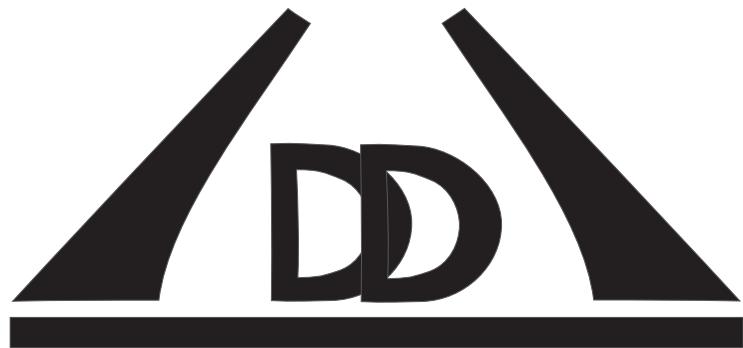


# Proceedings of the International Conference



## DAY<sup>S</sup> on DIFFRACTION 2016

June 27 – July 1, 2016

St. Petersburg, Russia

## Proceedings of the International Conference “Days on Diffraction 2016”, St. Petersburg, Russia

Edited by **O.V. Metygin** (Institute for Problems in Mechanical Engineering, St. Petersburg)

**A.P. Kiselev** (St. Petersburg Department of V. A. Steklov Mathematical Institute)

**P.V. Kapitanova** (ITMO University, St. Petersburg)

**L.I. Goray** (St. Petersburg Academic University & Institute for Analytical Instrumentation)

**A.Ya. Kazakov** (St. Petersburg University of Aerospace Instrumentation)

**A.S. Kirpichnikova** (Liverpool Hope University)

“Days on Diffraction” is an annual conference taking place in May–June in St. Petersburg since 1968. The present event is organized by St. Petersburg State University, St. Petersburg Department of the Steklov Mathematical Institute, the Euler International Mathematical Institute and the ITMO University.

More than 280 scientists from 26 countries participated in “Days on Diffraction 2016”; the Organizing Committee thanks them all. Of special gratitude are the authors of extended abstracts submitted to the Proceedings; 92 of them (selected by peer-review) are published in the present issue.

**Organizing committee:** V. M. Babich /Chair/, A. S. Kirpichnikova /Secretary/,  
T. V. Vinogradova /Visas/, N. V. Zalesskaya /Accommodation/, I. V. Andronov,  
P. A. Belov, L. I. Goray, A. Ya. Kazakov, N. Ya. Kirpichnikova, A. P. Kiselev,  
M. A. Lyalinov, O. V. Metygin, M. V. Perel, A. M. Samsonov, V. P. Smyshlyayev,  
R. Stone, N. Zhu

**Web site of the conference:** <http://www.pdmi.ras.ru/~dd/>

**The conference is organized and sponsored by**



St. Petersburg Department  
of V.A. Steklov  
Institute of Mathematics



St. Petersburg State  
University



The Euler International  
Mathematical Institute



ITMO University



Russian Foundation  
for Basic Research



IEEE Russia (Northwest)  
Section AP/ED/MTT  
Joint Chapter



Russian Academy of Sciences



The Federal Agency for  
Scientific Organizations

IEEE Catalog No.:  
**CFP16489-ART**

ISBN:  
**978-1-5090-5800-6**

Copyright and Reprint Permission: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923. For reprint or republication permission, email to IEEE Copyrights Manager at [pubs-permissions@ieee.org](mailto:pubs-permissions@ieee.org). All rights reserved. Copyright © 2016 by IEEE.

## CONTENTS

<b>Eron L. Aero, Anatolii N. Bulygin, Yurii V. Pavlov</b>	
Methods of construction of exact analytical solutions for nonautonomic nonlinear Klein–Fock–Gordon equation . . . . .	9
<b>Gennady V. Alekseev, Aleksey V. Lobanov, Olga S. Larkina</b>	
Theoretical analysis of 2D electromagnetic cloaking problems using the optimization method . . . . .	15
<b>Alena A. Astrakhantseva, Alexander Yu. Chebotarev, Gleb V. Grenkin, Andrey E. Kovtanyuk</b>	
Numerical analysis of the complex heat transfer in a layered medium . . . . .	21
<b>Sergei A. Avdonin, Alexander S. Blagoveshchensky, Abdon E. Choque-Rivero, Victor S. Mikhaylov</b>	
Dynamical inverse problem for two-velocity systems on finite trees . . . . .	25
<b>Andrey V. Badanin, Evgeny L. Korotyaev</b>	
Trace formulas for the beam equation . . . . .	31
<b>J.D. Baena, J.P. del Risco, S.B. Glybovski, A.P. Slobozhanyuk, P.A. Belov</b>	
Experimental characterization of microwave self-complimentary metasurfaces for linear-to-circular polarization transform . . . . .	36
<b>Aleksei A. Bagaev, Yuri M. Pis'mak</b>	
The 0D quantum field theory: multiple integrals via background field formalism . . . . .	41
<b>Kseniia V. Baryshnikova, Viktoriia E. Babicheva, Pavel A. Belov, Mihail I. Petrov</b>	
Substrate-mediated antireflective properties of silicon nanoparticle array . . . . .	46
<b>Lev M. Baskin, Muaed M. Kabardov, Nataliya M. Sharkova</b>	
Electron transport in a multi-resonator system formed by constrictions of a quantum waveguide .	52
<b>Alexander K. Belyaev, Vladimir A. Polianskiy, Aleksandr M. Lobachev, Victor S. Modestov, Artem S. Semenov, Aleksey I. Grishchenko, Yurii A. Yakovlev, Lev V. Shtukin, Dmitriy A. Tretyakov</b>	
Propagation of sound waves in stressed elasto-plastic material . . . . .	56
<b>Fedor Benimetskiy, Alexander Plekhanov, Alexander Kuchyanov, Roman Parkhomenko, Tamara Basova</b>	
Characterization of the structure and stimulated emission of spherical and cylindrical spasers .	62
<b>Alexander S. Blagoveshchensky, Aleksei P. Kiselev</b>	
A relation between the Sheppard–Saghafi solution and a certain solution of the wave equation with a singularity at a running point . . . . .	67
<b>A.S. Blagoveshchensky, F.N. Podymaka</b>	
On a Cauchy problem for the wave equation with data on a time-like hyperplane . . . . .	69
<b>V.V. Borzov, E.V. Damaskinsky</b>	
On the spectrum of discrete Schrödinger equation with one-dimensional perturbation . . . . .	73
<b>Boumaza, Hakim, Lafitte, Olivier</b>	
Description of the spectral bands for some 2D periodic Schrödinger operators . . . . .	79
<b>V. Bratov, J. Kaplunov, D.A. Prikazchikov</b>	
On steady-state moving load problems for an elastic half-space . . . . .	84

<b>Alexander M. Budylin, Yaroslav Yu. Koptelov, Sergey B. Levin</b>	
On continuous spectrum eigenfunctions asymptotics of three three-dimensional unlike-charged quantum particles scattering problem .....	89
<b>Alexander M. Budylin, Sergei B. Levin</b>	
Three one-dimensional quantum particles scattering problem with short-range repulsive pair potentials. To the question of absolutely continuous spectrum eigenfunctions asymptotics justification	95
<b>Alexander Yu. Chebotarev, Gleb V. Grenkin, Andrey E. Kovtanyuk, Igor V. Prokhorov</b>	
Analysis of a diffraction problem for equations of complex heat transfer .....	101
<b>Nataliya N. Dadoenkova, Yuliya S. Dadoenkova, Ivan S. Panyaev, Dmitry G. Sannikov, Igor L. Lyubchanskii, Ivars A. Rozhleys, Maciej Krawczyk</b>	
Complex photonic structure based on magneto-optic waveguide and photonic crystal .....	106
<b>Yuliya S. Dadoenkova, Florian F. L. Bentivegna, Nataliya N. Dadoenkova, Igor L. Lyubchanskii, Roman V. Petrov, Mirza I. Bichurin</b>	
Electric and magnetic tuning of the Goos–Hänchen shift of a light beam upon reflection from a magneto-electric heterostructure .....	112
<b>M. Danaifar, N. Granpayeh</b>	
Analysis of metasurface based structures by using equivalent conductivity method .....	118
<b>Pavel A. Dmitriev, Dmitry V. Permyakov, Sergey V. Makarov, Alexander E. Krasnok, Mihail I. Petrov, Valentine A. Milichko, Pavel A. Belov, Ivan S. Mukhin</b>	
Polarization and angle dependent enhancement of Raman scattering from silicon nanodisks .....	123
<b>Lyudmila A. Dmitrieva, Yuri A. Kuperin, Nikolai M. Smetanin, German A. Chernykh</b>	
Method of calculating Lyapunov exponents for time series using artificial neural networks committees .....	127
<b>M.P. Faleeva, I.Y. Popov</b>	
Bound state for dielectric waveguide with locally perturbed core .....	133
<b>Alexander Fedotov</b>	
On minimal meromorphic solutions of difference equations .....	137
<b>Alexander Fedotov, Ekaterina Shchetka</b>	
Complex WKB method for difference equations in unbounded domains .....	140
<b>George V. Filippenko</b>	
The energy flux analysis of the “shell” type waves in the infinite cylindrical shell filled with acoustical fluid .....	144
<b>Fomenko S.I., Golub M.V., Alexandrov A.A., Chen A.L., Wang Y.S., Zhang Ch.</b>	
Band-gaps and low transmission pass-bands in layered piezoelectric phononic crystals .....	149
<b>Friziuk K.S., Milichko V.A., Petrov M.I., Zuev D.A., Baranov A.V., Baranov M.A., Makarov S.V., Krasnok A.E., Belov P.A., Mukhin I.S.</b>	
Raman scattering governed by dark resonant modes in silicon nanoparticles .....	155
<b>Gavrilov S.N., Mochalova Yu.A., Shishkina E.V.</b>	
Trapped modes of oscillation and localized buckling of a tectonic plate as a possible reason of an earthquake .....	161
<b>Glushkov E.V., Glushkova N.V., Miakisheva O.A.</b>	
Guided wave generation and source energy partition in acoustic fluid with an immersed elastic plate .....	166

<b>Golub M.V., Shpak A.N., Müller I., Fritzen C.-P.</b>	
Numerical simulation of Lamb wave excitation by the partially debonded rectangular strip-like piezoelectric actuator based on the integral approach and hp-FEM .....	171
<b>Leonid I. Goray</b>	
Generalization of the energy balance for diffraction by randomly rough lossy 2D surfaces .....	177
<b>Hartmann M., Wohler M., Schühler M., Weisgerber L., Thielecke J., Heuberger A.</b>	
A dual frequency antenna for RSSI-based DOA estimation — from theory to prototype .....	182
<b>M. Hasan, I.V. Iorsh, I.A. Shelykh</b>	
Topological properties of the illuminated arrays of mesoscopic rings .....	188
<b>Anna A. Hurshkainen, Stanislav B. Glybovski, Irina V. Melchakova, Ingmar J. Voogt, Cornelis A.T. van den Berg, Alexander J. E. Raaijmakers</b>	
Decoupling of antennas with wire metasurface structures: MRI applications .....	193
<b>Aliaksandra Ivinskaya, Mihail I. Petrov, Andrey A. Bogdanov, Alexander S. Shalin, Ivan Shishkin, Pavel Ginzburg</b>	
Plasmonic substrates for optical tweezers .....	198
<b>Kapitanova P.V., Song M., Belov P.A.</b>	
Wireless power transfer system based on high-index dielectric resonators .....	202
<b>A.Ya. Kazakov</b>	
Confluent Heun equation with single added apparent singularity .....	207
<b>M.A. Kniazev, S.A. Kozlov, K. Dolgaleva</b>	
Third-harmonic generation enhancement by the interaction of few-cycle waves in nonlinear optical media .....	212
<b>Evgeny L. Korotyaev, Andrey Badanin</b>	
Resonances for the beam equation .....	218
<b>E. Korotyaev, N. Saburova</b>	
Eigenfunctions of Laplacians on periodic metric graphs .....	223
<b>K.L. Koshelev, A.A. Bogdanov, A.V. Lavrinenko</b>	
Slow light in nonlocal anisotropic metamaterials .....	229
<b>Kovrov A.E., Baranov D.A., Shalin A.S., Mukhin I.S., Simovski C.R.</b>	
Optically asymmetric structures for transparent electrodes .....	234
<b>Andrey E. Kovtanyuk, Igor V. Prokhorov, Alexander Yu. Chebotarev</b>	
A method of diagnostics of layered biological tissues .....	237
<b>Sergey B. Kozitskiy, Mikhail Yu. Trofimov, Alena D. Zakharenko</b>	
Boundary layers and normal mode parameters in a system with double-diffusive convection at large Rayleigh numbers .....	243
<b>Igor P. Krasnov</b>	
On electromagnetic forces and works done by them .....	247
<b>Alexander V. Kudrin, Tatyana M. Zaboronkova, Anna S. Zaitseva, Catherine Krafft</b>	
Electrodynamic characteristics of a loop antenna located on the surface of a uniaxial anisotropic cylinder .....	253
<b>V.V. Kurin, A.M. Klushin, I.A. Shereshevskii, N.K. Vdovicheva</b>	
Simulation of Josephson antenna in 3D space .....	259

<b>Kurseeva V.Yu., Valovik D.V.</b>	
On the infinitely many electromagnetic TE eigenmodes in a plane layered waveguide filled with nonlinear medium: analytical results .....	264
<b>Nikolay G. Kuznetsov, Oleg V. Motygin</b>	
The three-dimensional problem of the coupled time-harmonic motion of a freely floating body and water covered by brash ice .....	270
<b>Sergey I. Lepeshov, Dmitry A. Zuev, Alexander E. Krasnok, Pavel A. Belov, Andrey E. Miroshnichenko</b>	
Tuning of hybrid oligomers via femtosecond laser reshaping at nanoscale .....	277
<b>Sergey V. Li, Alexander E. Krasnok, Pavel A. Belov, Denis G. Baranov</b>	
Chiral near-field formation with all-dielectric nanoantennas .....	281
<b>Hanen Louati, Michel Rouleux</b>	
Semi-classical quantization rules for a periodic orbit of hyperbolic type .....	285
<b>Mikhail A. Lyalinov, Svetlana V. Polyanskaya</b>	
Eigenoscillations in a water-wave problem for an infinite pool of special form .....	291
<b>Machikhin A.S., Burmak L.I.</b>	
Calculation of interference pattern after diffraction of two interfering image-carrying beams by acoustic wave in uniaxial crystal .....	295
<b>Makin V.S., Pestov Yu.I., Makin R.S.</b>	
Abnormal spatial nanogratings formation by long pulse laser radiation on condensed matter surfaces .....	298
<b>Mikhail S. Mamaikin, Maria V. Komissarova, Irina G. Zakharova</b>	
Propagation of light bullets in media with quadratic nonlinearity .....	304
<b>Irina Munina, Pavel Turalchuk, Ekaterina Kunakovskaya, Irina Vendik</b>	
Attenuation of electromagnetic waves radiated by an implanted antenna .....	309
<b>S.V. Pasechnik, D.V. Shmeliova, A.P. Chopik, D.A. Semerenko, S.S. Kharlamov, A.V. Dubtsov</b>	
Electrically controlled porous polymer films filled with liquid crystals: new possibilities for photonics and THz applications .....	314
<b>Maria V. Perel, Mikhail S. Sidorenko</b>	
Asymptotic study of a two-scale electromagnetic field in a layered periodic structure .....	319
<b>Alexander V. Pereskokov</b>	
New type of semiclassical asymptotics of eigenstates near the boundaries of spectral clusters for Schrödinger-type operators .....	323
<b>Petrov P.S., Tatyana N. Petrova</b>	
On sound propagation in a shallow-water acoustical waveguide with variable bottom slope .....	327
<b>Boris A. Plamenevskii, Aleksandr S. Poretskii</b>	
Electromagnetic waveguides with several cylindrical ends and non-homogeneous anisotropic filling .....	332
<b>Podlipenko Y.K., Nakonechny A.G., Shestopalov Y.V.</b>	
Guaranteed estimation of solutions to Helmholtz problems from pointwise noisy observations .....	336
<b>A. Popov, I. Prokopovich, D. Edemskii</b>	
Experimental implementation of microwave subsurface holography .....	340

<b>Vladimir Rabinovich, Josué Hernández-Juárez</b>	
Effective methods of numerical estimates of acoustic fields in the stratified ocean generated by moving airborne sources .....	346
<b>Alexander Rusakov, Irina Vendik, Komsan Kanjanasit, Jiasheng Hong, Dmitry Filonov</b>	
Ultra-wideband antenna with single- and dual-band notched characteristics based on electric ring resonator .....	350
<b>Z.F. Sadrieva, I.S. Sinev, A.K. Samusev, I.V. Iorsh, A.A. Bogdanov, R. Malureanu, A.V. Lavrinenko</b>	
Optical bound state in the continuum in the one-dimensional photonic crystal slab: theory and experiment .....	356
<b>Zhanna Yu. Saritskaya</b>	
Stability of inverse coefficient problems' solutions for semilinear equations .....	361
<b>Roman S. Savelev, Alexey V. Yulin, Alexander E. Krasnok, Yuri S. Kivshar</b>	
Solitary waves in chains of silicon nanoparticles .....	367
<b>Valeria A. Sedaikina, Leonid N. Pestov</b>	
Acoustical imaging in semi-geodesic coordinates without velocity knowledge .....	373
<b>Shchelik G.S., Sofronov I.L.</b>	
Application of semi-analytical finite element method (SAFE) to inversion of acoustic logging data in non-cylindrical boreholes in anisotropic formation .....	376
<b>Ilya A. Shereshevskii, Nadezda K. Vdovicheva, Alexander S. Mel'nikov</b>	
Inhomogeneous superconducting states in the self-consistent Bogoliubov – de Gennes theory for Kitaev chain .....	380
<b>Sloushch V.A.</b>	
Estimates for the singular numbers of the sandwiched Airy transformation .....	387
<b>Alexander O. Spiridonov, Evgenii M. Karchevskii</b>	
Mathematical and numerical analysis of the spectral characteristics of dielectric microcavities with active regions .....	390
<b>Ivan A. Starkov, Alexander S. Starkov</b>	
Application of the matrix homogenization method to the Maxwell equations .....	396
<b>Anton A. Starovoytov, Tigran A. Vartanyan, Vladimir I. Belotitskii, Yuri A. Kumzerov, Anna A. Sysoeva, Natalia O. Alekseeva, Vladimir G. Solovyev</b>	
Emission of cyanine dye embedded in nanopores of anodic alumina matrix .....	402
<b>Pavel D. Terekhov, Ksenia V. Baryshnikova, Alexander S. Shalin, Andrey B. Evlyukhin, Irina A. Khromova</b>	
Nonradiating anapole modes of dielectric particles in terahertz range .....	406
<b>Dmitry L. Tkachev, Alexander M. Blokhin</b>	
The problem of flow about infinite plane wedge with inviscous non-heat-conducting gas. Linear stability of a weak shock wave .....	410
<b>Mikhail Yu. Trofimov, Sergey B. Kozitskiy, Alena D. Zakharenko</b>	
Weak shear modulus in the acoustic mode parabolic equation .....	416
<b>Vyacheslav A. Trofimov, Dmitry Yu. Zagursky, Irina G. Zakharova</b>	
Broadening of few-cycle THz pulse spectrum at electromagnetic energy absorption in multi-level medium .....	421

<b>Pavel Turalchuk, Irina Munina, Vladimir Yashenko, Orest Vendik</b>	
Two-mode loop antenna with doubled gain .....	427
<b>Andrei B. Utkin</b>	
Spacetime triangle diagram technique for sectoral horn waveguides .....	431
<b>Vladimir Vasilchuk</b>	
Asymptotic distribution of the spectrum of some symmetric polynomials of unitary invariant random matrix ensembles .....	435
<b>Wojda P., Kshevetskii S.P.</b>	
The finite difference methods of computation of X-rays propagation through a system of many lenses .....	440
<b>Natalia F. Yashina, Tatiana M. Zaboronkova, Catherine Krafft</b>	
Interaction of nonsymmetric electromagnetic waves guided by an anisotropic cylinder .....	445
<b>O.Y. Yermakov, A.I. Ovcharenko, A.A. Bogdanov, I.V. Iorsh, A.V. Lavrinenko, A.H. Babaieva</b>	
New degrees of freedom of spin-optronics implemented by using hybrid surface waves localized at hyperbolic metasurface .....	449
<b>Marina G. Zhuchkova</b>	
Wave propagation in a floating elastic plate with a periodic support .....	455
<b>G.P. Zograf, M.V. Rybin, D.A. Zuev, S.V. Makarov, P.A. Belov, N.Yu. Lopanitsyna, A.Yu. Kuksin, S.V. Starikov</b>	
Modeling of formation mechanism and optical properties of Si/Au core-shell nanoparticles .....	460
<b>D.A. Zuev, S.V. Makarov, V.A. Milichko, A.E. Krasnok, P.A. Belov, I.S. Mukhin, I.A. Morozov, D.G. Baranov, A.E. Miroshnichenko</b>	
Reversible and non-reversible tuning of hybrid optical nanoresonators .....	464
<b>Author index</b>	468