# Yulia Petrova. Curriculum Vitae

## Personal Data

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| **Name:** | Petrova Yulia (Iuliia) Petrovna |
| **Date of Birth:** | 29 June 1991, Ukhta, Russia (ex. USSR) |
| **Current position:** | Assistant Professor (Professora Adjunta), PUC-Rio |
| | Pontifícia Universidade Católica do Rio de Janeiro |
| **Current address:** | R. Marquês de São Vicente, 124 (room 854) |
| | Gávea, Rio de Janeiro, Brazil, 22451-040 |
| **Phone, email:** | +55 (21) 96 739 7394, yu.pe.petrova@gmail.com |
| **Homepage:** | https://yulia-petrova.github.io/ |
| **Marital status:** | married, no children |
| **Last CV update:** | 23/09/2023 |

## Research interests

- *Fluid dynamics*: multiphase flow in porous media, viscous/gravitational fingering phenomenon
- *Hyperbolic conservation laws*: Riemann problem, travelling and shock waves
- *Spectral theory*: asymptotics of eigenvalues for compact operators
- *Probability theory*: Gaussian processes, small ball probabilities
- *Industrial applications*: enhanced oil recovery (EOR) methods

## Education

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|---|---|
| Nov 2018 | PhD in Mathematics and Physics, St. Petersburg State University, Russia <br> Supervisor: Alexander I. Nazarov.  PhD thesis: «Exact $L_2$-small ball asymptotics for finite-dimensional perturbations of Gaussian processes» (in Russian). Short version (in Russian) |
| Jun 2013 | MSc in Mathematics, chair of Mathematical Physics, St. Petersburg State University, Russia |

## Professional Experience

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| 2023– present | Assistant Professor at PUC-Rio as a part of "Projeto Paz", Rio de Janeiro, Brazil |
| 2021– 2023 | Postdoc of excellence at Instituto de Matematica Pura e Applicada (IMPA) <br> Rio de Janeiro, Brazil. Researcher at Center PI, IMPA |
| 2017–2021 | Researcher at Chebyshev laboratory, St. Petersburg State University, Russia <br> Participant of industrial projects with PJSC «Gazprom Neft» |
| 2018–2021 | Teaching at Department of Mathematics and Computer Science <br> St. Petersburg State University, Russia |
| 2014–2018 | Teaching at Department of Mathematics and Information Technology <br> St. Petersburg Academic University, Russia |
| 2012–2015 | Teaching at Institute of Physics, Nanotechnology and Telecommunications <br> St. Petersburg Polytecnic University, Russia |

## Research Awards

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| 2019 | Laureat of the «Young Mathematician» prize of the St. Petersburg Mathematical Society |
| 2018–2019 | «Gazprom Neft» Scholarship |
| 2018 | Winner of 22nd Möbius Contest in nomination «Undergraduates and graduates» |
| 2009 | Euler Fellowship for undergraduate students |

## Recommendation letters

- Dan Marchesin, IMPA, Rio de Janeiro, Brazil (marchesi@impa.br)
- Alexander Nazarov, St. Petersburg department of PDMI, Russia (al.il.nazarov@gmail.com)
- Mikhail Lifshits, St. Petersburg State University, Russia (mikhail@lifshits.org)
- Yalchin Efendiev, Texas A&M, USA (yalchinrefendiev@gmail.com)

# Research Grants

| | |
|---|---|
| 2021–2022 | Co-principal investigator of Russian Science Foundation grant 21-11-00047: Stochastic processes and fields with application to data analysis |
| 2019–2021 | Participant of the Russian Science Foundation grant 19-71-30002: Analysis, geometry, mathematical physics and applications |
| 2019–2020 | Participant of the President grant MD-1791.2019.1: Parabolic equations describing displacement of viscous fluids in porous media and systems with hysteresis |
| 2017–2018 | Participant of Russian Science Foundation Grant 17-11-01003: Asymptotic spectral analysis: gaps, near-threshold anomalies, "invisibility" and eigenvalues |
| 2016–2018 | Participant of RFBR Grant 16-01-00258a: Approximation of stochastic processes and functionals of them |
| 2013–2016 | Participant of St. Petersburg State University Grant 6.38.670.2013: Partial Differential Equations and applications |

# Research Papers and Preprints

13. (with A.I. Nazarov) *$L_2$-small ball asymptotics for some demeaned Gaussian processes.* arXiv:2308.10080.

12. (with B. Plohr, D. Marchesin) *Vanishing adsorption admissibility criterion for contact discontinuities in the polymer model.* Submitted. arXiv:2211.10326.

11. (with F. Bakharev, A. Enin, N. Rastegaev) *Impact of dissipation ratio on vanishing viscosity solutions of the Riemann problem for chemical flooding model.* Journal of Hyperbolic Differential Equations, 20(2):407–432, 2023. doi: 10.1142/S0219891623500121

10. (with A.I. Nazarov) *$L_2$-small ball asymptotics for Gaussian random functions: A survey.* Probability Surveys, 20:608–663, 2023. doi: 10.1214/23-PS20.

9. (with F. Bakharev, A. Enin, K. Kalinin, N. Rastegaev, S. Tikhomirov) *Optimal polymer slugs injection profiles.* Journal of Computational and Applied Mathematics, January 2023, p.115042; doi:10.1016/j.cam.2022.115042.

8. (with F. Bakharev, A. Enin, A. Groman, A. Kalyuzhnuk, S. Matveenko, I.Starkov, S. Tikhomirov) *Velocity of viscous fingers in miscible displacement: Comparison with analytical models.* Journal of Computational and Applied Mathematics, March 2022; doi:10.1016/j.cam.2021.113808.

7. (with S. Tikhomirov, F. Bakharev, A. Groman, A. Kalyuzhnyuk, A. Enin, K. Kalinin, N. Rastegaev) *Calculation of graded viscosity banks profile on the rear end of the polymer slug.* Paper SPE-206426-MS, SPE Russian Petroleum Technology Conference, October 2021; doi:10.2118/206426-MS.

6. *$L_2$-small ball asymptotics for a family of finite-dimensional perturbations of Gaussian functions.* Zapiski Nauchnykh Seminarov POMI, Nikitin's memorial volume, 501:236–258, 2021. [In Russian]. English: Journal of Mathematical Sciences, 273(5): 816–831, 2023. doi:10.1007/s10958-023-06544-5.

5. (with F. Bakharev, L. Campoli, A. Enin, S. Matveenko, S. Tikhomirov, A. Yakovlev) *Numerical investigation of viscous fingering phenomenon for raw field data.* Transport in Porous Media, pp. 1–22, 2020; doi:10.1007/s11242-020-01400-5.

4. *On spectral asymptotics for a family of finite-dimensional perturbations of operators of trace class.* Doklady Math., 98(1):367–369, 2018; doi:10.1134/S1064562418050204.

3. *Exact $L_2$-small ball asymptotics for some Durbin processes.* Zapiski Nauchnykh Seminarov POMI, 466:211–233, 2017. [In Russian]. English transl.: Journal of Mathematical Sciences, 244(5):842–857, 2020. doi:10.1007/s10958-020-04657-9.

2. *Spectral asymptotics for problems with integral constraints.* Mat. Zametki, 102(3):405–414, 2017 [In Russian]. English transl.: Mathematical Notes, 102(3-4):369–377, 2017. doi:10.1134/S0001434617090073.

1. (with A.I. Nazarov) *The small ball asymptotics in Hilbertian norm for the Kac–Kiefer–Wolfowitz processes.* Teor. Veroyatnost. i Primenen., 60(3):482–505, 2015. English transl.: Theory of Probability and its Applications, 60(3):460–480, 2016; doi:10.1137/S0040585X97T987752.

## Participation at Conferences & Schools

| | | |
|---|---|---|
| Oct 2023 | *(planned)* VI Workshop on Fluids and PDE, Campinas, Brazil | |
| July 2023 | School: Deterministic and random features of fluids, EPFL, Lausanne, Switzerland | |
| June 2023 | Shocking Developments: New Directions in Compressible and Incompressible Flows, Conference in Honor of Alexis Vasseur's 50th Birthday, Leipzig, Germany | |
| May 2023 | Mini-conference dedicated to 60-th birthday of A.I. Nazarov. Online | .pdf |
| Feb 2023 | Multiscale Analysis and Methods for Quantum and Kinetic Problems. Singapore. Talk in junior researcher section: "Two tube model of miscible displacement: travelling waves and normal hyperbolicity" | Video .pdf .pptx |
| Jan 2023 | 13th Americas Conference on Diff. Equations and Nonlinear Analysis and ICMC Summer Meeting on Differential Equations. São Carlos, Brazil. Invited speaker in section "Conservation Laws and Transport Equations". "Two tube model of miscible displacement: travelling waves and normal hyperbolicity" | Slides: .pdf .pptx |
| Oct 2022 | Conference IMPA 70 years & International Conference on Dynamical Systems. Celebrating the 60th Birthday of Marcelo Viana, Rio de Janeiro, Brazil | |
| July 2022 | O.A. Ladyzhenskaya centennial conference on PDE's. St. Petersburg, Russia. Online participation. "On the impact of dissipation ratio on vanishing viscosity solutions of Riemann problems for chemical flooding models" | Poster |
| July 2022 | Hyperbolic Balance Laws & Beyond. Magdeburg, Germany | Poster |
| June 2022 | International Conference on Hyperbolic Problems (HYP). Malaga, Spain "On admissibility criteria for contact discontinuities in Glimm-Isaacson model" | Slides |
| May 2022 | Workshop: Branching systems, reaction-diffusion equations and population models, Centre de recherches matematiques (CRM), Montreal. Online. | |
| Dec 2021 | International conference "Probabilistic methods in analysis", in Sirius, Sochi, Russia. Plenary talk: "Small ball probabilities for Gaussian processes" | Slides |
| Dec 2021 | Workshop: "Nonlinear PDEs and Modelling", St. Petersburg, Russia. Talk: "Looking for exact mixing velocities in miscible displacement: two-tube model" | Slides |
| Aug 2021 | InterPore2021. Brazilian Chapter. | Slides |
| June 2021 | InterPore2021. Online conference. Talk: "Graded viscosity banks on the rear end of the polymer slug" | Slides |
| Aug 2019 | Third ZiF Summer School  "Randomness in Physics and Mathematics" From Stochastic Processes to Networks. Bielefeld, Germany | Poster |
| May 2019 | Stochastic models II. Euler Institute, St. Petersburg, Russia Talk: "Exact $L_2$-small ball probabilities for Durbin processes" | Slides |
| Jan 2018 | The third Indo-Russian meeting in probability and statistics. Bangalore, India Talk: "Exact small ball asymptotics in $L_2$-norm for finite-dimensional perturbations of Gaussian processes: spectral method" | Slides |
| Dec 2017 | St. Petersburg winter conference on Probability Theory and Mathematical physics. PDMI-MIAN. Talk: "On exact spectral asymptotics of finite-dimensional perturbations of integral operators of trace class" | Slides |
| June 2017 | Symposium on Probability Theory and Random Processes, St. Petersburg "Exact $L_2$-small ball asymptotics for perturbations of Brownian bridge" | Slides |
| April 2017 | International conference on partial differential equations, Beijing, China "Spectral asymptotics in some problems with integral constraints" | Poster |
| June 2016 | Days of Diffraction-2016, St. Petersburg, Russia Talk: "Spectral asymptotics in some problems with integral constraints" | Slides |
| May 2016 | The 2nd Russian-Indian Joint Conference in Statistics and Probability. Talk: "Small ball asymptotics for detrended Green Gaussian processes" | Slides |
| Sept 2015 | Yu.V.Linnik Centennial Conference, St. Petersburg, Russia Talk: "The $L_2$-small ball asymptotics for the Kac-Kiefer-Wolfowitz processes" | |
| July 2015 | 7th St.Petersburg Conference in Spectral Theory Talk: "Asymptotics of eigenvalues for some integro-differential operators" | Slides |
| July 2014 | Students school on PDEs and Geometric Measure Theory, CIME, Italy | |
| July 2010 | XIII Diffiety School on Mathematics, Santo Stefano del Sole, Italy | |
| July 2009 | XII Diffiety School on Mathematics, Santo Stefano del Sole, Italy | |

# INVITED TALKS AT SEMINARS (2020-2023)

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| Sept 2023 | 98º EDAÍ, dynamical systems seminar (PUC-Rio, UFRJ, UFF), Rio, Brazil. Seminar organizer: Lorenzo J. Diaz, Manuel Stadlbauer, Gabriela Estevez. Talk: "Travelling waves: dynamical perspective" (in Portuguese) — .pdf .pptx |
| March 2023 | Q.T.P. seminar at PUC-Rio (Que Termina em Pizza), Rio, Brazil. Seminar organizer: Lorenzo J. Diaz. Talk: "Viscous fingering: theory and applications" — .pdf .pptx |
| Nov 2022 | Oberseminar "Nonlinear Dynamics" at Freie Universität Berlin, Germany (joint talk with S.Tikhomirov). Seminar organizers: Bernold Fiedler, Isabelle Schneider, Eckehard Schöll, Matthias Wolfrum. Talk: "Two tube model of miscible displacement: travelling waves and normal hyperbolicity" — Slides |
| July 2022 | Seminário de Probabilidade at Instituto de Matemática, UFRJ, Rio, Brazil. Seminar organizers: Giulio Iacobelli and Maria Eulalia Vares. Talk: "Small ball probabilities for Gaussian processes" — Slides |
| July 2022 | Seminário Luiz Adauto de Análise/EDP at Instituto de Matemática, UFRJ, Rio, Brazil. Seminar organizer: Daniel Marroquin. Talk: "On chemical flooding models: Riemann problem solutions and viscous fingering phenomenon" — Slides |
| May 2022 | Oberseminar "Nonlinear Dynamics" WIAS Berlin, Germany. Online. Seminar organizers: Bernold Fiedler, Isabelle Schneider, Eckehard Schöll, Matthias Wolfrum. Talk: "On the impact of dissipation ratio on vanishing viscosity solutions of Riemann problems for chemical flooding models" — Slides |
| 12 May 2022 | 2-do Encontro Mulheres Matematicas do IMPA, Rio, Brazil. Online. Organizers: Claudia Lorena Duarte, Daniela Paiva Penuela, Zoraida Fernandez Rico. Sessão Temática - Dinâmica dos Fluidos. — Slides |
| April 2022 | CeMEAI seminar at ICMC/USP in São Carlos, Brazil. Seminar organizer: Tiago Pereira. Talk: "On solutions of a Riemann problem for a chemical flooding model" — Slides |
| April 2022 | Seminar of Applied and Computational Mathematics at IMPA, Rio, Brazil. Seminar organizers: Alexei Mailybaev, Dan Marchesin. Talk: "Toy model of viscous fingering" — Slides |
| April 2022 | Seminar on Analisis and PDE at IMPA, Rio, Brazil. Seminar organizer: Felipe Linares. Talk: "On the impact of dissipation ratio on vanishing viscosity solutions of Riemann problems for chemical flooding models" — Slides |
| March 2022 | Seminario das Mulheres IMPA, Rio, Brazil. Seminar organizer: Zoraida Fernandez-Rico. Talk: "Small ball probabilities for Gaussian Processes" — Slides |
| March 2022 | Centro PI seminar at IMPA, Rio, Brazil. Seminar organizers: Roberto Imbuzeiro, Paulo Orenstein. Talk: "Oil Recovery: Fundamental research and Industrial applications" — Slides |
| Feb 2022 | Applied Math/PDE Seminar UC Davis, California, USA. Online. Seminar organizers: Blake Temple, Steve Shkoller, Sameer Iyer. Talk: "On solutions of a Riemann problem for a chemical flooding model" — Slides |
| Nov 2021 | Gabriel Lame Chair Seminar at Chebyshev Laboratory, St. Petersburg, Russia. Online. Seminar organizer: Jean-Michel Roquejoffre. Talk: "On the impact of diffusion ratio on vanishing viscosity solutions of Riemann problems for chemical flooding models" — Slides |
| Oct 2021 | Seminario de EDP e Matematica Aplicada. Online. Seminar organizers: Juan Limaco, Mauro Rincon, Max Souza, Marcelo Calvacanti. Talk: "Admissibilidade das descontinuidades de contato: aplicação para recuperação melhorada de petróleo" (in Portuguese) |
| May 2021 | Colloquium of Industrial Projects at Chebyshev Laboratory, St. Petersburg, Russia. Organizer: Sergey Tikhomirov. Talk: "On mathematical results in Enhanced Oil Recovery project" (in Russian) — Slides |
| Feb 2020 | Student colloquium at Chebyshev Laboratory, St. Petersburg, Russia. Talk: "Mathematical models describing the process of oil recovery" |

## Teaching Experience

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| 2023.2 | "Introduction to Fourier analysis" | |
| 2023.1 | "Shock waves in conservation laws and reaction-diffusion eqs" Department of Mathematics, PUC-Rio, Rio de Janeiro, Brazil | Web-page |
| Spring 2021 | Problem solving classes, calculus of variations for mathematicians Faculty of Mathematics and Computer Science St. Petersburg State University | Materials (rus) / Students reviews |
| Fall 2020 | Problem solving classes, probability theory for mathematicians Faculty of Mathematics and Computer Science St. Petersburg State University | Materials (rus) / Students reviews |
| Spring 2020 | Problem solving classes, complex analysis Faculty of Mathematics and Computer Science St. Petersburg State University | Materials (rus) / Students reviews |
| 2018-2019 | Problem solving classes, calculus (I, II, III, IV semesters) Faculty of Mathematics and Computer Science St. Petersburg State University | Materials (rus) / Students reviews |
| Jan 2019 | Lecturer of the course «Random walks» in Educational Program in mathematics and computer science at «Sirius», Sochi, Russia | |
| Nov 2019 | Assistant to the course «Dynamical systems» in COMSATS University Islamabad, Lahore Campus, Pakistan. ICTP-CUI Visiting Scholars Program for Training and Research in Math | |
| 2014–2018 | Problem solving classes, calculus (I, II, III, IV semesters) for physicists. St. Petersburg Academic University | Materials III, IV |
| 2012–2014 | Problem solving classes, PDEs for physicists St. Petersburg Polytecnic University | |
| 2012–2017 | Teaching *Olympiad Mathematics* in "Formulo de Integreco", International educational center for gifted high-school students. | Materials (eng) |

## Additional experience

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| Organizational: | <ul><li>co-organizer of seminar "Applied and Computational Mathematics" at IMPA</li><li>co-organizer of the seminar «Industrial Mathematics» from Feb 2019 till Feb 2022 at Chebyshev Laboratory, St. Petersburg, Russia. See also YouTube</li></ul> |
| Industrial: | I was a part of a long-term industrial project in Chebyshev Laboratory on Enhanced Oil Recovery (EOR) methods jointly with petroleum company «Gazprom Neft» in 2018–2021 in St. Petersburg, Russia |
| Programming: | COMSOL Multiphysics, Matlab, Git, basics of Python. Among numerical methods I worked with FEM, FVM, FDM |
| Adaptivity: | I easily adapt to different countries. I have been to almost all European countries, India, China, Pakistan, Egypt, Mexico. Now I am working in Brazil |
| Olympiads: | At school I frequently was the winner of city olympiads in maths, physics, chemistry and informatics. Several times I was the winner of math olympiad of republic level. I was actively teaching olympiad mathematics during my university studies |
| Thesis committee: | PhD thesis: Júlia Domingues Lemos (IMPA, 2022). Master thesis: Giulia Carvalho Fritis (UFJF, 2023), Temirlan Abildaev (SPSU, 2020). Bachelor thesis: Alexander Tarasov (SPSU, 2019), Tatyana Moseeva (SPSU, 2020). |
| Divulgation of mathematics: | Lecture at cultural center Adelante "El matrimonio entre natureza e arquitectura" ou "Las matemáticas en la obra de Antoni Gaudí", 2015, St. Petersburg, link (spanish) |

## Languages

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| Russian: | Native speaker |
| English: | Fluent |
| Portuguese: | Proficient. Avançado superior na preparação Celpe-Bras, October 2022 |
| Spanish: | Proficient. Intermediate talking, proficient reading and writing |