

THE BULLETIN OF SYMBOLIC LOGIC

Edited by

Laurent Bienvenu, *Managing Editor*

Matthias Baaz Ali Enayat

James Cummings Leonid Libkin

Paola D'Aquino Øystein Linnebo

Peter Dybjer

Reviews Editors

Clinton Conley, *Managing Editor for Reviews*

Mark van Atten Bernard Linsky

Benno van den Berg Antonio Montalbán

Thomas Colcombet Rahim Moosa

Samuel Coskey Christian Retoré

Bradd Hart Nam Trang

Thesis Abstracts Editor

Christian Rosendal

VOLUME 27 • 2021

Copyright © 2022 by the Association for Symbolic Logic. All rights reserved.
Reproduction by photostat, photo-print, microfilm, or like process by permission only.



PUBLISHED BY CAMBRIDGE UNIVERSITY PRESS FOR
AND ON BEHALF OF THE ASSOCIATION OF SYMBOLIC LOGIC.

CONTENTS OF VOLUME 27

ARTICLES

ARAI, TOSHIYASU, WAINER, STANLEY S., and WEIERMANN, ANDREAS. Goodstein sequences based on a parametrized Ackermann–Péter function.....	168
BEZHANISHVILI, GURAM, BEZHANISHVILI, NICK, LUCERO-BRYAN, JOEL, and VAN MILL, JAN. The McKinsey–Tarski theorem for locally compact ordered spaces.....	187
BUTTON, TIM. Level theory, part 1: Axiomatizing the bare idea of a cumulative hierarchy of sets.....	436
BUTTON, TIM. Level theory, part 2: Axiomatizing the bare idea of a potential hierarchy.....	461
CHENG, YONG. Current research on Gödel’s incompleteness theorems.....	113
CHEN-MERTENS, WILLIAM, KOJMAN, MENACHEM, and STEPRĀNS, JURIS. Strong colorings over partitions.....	67
DUMMETT, MICHAEL. Sense and reference from a constructivist standpoint ...	485
EDER, GÜNTHER. Projective duality and the rise of modern logic.....	351
GOUDSMIT, JEROEN P. Decidability of admissibility: On a problem by Friedman and its solution by Rybakov.....	1
KENNEDY, JULIETTE and VÄÄNÄNEN, JOUKO. Logicality and model classes.....	385
KOSSAK, ROMAN and WCISŁO, BARTOSZ. Disjunctions with stopping conditions.....	231
LETHEN, TIM. Kurt Gödel on logical, theological, and physical antinomies ...	267
MALLIARIS, M. and SHELAH, S. Notes on the stable regularity lemma.....	415
MARTIN-LÖF, PER. The sense/reference distinction in constructive semantics.....	501
PAULSON, LAWRENCE C. Ackermann’s function in iterative form: A proof assistant experiment.....	426
RASGA, JOÃO, SERNADAS, CRISTINA, and CARNIELLI, WALTER. Reduction techniques for proving decidability in logics and their meet–combination.....	39
SANTOS, PAULO GUILHERME and KAHLE, REINHARD. Variants of Kreisel’s conjecture on a new notion of provability.....	337
SARGSYAN, GRIGOR and TRANG, NAM. Sealing of the universally Baire sets.....	254

REVIEWS

SMYTHE, B. IAN. Two articles on classification in topology.....	212
WEINERT, THILO. William Chan, <i>An introduction to combinatorics of determinacy</i>	91

IN MEMORIAM

In Memoriam: Michael Morley, 1930–2020.....	514
In Memoriam: J. Michael Dunn, 1941–2021.....	519

THESIS ABSTRACTS

ABBADINI, MARCO. <i>On the Axiomatisability of the Dual of Compact Ordered Spaces</i> , Università degli studi di Milano, Italy, 2021. Supervised by Vincenzo Marra	526
BERGFALK, JEFFREY. <i>Dimensions of Ordinals: Set Theory, Homology Theory, and the First Omega Alephs</i> , Cornell University, Ithaca, NY, USA, 2018. Supervised by JustinTatch Moore.....	526
CARAI, LUCA. <i>New Directions in Duality Theory for Modal Logic</i> , New Mexico State University, USA, 2021. Supervised by Guram Bezhanishvili.....	527
CORBALÁN, MARÍA INÉS. <i>From Generative Linguistics to Categorical Grammars: Overt Subjects in Control Infinitives</i> , University of Campinas, Brazil, 2018. Supervised by Marcelo Esteban Coniglio	215
COSCARELLI, BRUNO, COSTA. <i>Model Theory in a Paraconsistent Environment</i> , University of Campinas, Brazil, 2020. Supervised by Marcelo Esteban Coniglio	216
d'ELBÉE, CHRISTIAN. <i>Expansions and Neostability in Model Theory</i> , Institut Camille Jordan, Université de Lyon, Lyon, France, 2019. Supervised by Thomas Blossier and Zóe Chatzidakis.	216
JACINTO, BRUNO. <i>Necessitism, Contingentism, and Theory Equivalence</i> , University of St Andrews, St Andrews, Scotland, UK (SASP PhD Programme), 2016. Supervised by Stephen Read and Gabriel Uzquiano	217
JAHEL, COLIN. <i>Some Progress on the Unique Ergodicity Problem</i> , Université Claude Bernard Lyon 1, Villeurbanne, France, 2021. Supervised by Lionel Nguyen Van Thé and Todor Tsankov.....	527
KO, LILING. <i>Towards Finding a Lattice that Characterizes the $> \omega^2$-Fickle Recursively Enumerable Turing Degrees</i> , University of Notre Dame, USA, 2021. Supervised by Peter Cholak	528
KRAPP, LOTHAR SEBASTIAN. <i>Algebraic and Model Theoretic Properties of O-minimal Exponential Fields</i> , Universität Konstanz, Germany, 2019. Supervised by Salma Kuhlmann	529
LI, XUE. <i>Automating the Repair of Faulty Logical Theories</i> , Artificial Intelligence Applications Institute, School of Informatics, University of Edinburgh, UK, 2021. Supervised by Alan Bundy	530
LIU, YONG. <i>The Structure of $d.r.e.$ Degrees</i> , National University of Singapore, Singapore, 2017. Supervised by Yue Yang	218
LUTZ, PATRICK. <i>Results on Martin's Conjecture</i> , University of California, Berkeley, CA, USA, 2021. Supervised by Theodore Slaman	219
MILLER, JUSTIN. <i>Intrinsic density, asymptotic computability, and stochasticity</i> , University of Notre Dame, Notre Dame, IN, USA, 2021. Supervised by Peter Cholak	220
PARISI, ANDREW. <i>Second-Order Modal Logic</i> , University of Connecticut, USA, 2017. Supervised by Marcus Rossberg	530
PARK, SEWON. <i>Continuous Abstract Data Types for Verified Computation</i> , KAIST, South Korea, 2021. Supervised by Martin Ziegler.....	531
PENG, CHENG. <i>On Transfinite Levels of the Ershov Hierarchy</i> , National University of Singapore, Singapore, 2018. Supervised by Yue Yang.....	220
POVEDA, ALEJANDRO. <i>Contributions to the Theory of Large Cardinals through the Method of Forcing</i> , Doctorate program in Mathematics and Computer Science—Universitat de Barcelona, Barcelona, Spain, 2020. Supervised by Joan Bagaria	221

TOUCHARD, PIERRE. <i>Transfer Principles in Henselian Valued Fields</i> , Westfälische Wilhelms-Universität Münster, Germany, 2020. Supervised by Martin Hils.....	222
ZOU, TINGXIANG. <i>Pseudofinite Structures and Counting Dimensions</i> , Université de Lyon, Lyon, France, 2019. Supervised by Frank Wagner	223

MEETINGS OF THE ASSOCIATION FOR SYMBOLIC LOGIC

2020 Winter Meeting of the Association for Symbolic Logic.....	94
2021 Winter Meeting of the Association for Symbolic Logic, Virtual Gathering, Eastern APA Meeting, January 7–8, 2021	98
2021 Winter Meeting of the Association for Symbolic Logic, Virtual Gathering, Joint Mathematics Meeting, January 8–9, 2021	102
2021 North American Annual Meeting of the Association for Symbolic Logic, University of Notre Dame, South Bend IN, USA, June 22–25, 2021	298

NOTICES

Notices	107, 224, 331, 537
Officers and Committees of the Association for Symbolic Logic	532



**UNITED STATES
POSTAL SERVICE®**

**Statement of Ownership, Management, and Circulation
(All Periodicals Publications Except Requester Publications)**

1. Publication Title Bulletin of Symbolic Logic	2. Publication Number 012 – 819	3. Filing Date 10/1/2021
--	------------------------------------	-----------------------------

4. Issue Frequency quarterly March-June-September-December	5. Number of Issues Published Annually 4	6. Annual Subscription Price \$528.00
---	---	--

7. Complete Mailing Address of Known Office of Publication (Not printer) (Street, city, county, state, and ZIP+4®) Association for Symbolic Logic Department of Mathematics University of Connecticut	Contact Person Richard A Shore Telephone (Include area code) 607-279-6135
--	--

8. Complete Mailing Address of Headquarters or General Business Office of Publisher (Not printer)
Association for Symbolic Logic
Department of Mathematics
University of Connecticut

9. Full Names and Complete Mailing Addresses of Publisher, Editor, and Managing Editor (Do not leave blank)

Publisher (Name and complete mailing address)
Richard A Shore 14 Kenwood Avenue
Newton MA 024569

Editor (Name and complete mailing address)
Professor Laurent Bienvenu CNRS & Université de Bordeaux

Managing Editor (Name and complete mailing address)
Professor Laurent Bienvenu CNRS & Université de Bordeaux

10. Owner (Do not leave blank. If the publication is owned by a corporation, give the name and address of the corporation immediately followed by the names and addresses of all stockholders owning or holding 1 percent or more of the total amount of stock. If not owned by a corporation, give the names and addresses of the individual owners. If owned by a partnership or other unincorporated firm, give its name and address as well as those of each individual owner. If the publication is published by a nonprofit organization, give its name and address.)

Full Name	Complete Mailing Address
Association for Symbolic Logic	Department of Mathematics University of Connecticut 341 Mansfield Road, U-1009 Storrs, CT 06269-1009, USA

11. Known Bondholders, Mortgagees, and Other Security Holders Owning or Holding 1 Percent or More of Total Amount of Bonds, Mortgages, or Other Securities. If none, check box None

Full Name	Complete Mailing Address

12. Tax Status (For completion by nonprofit organizations authorized to mail at nonprofit rates) (Check one)
The purpose, function, and nonprofit status of this organization and the exempt status for federal income tax purposes:
 Has Not Changed During Preceding 12 Months
 Has Changed During Preceding 12 Months (Publisher must submit explanation of change with this statement)

13. Publication Title		14. Issue Date for Circulation Data Below		
Bulletin of Symbolic Logic		MARCH 2021		
15. Extent and Nature of Circulation		Average No. Copies Each Issue During Preceding 12 Months	No. Copies of Single Issue Published Nearest to Filing Date	
a. Total Number of Copies (<i>Net press run</i>)		1023	1058	
b. Paid Circulation (<i>By Mail and Outside the Mail</i>)	(1)	Mailed Outside-County Paid Subscriptions Stated on PS Form 3541 (Include paid distribution above nominal rate, advertiser's proof copies, and exchange copies)	374	298
	(2)	Mailed In-County Paid Subscriptions Stated on PS Form 3541 (<i>Include paid distribution above nominal rate, advertiser's proof copies, and exchange copies</i>)	0	0
	(3)	Paid Distribution Outside the Mails Including Sales Through Dealers and Carriers, Street Vendors, Counter Sales, and Other Paid Distribution Outside USPS®	513	419
	(4)	Paid Distribution by Other Classes of Mail Through the USPS (e.g., First-Class Mail®)	0	0
c. Total Paid Distribution [<i>Sum of 15b (1), (2), (3), and (4)</i>]		887	717	
d. Free or Nominal Rate Distribution (<i>By Mail and Outside the Mail</i>)	(1)	Free or Nominal Rate Outside-County Copies included on PS Form 3541	0	0
	(2)	Free or Nominal Rate In-County Copies Included on PS Form 3541	0	0
	(3)	Free or Nominal Rate Copies Mailed at Other Classes Through the USPS (e.g., First-Class Mail)	0	0
	(4)	Free or Nominal Rate Distribution Outside the Mail (<i>Carriers or other means</i>)	0	0
e. Total Free or Nominal Rate Distribution (<i>Sum of 15d (1), (2), (3) and (4)</i>)		0	0	
f. Total Distribution (<i>Sum of 15c and 15e</i>)		887	717	
g. Copies not Distributed (<i>See Instructions to Publishers #4 (page #3)</i>)		136	341	
h. Total (<i>Sum of 15f and g</i>)		1023	1058	
i. Percent Paid (<i>15c divided by 15f times 100</i>)		100%	100%	

* If you are claiming electronic copies, go to line 16 on page 3. If you are not claiming electronic copies, skip to line 17 on page 3.



**Statement of Ownership, Management, and Circulation
(All Periodicals Publications Except Requester Publications)**

16. Electronic Copy Circulation	Average No. Copies Each Issue During Preceding 12 Months	No. Copies of Single Issue Published Nearest to Filing Date
a. Paid Electronic Copies ▶		
b. Total Paid Print Copies (Line 15c) + Paid Electronic Copies (Line 16a) ▶		
c. Total Print Distribution (Line 15f) + Paid Electronic Copies (Line 16a) ▶		
d. Percent Paid (Both Print & Electronic Copies) (16b divided by 16c × 100) ▶		

I certify that 50% of all my distributed copies (electronic and print) are paid above a nominal price.

17. Publication of Statement of Ownership

If the publication is a general publication, publication of this statement is required. Will be printed Publication not required.
 in the December 2021 issue of this publication.

18. Signature and Title of Editor, Publisher, Business Manager, or Owner	Date 10/1/2021
--	-----------------------

I certify that all information furnished on this form is true and complete. I understand that anyone who furnishes false or misleading information on this form or who omits material or information requested on the form may be subject to criminal sanctions (including fines and imprisonment) and/or civil sanctions (including civil penalties).

THE BULLETIN OF SYMBOLIC LOGIC (ISSN print: 1079–8986, ISSN online: 1943–5894) is published quarterly, in the months of March, June, September, and December, by the Association for Symbolic Logic, Inc., Department of Mathematics, University of Connecticut, 341 Mansfield Road, U-1009, Storrs, CT 06269-1009, USA. Periodicals postage is paid at Storrs CT and at additional mailing offices. The BULLETIN is distributed with THE JOURNAL OF SYMBOLIC LOGIC. The 2021 annual subscription price for the two journals, in either print or electronic form, is US\$1005 or £630; the print/electronic bundle prices are \$1120 or £703: <http://journals.cambridge.org/bsl> for more information. **Postmaster:** Send address changes to **Journals Customer Services Department, Cambridge University Press, One Liberty Plaza, New York, NY 10006, USA**. Business correspondence should be sent to the Secretary-Treasurers of the Association, Russell Miller and David Solomon (address below).

Subscription orders for the JOURNAL and BULLETIN, or REVIEW should be sent to subscriptions_newyork@cambridge.org. All orders must be accompanied by payment by check, credit card (Visa, MasterCard, JCB or American Express only), or debit card. To receive a replacement copy of the BULLETIN, please report damaged, defective or missing issues within nine months of the date of publication.

Volumes 1 through 19 of the BULLETIN are available online at JSTOR: volumes 1 through 26 via Cambridge University Press, <http://journals.cambridge.org/bsl> – access to the latter is free to members.

Individual membership in the Association is open to anyone interested in its work. Annual dues for members are US\$102, £78 sterling or €85 (\$51, £39 sterling or €43 for student, emeritus and unemployed members; see <http://www.aslonline.org/membership-individual.html> for more information, including conditions and privileges). Dues include subscriptions to the current volumes of the JOURNAL, the BULLETIN, and the REVIEW.

Institutional membership in the Association is available to any academic institution or department. Annual institutional membership dues for 2021 are US\$1200 (full) or \$790 (basic); privileges include choices of current subscriptions, back volumes, regular individual and student memberships.

Requests for information, applications for *new* membership, renewals of institutional membership, business correspondence, and notices or announcements for publication in the BULLETIN should be sent to **ASL, Department of Mathematics, University of Connecticut, 341 Mansfield Road, U-1009, Storrs, CT 06269-1009, USA**. The electronic mail address of the Association's business office is asl@uconn.edu. Requests for back issues should be sent to **Cambridge University Press**, address above.

POSTMASTER: Individual membership *renewals*, notices of change of address, and dues payments, should be sent to **Association for Symbolic Logic, c/o Journals Customer Services Department, Cambridge University Press, One Liberty Plaza, New York, NY 10006, USA**, USmemberservices@cambridge.org.

The paper used in the BULLETIN is acid-free and falls within the guidelines established to ensure permanence and stability.

The BULLETIN has been registered with the Copyright Clearance Center, Inc. The appearance of a code at the bottom of the first page of an article indicates the copyright owner's consent for copying beyond that permitted by Sections 107 or 108 of the US Copyright Law, provided that the per-copy fee stated in the code is paid directly to **Copyright Clearance Center Inc., 222 Rosewood Drive, Danvers, MA 01923, USA**. This consent does not extend to copying for general distribution, for advertising or promotion purposes, for creating new collective works, or for resale. Specific written permission for such copying must be obtained from the Association.

Cambridge Core

For further information about this journal
please go to the journal web site at:
[cambridge.org/bsl](https://doi.org/10.1017/bsl.2022.6)

CAMBRIDGE
UNIVERSITY PRESS