

# Physics–Uspekhi

Advances in Physical Sciences



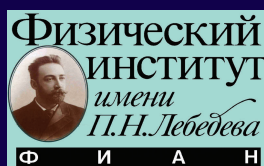
June 2015

Volume 58, Number 6

Translation of the Russian journal

Успехи физических наук, Uspekhi Fizicheskikh Nauk

June 2015, Volume 185, No. 6



**Turpion**

**IOP** Publishing



# PHYSICS- USPEKHI

ISSN 1063-7869 (Print)

ISSN 1468-4780 (Online)

CODEN: PHUSEY

## Uspekhi Fizicheskikh Nauk

### Editor

LV Keldysh *PN Lebedev Physical Institute,  
Russian Academy of Sciences (RAS), Moscow*

### First Deputy Editor

VA Rubakov *Institute for Nuclear Research, RAS, Moscow*

### Associate Editors

LP Pitaevskii *PL Kapitza Institute for Physical Problems,  
RAS, Moscow*

OV Rudenko *M V Lomonosov Moscow State University,  
Moscow*

### Managing Editor

MS Aksent'eva *Uspekhi Fizicheskikh Nauk, RAS, Moscow*

### Editorial Board

EB Aleksandrov *All-Russian Research Center  
'SI Vavilov State Optical Institute'*

PI Arseev *PN Lebedev Physical Institute, RAS, Moscow*

VS Beskin *PN Lebedev Physical Institute, RAS, Moscow*

VB Braginsky *M V Lomonosov Moscow State University,  
Moscow*

Yu V Gulyaev *Institute of Radioengineering and Electronics,  
RAS, Moscow*

SP Denisov *Russian State Research Center  
'Institute for High Energy Physics'*

IM Dremine *PN Lebedev Physical Institute, RAS, Moscow*

GR Ivanitskii *Institute of Theoretical and Experimental  
Biology, RAS, Pushchino, Moscow Region*

AA Kaplyanskii *A F Ioffe Physico-Technical Institute,  
RAS, St.-Petersburg*

GN Kulipanov *GI Budker Institute of Nuclear Physics,  
RAS, Novosibirsk*

MB Mensky *PN Lebedev Physical Institute, RAS, Moscow*

GA Mesyats *PN Lebedev Physical Institute, RAS, Moscow*

LB Okun *Russian State Research Center  
'Institute of Theoretical and Experimental  
Physics', Moscow*

VI Ritus *PN Lebedev Physical Institute, RAS, Moscow*

MV Sadvskii *Institute of Electrophysics, Ural Branch of RAS,  
Ekaterinburg*

BM Smirnov *Institute for High Temperatures, RAS, Moscow*

VE Fortov *Institute for High Energy Density,  
RAS, Moscow*

### Scientific and Staff Editors

MS Aksent'eva, EA Frimer, TB Larionova, TG Orekhova,  
TP Romanova, EV Zakharova

**Uspekhi Fizicheskikh Nauk** (Успехи Физических Наук, [www.ufn.ru](http://www.ufn.ru)) publishes reviews of the current state of the most topical problems in physics and in associated fields under the general headings: reviews of topical problems, physics of our days, instruments and methods of investigation, methodological notes, from the history of physics, conferences and symposia, personalia, physics news on the Internet, and bibliography. The journal was founded in 1918 and is published monthly.

© 2015 Uspekhi Fizicheskikh Nauk and PN Lebedev Physical Institute of the Russian Academy of Sciences

## Physics – Uspekhi

### Scientific Editors

MS Aksent'eva, A Radzig, A M Semikhatov

### English Language Editor

K Franchuk, M.A., Carleton University, Ottawa, Canada

### Desk Editors

AV Bobkov, NV Gribkova, OV Morgunova

**Physics–Uspekhi (Advances in Physical Sciences)** is the English edition of the Russian monthly journal *Uspekhi Fizicheskikh Nauk*. Translation into English started with Russian volume 66. From 1958 until 1992 the journal was published by American Institute of Physics under the title *Soviet Physics – Uspekhi* and in 1993 under its current title *Physics – Uspekhi*. Since 1994 *Physics – Uspekhi* has been published jointly by Uspekhi Fizicheskikh Nauk and Turpion Ltd. From the beginning of 1996 *Physics – Uspekhi* is being translated, typeset and edited in Moscow by Uspekhi Fizicheskikh Nauk (UFN), from 2009 published by Uspekhi Fizicheskikh Nauk, Moscow, printed by Page Bros, Norwich, UK.

### Institutional subscription information

 (volume 58, 2015, monthly)

For all countries, except the United States, Canada, Central and South America, the subscription rates are: Print + Online (1958 – 2015) £ 1786; Online only (1958 – 2015) £ 1607; Single issue £ 179. Delivery is by air-speeded mail from the UK.

**Orders, back issues, change of address to: Physics–Uspekhi**, Journals Subscription Fulfilment, IOP Publishing, Temple Circus, Temple Way, Bristol BS1 6HG, United Kingdom

For the United States, Canada, Central and South America, the subscription rates are:

Print + Online (1958 – 2015) US \$3215; Online only (1958 – 2015)

US \$ 2894; Single issue US \$ 322. Delivery is by transatlantic

airfreight and onward mailing. **United States Postal Identification**

**Statement Physics – Uspekhi**, volume 58, published monthly.

Periodicals Postage Paid at Continental Station, PA and additional

mailing offices. POSTMASTER: Send orders, address changes to

*Physics – Uspekhi*, IOP Publishing, PO Box 320, Congers, NY 10920-0320, USA.

**Online services:** Since 2008 electronic access to the journal content is hosted by IOP Publishing. All subscriptions to the journal include electronic access dating from the first English translation volume. The electronic version of the journal is available at <http://iopscience.org/phu>. All questions regarding online access should be sent to customer services at [custserv@iop.org](mailto:custserv@iop.org) or [custserv@turpion.ru](mailto:custserv@turpion.ru)

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form, or by any means, electronic, mechanical, photographic, recording, or otherwise, without the prior permission of Uspekhi Fizicheskikh Nauk.

**Editorial Office:** P N Lebedev Physical Institute, RAS, Leninskii prospekt 53, 119991 Moscow, Russian Federation  
Tel. (7-499) 132 62 65, (7-499) 132 63 48, (7-499) 190 34 52  
Tel. / Fax (7-499) 190 42 44. E-mail: [ufn@ufn.ru](mailto:ufn@ufn.ru)

© 2015 Uspekhi Fizicheskikh Nauk and PN Lebedev Physical Institute of the Russian Academy of Sciences

*Russian original  
reference  
Usp. Fiz. Nauk  
Vol. 185, pages*

## Contents

*English translation  
reference  
Phys. Usp.  
Vol. 58, pages*

561	<b>Analytic models of relativistic accretion disks</b> V V Zhuravlev	<b>527</b>
593	<b>Model of stretching vortex filaments and foundations of the statistical theory of turbulence</b> K P Zybin, V A Sirota	<b>556</b>
613	<b>Gas rotation in discharges in a longitudinal magnetic field</b> A V Nedospasov	<b>574</b>
619	<b>Clusters as a diagnostics tool for gas flows</b> M Ganeva, P V Kashtanov, A V Kosarim, B M Smirnov, R Hippler	<b>579</b>
631	<b>75th anniversary of the N V Pushkov Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation of the Russian Academy of Sciences (IZMIRAN)</b> (Scientific session of the Physical Sciences Division of the Russian Academy of Sciences, 25 February 2015):	<b>589</b>
632	<b>N V Pushkov Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation of the Russian Academy of Sciences (IZMIRAN) yesterday, today, tomorrow</b> V D Kuznetsov	<b>590</b>
643	<b>Problems of magnetic dynamo</b> D D Sokoloff	<b>601</b>
649	<b>Some aspects of magnetosphere–ionosphere relations</b> A A Petrukovich, M M Mogilevsky, A A Chernyshov, D R Shklyar	<b>606</b>
655	<b>Magnetic and optical measurements and signatures of reconnection in the cusp and vicinity</b> V V Safargaleev, T I Sergienko, A V Safargaleev, A L Kotikov	<b>612</b>
664	<b>Space solar research: achievements and prospects</b> V D Kuznetsov	<b>621</b>
630	<b>Physics news on the Internet</b> Yu N Eroshenko	<b>630</b>

◇ ◇ ◇

## In the next issue

*Radio emission of extensive air showers*  
A D Filonenko

*Low energy methods of molecular laser isotope separation*  
G N Makarov

*Theory of plasma emitter of positive ions*  
I A Kotelnikov, V T Astrelin

*Why nature needs 1/f-noise*  
Yu E Kuzovlev

*Physics news on the Internet*