Laboratory Press**PRODUCTION EDITOR****Mary Mulligan**  
Cold Spring Harbor Laboratory Press**EDITORIAL COORDINATOR****Ann Marie Micenmacher**  
Case Western Reserve University

**Editorial Office:** RNA, Center for RNA Molecular Biology, Room W127, School of Medicine, Case Western Reserve University, 10900 Euclid Avenue, Cleveland, OH 44106-4973, USA. Telephone: 216-368-1852; fax: 216-368-2010; e-mail: majournal@case.edu.

**Publishing and Advertising Offices:** Cold Spring Harbor Laboratory Press, 1 Bungtown Road, Cold Spring Harbor, New York 11724-2203. For advertising rates and data, contact Marcie Siconolfi, Advertising Manager, at 516-422-4010 (telephone) or 516-422-4092 (fax).

**Instructions for Contributors:** Instructions for contributors are published in each issue of RNA and are available online (<http://www.majournal.org>).

**Subscriptions:** Kathleen Cironi, Subscription Manager. For 2022 institutional prices, go to <http://majournal.cshlp.org/site/subscriptions/cost.dtl>. Orders may be sent to Cold Spring Harbor Laboratory Press, Fulfillment Department, 500 Sunnyside Boulevard, Woodbury, New York 11797-2924. Telephone: Continental U.S. and Canada 1-800-843-4388; all other locations 1-516-422-4100. Fax: 1-516-422-4097. Claims for missing issues must be received within four months of issue date.

**Member Subscriptions:** Members of the RNA Society automatically receive RNA as part of their annual membership dues.

**The RNA Society:** Membership information and application forms may be obtained from: The RNA Society, 9650 Rockville Pike, Bethesda, MD 20814-3998, USA. Telephone: 301-530-7120; fax: 301-530-7049; e-mail: ma@faseb.org.

**COPYRIGHT INFORMATION:** Authors of articles published in RNA retain copyright of the articles (except US Government employees) but grant Cold Spring Harbor Laboratory Press exclusive right to publish the articles for a period of 12 months following full-issue publication. This includes the rights to publish, reproduce, distribute, display, and store the article in all formats; to translate the article into other languages; to create adaptations, summaries, extracts, or derivations of the article; and to license others to do any or all of the above. Authors can reuse their articles in their work as long as RNA is credited as the place of original publication. Twelve months following publication, these articles are made available under a CC-BY-NC 4.0 Creative Commons license. Articles that carry the Open Access designation are available immediately under a CC-BY 4.0 or CC-BY-NC 4.0 Creative Commons license. Detailed copyright terms are online at <http://majournal.cshlp.org/site/misc/terms.xhtml>. Permission information is online at [http://majournal.cshlp.org/site/misc/permissions\\_landing.xhtml](http://majournal.cshlp.org/site/misc/permissions_landing.xhtml).

RNA (ISSN 1355-8382) is published monthly by Cold Spring Harbor Laboratory Press, 500 Sunnyside Blvd., Woodbury, NY 11797-2924. Periodicals paid at Woodbury, NY, and additional mailing offices. **POSTMASTER:** Send address changes to Cold Spring Harbor Laboratory Press, Journals Fulfillment Dept., 500 Sunnyside Blvd., Woodbury, NY 11797-2924.

## FORTHCOMING PAPERS

### Perspective

#### The limits of human microRNA annotation have been met

*Bastian Fromm, Xiangfu Zhong, Marcel Tarbier, Marc R. Friedländer, and Michael Hackenberg*

### Bioinformatics

#### FISH-quant v2: a scalable and modular tool for smFISH image analysis

*Arthur Imbert, Wei Ouyang, Adham Safieddine, Emeline Coleno, Christophe Zimmer, Edouard Bertrand, Thomas Walter, and Florian Mueller*

### Articles

#### The interplay between translational efficiency, poly(A) tails, microRNAs, and neuronal activation

*Timothy J. Eisen, Jingyi Jessica Li, and David P. Bartel*

#### Plasticity and conditional essentiality of modification enzymes for domain V of *Escherichia coli* 23S ribosomal RNA

*Josefine Liljeruhm, Margus Leppik, Letian Bao, Triin Truu, Maria Calvo-Noriega, Nicola S. Freyer, Aivar Liiv, Jinfan Wang, Rubén Crespo Blanco, Rya Ero, Jaanus Remme, and Anthony C. Forster*

#### Evolutionary divergence of *Firre* localization and expression

*Christian Much, Michael J. Smallegan, Taeyoung Hwang, Skylar D. Hanson, Gabrijela Dumbović, and John L. Rinn*

#### Thermodynamic characterization of naturally occurring RNA pentaloops

*Sharear Saon and Brent M. Znosko*

### Methods

#### Global SLAM-seq for accurate mRNA decay determination and identification of NMD targets

*Hanna Alalam, Jorge A. Zepeda-Martínez, and Per Sunnerhagen*

#### Mito-FUNCAT-FACS reveals cellular heterogeneity in mitochondrial translation

*Yusuke Kimura, Hironori Saito, Tatsuya Osaki, Yasuhiro Ikegami, Taisei Wakigawa, Yoshiho Ikeuchi, and Shintaro Iwasaki*