St. Petersburg Mathematical Journal

(Formerly Leningrad Mathematical Journal)

Volume 32 Number 4 August 2021

A Translation of

РОССИЙСКАЯ АКАДЕМИЯ НАУК

АЛГЕБРА и АНАЛИЗ

TOM 32 № 4 2020



Providence, Rhode Island USA

ST. PETERSBURG MATHEMATICAL JOURNAL

(Formerly Leningrad Mathematical Journal)

A translation of the Russian bimonthly

Алгебра и анализ

"Наука", С.-Петербургское отделение, 2020 г.

Editor-in-Chief: S. V. Kislyakov

Editorial Board

A. B. Aleksandrov A. N. Parshin A. D. Baranov F. V. Petrov

(Executive Secretary) M. A. Semenov-Tyan-Shanskii

S. V. Buyalo T. A. Suslina

I. A. Dynnikov (Deputy Editor-in-Chief)

A. V. Malyutin

N. K. Nikol'skii

A. L. Chistov

A. V. Yakovlev

I. A. Panin

Advisory Board: A. N. Andrianov, V. M. Babich, O. Ya. Viro, and N. Yu. Netsyetaev

SUBSCRIPTION INFORMATION. The 2021 subscription is for one volume of six issues. Beginning in 2004, St. Petersburg Mathematical Journal is accessible from www.ams.org/journals/. The subscription prices for Volume 32: Paper format with free electronic access: List US\$2775; AMS Institutional Member: US\$2220. Electronic only: List US\$2636; AMS Institutional Member: US\$2108.80. 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/backvols.

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 02904-2213 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. Requests for permission to reuse portions of AMS publication content are handled by the Copyright Clearance Center. For more information, please visit www.ams.org/publications/pubpermissions.

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 02904-2213 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 02904-2213 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.

© 2021 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 26 25 24 23 22 21



N. N. Ural'tseva at the city seminar on mathematical physics, 1968.

This issue, like the preceding one, is dedicated to the anniversary of Nina Nikolaevna Ural'tseva, an outstanding St. Petersburg mathematician, a great expert in partial differential equations and calculus of variations.

St. Petersburg Mathematical Journal

Volume 32 Number 4 August 2021

A Translation of

РОССИЙСКАЯ АКАДЕМИЯ НАУК

АЛГЕБРА и АНАЛИЗ

TOM 32 № 4 2020



Providence, Rhode Island USA

ST. PETERSBURG MATHEMATICAL JOURNAL

(Formerly Leningrad Mathematical Journal)

A translation of the Russian bimonthly

Алгебра и анализ

"Наука", С.-Петербургское отделение, 2020 г.

Editor-in-Chief: S. V. Kislyakov

Editorial Board

A. B. Aleksandrov A. N. Parshin A. D. Baranov F. V. Petrov

(Executive Secretary) M. A. Semenov-Tyan-Shanskii

S. V. Buyalo T. A. Suslina

I. A. Dynnikov (Deputy Editor-in-Chief)

A. V. Malyutin

N. K. Nikol'skii

A. L. Chistov

A. V. Yakovlev

I. A. Panin

Advisory Board: A. N. Andrianov, V. M. Babich, O. Ya. Viro, and N. Yu. Netsyetaev

SUBSCRIPTION INFORMATION. The 2021 subscription is for one volume of six issues. Beginning in 2004, St. Petersburg Mathematical Journal is accessible from www.ams.org/journals/. The subscription prices for Volume 32: Paper format with free electronic access: List US\$2775; AMS Institutional Member: US\$2220. Electronic only: List US\$2636; AMS Institutional Member: US\$2108.80. 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/backvols.

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 02904-2213 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. Requests for permission to reuse portions of AMS publication content are handled by the Copyright Clearance Center. For more information, please visit www.ams.org/publications/pubpermissions.

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 02904-2213 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 02904-2213 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.

© 2021 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 26 25 24 23 22 21

CONTENTS

Expository Survey

M. A. Dorodnyi and T. A. Suslina, Homogenization of hyperbolic equations with periodic coefficients in \mathbb{R}^d : Sharpness of the results	605
Research Papers	
S. Eberle and G. S. Weiss, Characterizing compact coincidence sets in the obstacle problem—a short proof	705
L. El Hajj and H. Shahgholian, Remarks on the convexity of free boundaries (Scalar and system cases)	713
S. Jeon and A. Petrosyan, Almost minimizers for certain fractional variational problems	729
T. Keßler and S. Rjasanow, Limit model for the Vlasov–Maxwell system with strong magnetic fields via gyroaveraging	753
E. Yu. Panov, On the decay of viscosity solutions to Hamilton–Jacobi equations with almost periodic initial data	767
B. A. Plamenevskii and A. S. Poretskii, Radiation and scattering in electromagnetic waveguides near thresholds	781
M. V. Safonov, Growth theorems for metric spaces with applications to PDE.	809

RUSSIAN CONTENTS *

СОДЕРЖАНИЕ

Обзоры

Дородный М. А., Суслина Т. А. Усреднение гиперболических уравнений с периодическими коэффициентами в \mathbb{R}^d : точность результатов					
Статьи					
Eberle S., Weiss G. S. Characterizing compact coincidence sets in the obstacle problem —	137				
a short proof	137				
	146				
· · · · · · · · · · · · · · · · · · ·	166				
Keßler T., Rjasanow S. Limit model for the Vlasov-Maxwell system with strong magnetic					
	200				
Панов Е. Ю. О стабилизации вязкостных решений уравнений Гамильтона-Якоби с					
почти периодическими начальными данными	217				
Пламеневский Б. А., Порецкий А. С. Излучение и рассеяние в электромагнитных					
волноводах вблизи пороговволноводах вблизи порогов	234				
Safonov M. V. Growth theorems for metric spaces with applications to PDE	271				

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







