

## Dr. Olga O. Bochkareva

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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 interaction. I'm developing new computational methods for microbial genome analysis and apply them to fundamental and applied scientific problems.

### Work experience:

**2023 – present** ESPRIT Principal Investigator (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. Evolutionary trajectories of secondary replicons in bacteria **FEMS'23** Hamburg, 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 Pervoshchikova**, 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.

**2021-present Prof. Mikhail Gelfand**, IITP RAS, **Russia**. Project: Evolution of multi-partite genomes.

**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