

St. Petersburg Mathematical Journal

(Formerly Leningrad Mathematical Journal)

Volume 26 Number 2 April 2015

A Translation of

РОССИЙСКАЯ АКАДЕМИЯ НАУК

АЛГЕБРА

И

АНАЛИЗ

ТОМ 26 № 2 2014



American Mathematical Society

Providence, Rhode Island USA

ISSN 1061-0022 (print)

ISSN 1547-7371 (online)

ST. PETERSBURG MATHEMATICAL JOURNAL

(Formerly Leningrad Mathematical Journal)

A translation of the Russian bimonthly

Алгебра и анализ

“Наука”, С.-Петербургское отделение, 2014 г.

Editorial Board

A. B. Aleksandrov	N. Yu. Netsvetaev
A. N. Andrianov (Deputy Editor-in-Chief)	N. K. Nikol'skiĭ
V. M. Babich	A. N. Parshin
A. D. Baranov (Executive Secretary)	M. A. Semenov-Tyan-Shanskiĭ
S. V. Buyalo	A. A. Suslin
O. Ya. Viro	T. A. Suslina
S. V. Kislyakov (Editor-in-Chief)	N. N. Ural'tseva (Deputy Editor-in-Chief)
P. P. Kulish	V. P. Khavin
A. V. Mal'yutin	A. L. Chistov
	A. V. Yakovlev

SUBSCRIPTION INFORMATION. The 2015 subscription is for one volume of six issues. Beginning in 2004, *St. Petersburg Mathematical Journal* is accessible from www.ams.org/journals/. Subscription prices for Volume 26 are as follows: for paper delivery, US\$2282 list, US\$1825.60 institutional member; for electronic delivery, US\$2168 list, US\$1734.40 institutional member. Upon request, subscribers to paper delivery of this journal are also entitled to receive electronic delivery. If ordering the paper version, add US\$5 for delivery within the United States; US\$19 for delivery outside the United States. Subscription renewals are subject to late fees. See www.ams.org/journal-faq for more journal subscription information.

BACK NUMBER INFORMATION. For back issues see www.ams.org/bookstore.

Orders for subscriptions and publications of the American Mathematical Society 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. 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 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 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.)

St. Petersburg Mathematical Journal (ISSN 1061-0022 (print); ISSN 1547-7371 (online)) is published bimonthly by the American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294 USA. Periodicals postage paid at Providence, Rhode Island. Postmaster: Send address changes to St. Petersburg Mathematical Journal, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294 USA.

Manuscripts should be addressed to “Algebra i Analiz”, St. Petersburg Publishing Company of the Russian Academy of Sciences, Mendeleevskaya Liniya 1, St. Petersburg 199034, Russia. Submitting simultaneously a tex-file to the address pmj@pdmi.ras.ru is highly appreciated.

© 2015 American Mathematical Society. All rights reserved.

This journal is indexed in *Mathematical Reviews* and *Zentralblatt MATH*.

This journal is archived in *Portico* and in *CLOCKSS*.

Translation authorized by the All-Union Agency for Author's Rights, Moscow.

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 20 19 18 17 16 15

St. Petersburg Mathematical Journal

Volume 26 Number 2 April 2015

A Translation of

РОССИЙСКАЯ АКАДЕМИЯ НАУК

АЛГЕБРА И АНАЛИЗ

ТОМ 26 № 2 2014



American Mathematical Society

Providence, Rhode Island USA

ISSN 1061-0022 (print)

ISSN 1547-7371 (online)

ST. PETERSBURG MATHEMATICAL JOURNAL

(Formerly Leningrad Mathematical Journal)

A translation of the Russian bimonthly

Алгебра и анализ

“Наука”, С.-Петербургское отделение, 2014 г.

Editorial Board

A. B. Aleksandrov	N. Yu. Netsvetaev
A. N. Andrianov (Deputy Editor-in-Chief)	N. K. Nikol'skiĭ
V. M. Babich	A. N. Parshin
A. D. Baranov (Executive Secretary)	M. A. Semenov-Tyan-Shanskiĭ
S. V. Buyalo	A. A. Suslin
O. Ya. Viro	T. A. Suslina
S. V. Kislyakov (Editor-in-Chief)	N. N. Ural'tseva (Deputy Editor-in-Chief)
P. P. Kulish	V. P. Khavin
A. V. Mal'yutin	A. L. Chistov
	A. V. Yakovlev

SUBSCRIPTION INFORMATION. The 2015 subscription is for one volume of six issues. Beginning in 2004, *St. Petersburg Mathematical Journal* is accessible from www.ams.org/journals/. Subscription prices for Volume 26 are as follows: for paper delivery, US\$2282 list, US\$1825.60 institutional member; for electronic delivery, US\$2168 list, US\$1734.40 institutional member. Upon request, subscribers to paper delivery of this journal are also entitled to receive electronic delivery. If ordering the paper version, add US\$5 for delivery within the United States; US\$19 for delivery outside the United States. Subscription renewals are subject to late fees. See www.ams.org/journal-faq for more journal subscription information.

BACK NUMBER INFORMATION. For back issues see www.ams.org/bookstore.

Orders for subscriptions and publications of the American Mathematical Society 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. 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 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 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.)

St. Petersburg Mathematical Journal (ISSN 1061-0022 (print); ISSN 1547-7371 (online)) is published bimonthly by the American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294 USA. Periodicals postage paid at Providence, Rhode Island. Postmaster: Send address changes to St. Petersburg Mathematical Journal, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294 USA.

Manuscripts should be addressed to “Algebra i Analiz”, St. Petersburg Publishing Company of the Russian Academy of Sciences, Mendeleevskaya Liniya 1, St. Petersburg 199034, Russia. Submitting simultaneously a tex-file to the address pmj@pdmi.ras.ru is highly appreciated.

© 2015 American Mathematical Society. All rights reserved.

This journal is indexed in *Mathematical Reviews* and *Zentralblatt MATH*.

This journal is archived in *Portico* and in *CLOCKSS*.

Translation authorized by the All-Union Agency for Author's Rights, Moscow.

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 20 19 18 17 16 15

CONTENTS

Research Papers

P. D. Andreev , Proof of the Busemann conjecture for G -spaces of nonpositive curvature	193
V. A. Artamonov , Semi-simple Hopf algebras with restrictions on irreducible modules of dimension exceeding 1	207
A. V. Malyutin , Pretrees and the shadow topology	225
S. A. Nazarov , Asymptotic expansions for eigenvalues of the Steklov problem in singularly perturbed domains	273
B. N. Khabibullin, G. R. Talipova, and F. B. Khabibullin , Subsequences of zeros for Bernstein spaces and the completeness of systems of exponentials in spaces of functions on an interval	319
Ya. Shitov , Tropical semimodules of dimension two	341

Easy Reading for Professionals

N. O. Kotelina and A. B. Pevnyĭ , Sidel'nikov inequality	351
---	-----

RUSSIAN CONTENTS*

«Наука»

СОДЕРЖАНИЕ

Статьи

<i>Андреев П. Д.</i> Доказательство гипотезы Буземана для G -пространств неположительной кривизны	1
<i>Артамонов В. А.</i> Полупростые алгебры Хопфа с ограничениями на неприводимые неодномерные модули	21
<i>Малютин А. В.</i> Преддеревья и топология теней	45
<i>Назаров С. А.</i> Асимптотические разложения собственных чисел задачи Стеклова в сингулярно возмущенных областях	119
<i>Хабибуллин Б. Н., Талипова Г. Р., Хабибуллин Ф. Б.</i> Подпоследовательности нулей для пространств Бернштейна и полнота систем экспонент в пространствах функций на интервале	185
<i>Shitov Ya.</i> Tropical semimodules of dimension two.	216
Легкое чтение для профессионала	
<i>Котелина Н. О., Певный А. Б.</i> Неравенство Сидельникова	229

*The American Mathematical Society scheme for transliteration of Cyrillic may be found at the end of index issues of *Mathematical Reviews*.



1061-0022(201504)26:2;1-P