Dr. Olga O. Bochkareva

Date of Birth: Sept. 10, 1988
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Research interests:

My research interests cover various topics of microbial genomics with the large focus to genome organization and evolution, genotype-to-phenotype connection, and host-microbe interraction. I'm developing new computational methods for microbial genome analysis and apply them to fundamental and applied scientific problems.

Work experience:

2023 – present senior postdoc, CUBE, Centre for Microbiology and Environmental Systems Science, University of Vienna, Austria.
2019 – 2023 postdoctoral researcher, Institute of Science and Technology (ISTA), Austria. Prof. Fyodor Kondrashov group.
2017- 2019 junior research scientist, Department of Life Sciences, Skolkovo Institute of Science and Technology, Moscow, Russia. Prof. Mikhail Gelfand group.
2012- 2019 junior research scientist, Kharkevich Institute for Information Transmission Problems RAS, Moscow, Russia. Prof. Mikhail Gelfand group.

Education:

2012–2019 Ph.D., Kharkevich Institute for Information Transmission Problems RAS. PhD thesis: *"Reconstruction of evolutionary history of genome rearrangements in bacteria",* Supervisor: *Prof. Mikhail S. Gelfand.*
2010–2012 Master of Science (applied mathematics and physics), Department of Molecular and Biological Physics, Moscow Institute of Physics and Technology. Master thesis *"Bacterial microevolution and genome rearrangements",* Supervisor: *Prof. Mikhail S. Gelfand.*
2005–2010 Bachelor of Science (applied mathematics and physics), Department of Molecular and Biological Physics, Moscow Institute of Physics and Technology.

Funding and Awards:

2023 ESPRIT Programme ("Early Stage Programme: Research, Innovation and Training"), funding from **Austrian Science Fund**, total amount – **294.015€**.
2019 ISTplus postdoctoral fellowship. Funding from the **European Union's Horizon 2020** research and innovation programme under the Marie Skłodowska-Curie grant agreement No 754411

Publications:

8 peer-reviewed publications, 3 first and 3 last authorships

(- equal contribution)*

1. Maximilian Baumgartner, Rebecca Zirnbauer, Sabine Schlager, Daniel Mertens, Nikolaus Gasche, Barbara Sladek, Craig Herbold, **Olga Bochkareva**, Vera Emelianenko, Harald Vogelsang, Michaela Lang, Anton Klotz, Birgit Moik, Athanasios Makristathis, David Berry, Stefanie Dabsch, Vineeta Khare & Christoph Gasche. Atypical enteropathogenic E. coli are associated with disease activity in ulcerative colitis **Gut Microbes,** 2022, Nov 22; 14(1):2143218 *https://doi.org/10.1080/19490976.2022.2143218*
2. Natalia O Dranenko, Maria Tutukina, Mikhail S. Gelfand, Fyodor Kondrashov & **Olga O Bochkareva (last authorship)** Chromosome-encoded IpaH ubiquitin ligases indicate non-human pathogenic *Escherichia* **SciRep** 2022 Apr 27, 12:6868 doi: 10.1038/s41598-022-10827-3
3. Alexey Zabelkin, Yulia Yakovleva, **Olga Bochkareva*** & Nikita Alexeev*. PaReBrick: PArallel REarrangements and BReaks identification toolkit. **Bioinformatics** 2021 Oct 03; 38(2):357-363 https://doi.org/10.1093/bioinformatics/btab691
4. Zaira Seferbekova, Alexey Zabelkin, Yulia Yakovleva, Robert Afasizhev, Nikita Alexeev, Mikhail S Gelfand & **Olga O Bochkareva.** High rates of genome rearrangements and pathogenicity of *Shigella* spp. **Frontiers Microbiology** 2021 Apr 12; 12:831. doi:10.3389/fmicb.2021.628622
5. Olga Sigalova, Andrei V Chaplin, **Olga O Bochkareva**, Pavel V Shelyakin, Vsevolod A Filaretov, Evgeny E Akkuratov, Valentina Burskaya & Mikhail S Gelfand. *Chlamydia* pan-genomic analysis reveals balance between host adaptation and selective pressure to genome reduction. **BMC Genomics.** 2019 Sep 12;20(1):710. doi: 10.1186/s12864-019-6059-5.
6. Pavel V Shelyakin*, **Olga O Bochkareva***, Anna A Karan & Mikhail S Gelfand. Micro-evolution of three *Streptococcus* species: selection, antigenic variation, and horizontal gene inflow. **BMC Evol. Biol.** 2019. Mar 27;19(1):83. doi: 10.1186/s12862-019-1403-6.
7. **Olga O Bochkareva**, Elena V Moroz, Iakov I Davydov & Mikhail S Gelfand. Genome rearrangements and selection in multi-chromosome bacteria *Burkholderia* spp. **BMC Genomics**. 2018 Dec 27;19(1):965. doi: 10.1186/s12864-018-5245-1.
8. **Olga O Bochkareva**, Natalia O Dranenko, Elena S Ocheredko, German M Kanevsky, Yaroslav N Lozinsky, Vera A Khalaycheva, Irena I Artamonova & Mikhail S Gelfand. Genome rearrangements and phylogeny reconstruction in *Yersinia pestis*. **PeerJ**. 2018 Mar 27;6:e4545. doi: 10.7717/peerj.4545.

Preprints and submitted papers:

- Natalia O Dranenko, Aleksandra D Rodina, Yaroslav V Demenchuk, Mikhail S. Gelfand & **Olga O Bochkareva.** Evolutionary trajectories of secondary replicons in multipartite genomes **bioRxiv** 2023 Apr 09: 536151; doi:10.1101/2023.04.09.536151
- Alper Yurtseven, Sofia Buyanova, Amay A. Agrawal, **Olga O. Bochkareva** & Olga V. Kalinina Machine learning and phylogenetic analysis improves predicting antibiotic resistance in *M. tuberculosis* **bioRxiv** 2023 Sept 06:556328

Papers in preparation:

- Ekaterina V. Vostokova, Natalia O. Dranenko, Mikhail S. Gelfand, **Olga O. Bochkareva**. Genome rearrangements and host adaptation in *Wolbachia*
- Alexey Zabelkin & **Olga O. Bochkareva.** BADLON: linear collinear Blocks Analysis: Distribution, Location, and compositiON
- K. Jain, R. Hauschild, **O. Bochkareva**, R. Roemhild, C. Guet Conservation of start codon controls expression dynamics of mar operon

Invited Talks

1. Computational identification and biological interpretation of genome rearrangements in microbes **2023 2nd Young AMICI Symposium** organized by University of Vienna, Austria (online)
2. Detection of genome rearrangements responsible for bacterial phenotype switching. **2022 Helmholtz Institute for Pharmaceutical Research Saarland (HIPS)** Saarland, Germany
3. How bacteria switch to dark side. 2022 **SMTB'22 University of Tartu,** Tartu, Estonia
4. Microbes: taxonomy, genome structure and molecular evolution **2022** workshop organized by **Institute of Bioinformatics (online)**
5. Role of genome rearrangements in formation of bacterial phenotypes, **2021 EMBL, Heidelberg** Germany
6. Comparative genomics of prokaryotes (cookbook), **2020** Summer School of **Bioinformatics Institute**, **online**
7. Structure and evolution of bacterial chromosomes **2019 Bioinformatics Institute** Open Lectures series, St. Petersburg, Russia
8. Comparative genomics of prokaryotes (cookbook), **2019** workshop organized by **Bioinformatics Institute**, St. Petersburg, Russia

Conference Talks:

1. Evolutonary trajectories of secondary replicons in bacteria **FEMS'23** Humburg, Germany
2. Detection of genome rearrangements responsible for bacterial phenotype switching. **SASBi'22** Stellenbosch, South Africa
3. Evolutionary benefits of bacterial genomes with chromids **MCCMB'21** Moscow, Russia
4. Genome rearrangements in bacteria. **BiATA'19** St. Petersburg, Russia
5. Evolution of bacterial chromosomes. **Chromosome'18** Novosibirsk, Russia

Supervised students:

2023 Bogdan Sotnikov, Vera Rubinova, Bioinformatics Institute. Russia. **Term project**
"Non-canonical start codons and where to find them "
2022 Ekaterina Vostokova, Skoltech, Russia. Co-advising **Master project**
"Evolution of *Wolbachia* genomes." co-PI: Mikhail Gelfand.
2021 Ariadna Semenova, Moscow State University, Russia. **Term project**
"Insertion sequences in B. mallei: adaptation to intracellular lifestyle"
2020 Yulia Yakovleva, Alexey Zabelkin Bioinformatics Institute, Russia. **Term project**
"PaReBrick: PArallel REarrangements and BReakpoints identification toolkit" (published in Bioinformatics)
2020 Kristina Perevoshchikova, Moscow State University, Russia. **Term project**
"Evolutionary benefits of bacterial genomes with chromids"
2019 Zaira Seferbekova, Moscow State University, Russia. **Term project**
"Impact of mobile elements into pathogenicity of *Shigella*" (published in Frontiers Microbiology)
2019 Moldir Zhiyenbayeva, graduate student at HSE, Moscow, Russia. Co-advising **Master project**
"Comparative Genomics of Bacillus spp.". co-PI: Mikhail Gelfand.
2018 Natalia Dranenko, graduate student at MIPT, Moscow, Russia. Co-advising **Bachelor project**
"Reconstruction of OxyR ancestor sequence in bacteria". co-PI: Mikhail Gelfand.

Cooperation partners:

2023-present Prof. David Berry, University of Vienna, Vienna, **Austria**. Project: Identification of shafflons in gut microbiomes.

2022-present Prof. Fyodor Kondrashov, OIST, Okinawa, **Japan**. Project: Selection forces in multipartite bacterial genomes.

2022-present Prof. Calin Guet IST Austria, Klosterneuburg, **Austria**. Project: Conservation of non-canonical start codons in mar operon genes.

2022-present Prof. Olga Kalinina, Helmholtz Institute for Pharmazeutical Research Saarland (HIPS), **Germany**. Project: Machine learning and phylogenetic analysis improves predicting antibiotic resistance in *M. tuberculosis*

2021-present Prof. Dan I. Andersson, Uppsala University, **Sweden.** Project: Fitness effects of short random peptides.

2020-2022 Dr. Nikita Alexeev, ITMO University, Saint Petersburg, **Russia**. Project: Development of the bioinformatic toolkit for whole-genome analysis.

2020-2022 Prof. Christoph Gasche, Medical University of Vienna, Vienna, **Austria**. Project: Genetic factors under biofilms formation in pathogenic *E.coli*.

2016-2018 Prof. Marc Robinson-Rechavi, Evolutionary Bioinformatics Lab, Department of Ecology and Evolution, Université de Lausanne, Lausanne, **Switzerland**. Project: Positive selection and horizontal gene transfer in prokaryotes.

2010-2014 Prof. Pavel Pevzner, University of California at San Diego, California, **USA**. Project: Application of the MGRA (Multiple Genome Rearrangements and Ancestors) algorithm to microbial data.

Teaching experience:

Fall 2020 "Comparative genomics of prokaryotes", Lecturer/course instructor
course for master and PhD students (Bioinformatics Institute, St Petersburg, Russia), in Russian. Final evaluation by students: 9.3 out of 10 (the highest evaluation across all courses during the term)

Spring 2019 "Bioinformatics", co-instructor
course for master and PhD students (Skoltech, Moscow, Russia), in English

Autumn 2018 "Comparative Genomics", co-instructor
course for master and PhD students (joint program Skoltech/HSE, Moscow, Russia), in English

2011-2014 Math teacher, School 463, Moscow, Russia

Services for the scientific community and volunteering

1. Summer School of Theoretical and Molecular Biology
recruiting project leaders, lecturers and course instructors; design of lectures and courses; management of courses execution and labs; and moderation of scientific discussions;

2. Bioinformatics Institute
giving open lectures and workshops for broad audience interested in bioinformatics

3. Member of Scholars-without-borders programme:
for students and academics from Ukraine, Belarus or Russia who have been affected by the war

4. Reviewer
for Microbial Genomics, BMC Genomics, Frontiers Microbiology