Petar I. Penev, PhD

Tel: (404) 476-0547 Email: peteripenev@gmail.com
Addresses: 2151 Berkeley Way, Berkeley, CA 94720, USA;
Sofia, 1000, Bulgaria
Website: http://www.petarpenev.com
Github: https://github.com/petaripenev

EDUCATION

University of California, Berkeley — **Berkeley, CA, USA**
Postdoctoral Researcher — June 2021-Present

Georgia Institute of Technology — **Atlanta, GA, USA**
PhD Bioinformatics — January 2017-May 2021

Georgia Institute of Technology — **Atlanta, GA, USA**
MSc Bioinformatics — August 2015-December 2016

Wageningen University — **Wageningen, The Netherlands**
MSc Molecular Life Sciences — September 2014-June 2015

Sofia University "St. Kliment Ohridski" — **Sofia, Bulgaria**
BSc Molecular Biology — October 2010-May 2014

RESEARCH EXPERIENCE

Banfield Lab - University of California, Berkeley — **Berkeley, CA**
Postdoctoral Researcher — June 2021-Present

- Soil dynamics in a water year: active microbiome profiles and carbon persistence with depth and time. Project lead responsible for data management, sample preparation, data analysis, and multi-omic integration.
  - Developed and improved Snakemake pipelines for the genome assembly, annotation, binning, species diversity, isotope enrichment, and enzyme abundance analysis on five terabytes of raw NGS data results.
  - Established an online custom system for sample management, including a web interface and API, which synchronized sample labeling with metadata storage for 5650 samples.
  - Organized ten field sampling trips of 10-15 researchers and students. Performed 350 DNA extractions, 500 stable isotope incubations, and edaphic measurements.
- Performed structural modelling and annotation of unknown and hypothetical genes. Modelled the structure of a putative contractile injection system in a likely predatory bacterium using comparative methods.
- Identified rare ribosomal RNA sequences within Archaeal species that have the potential to improve ribosomal thermostability.
- Explored novel non-coding RNA elements within giant phages.
- Carried out comparative analysis of ribosomal proteins associated with viral takeover of *Bacteroidetes* ribosomes.
- Provided support and advice to other lab members on Python programming and PyMOL visualization.

Williams Lab - Center for the Origin of Life, Georgia Institute of Technology — **Atlanta, GA**
Research Assistant & PhD candidate — January 2017-May 2021

- Developed novel entropy conservation calculation, using Machine Learning (SVM and Random Forests) to detect ancient homologies between groups of sequences - TwinCons.
- Carried out metagenomic and meta-transcriptomic assembly of deep marine samples to study ribosomal expansion segments within novel candidate species.
- Created ProteoVision: a portal to help visualize conservation within ribosomal proteins from different phylogenetic groups.

  - Back end: developed database infrastructure for the web portal with MySQL, scripted access to public databases by API, and designed API infrastructure with the Django REST framework.
  - Front end: developed user interactivity with JavaScript, embedding 1D, 2D, and 3D viewers.
  - Teaching: tutored undergraduate students in Python and database design in this project.
- Performed genome assembly and variant calling on two *S. cerevisiae* mutant genomes with changes in the mito-ribosomal exit tunnel. Identified nine mutations of interest, which could explain the surviving phenotype in the ribosomal RNA.
- Performed structural and evolutionary analysis of ribosomal expansion segments and ribosomal proteins. Conducted covariation analysis of ribosomal RNA and conservation analysis of ribosomal proteins.
- Performed PyMOL scripting to visualize ribosomes from different branches of the tree of life.

Gaucher Lab - Georgia Institute of Technology **Atlanta, GA**
Research Assistant & master's student August 2015-December 2016

- Developed custom substitution matrices with PAML informed by experimental phylogenies of *E. coli* and used them to evaluate the performance of ancestral reconstruction algorithms.
- Performed structural analysis on the mechanism of color change within mRFP from experimental phylogeny.
- Performed clonal interference analysis studying the evolution of *E. coli* experimental phylogenies. Identified structurally important changes in pyruvate kinase of some *E. coli* cohorts.

Laboratory of Biochemistry - Plant Development, Wageningen UR **Wageningen, The Netherlands**
Researcher Mar 2015-May 2015

- Studied possible interactors of the Auxin Response Factor in *A. thaliana* supervised by professor Dolf Weijers. Performed PCR, qPCR, immunoprecipitation assays, and data analysis.

Institute of Plant Physiology and Genetics - Bulgarian Academy of Sciences **Sofia, Bulgaria**
Undergraduate Researcher September 2013-November 2013

- Studied expression levels of the model plant *A. thaliana* genes supervised by Dr. Kiril Mishev. Performed isolation of DNA, RNA, and proteins; executed separation of nucleic acids and proteins; carried out rt-PCR experiments and analysis of data.

Institute of Molecular Biology "Roumen Tsanev" - Bulgarian Academy of Sciences **Sofia, Bulgaria**
Undergraduate Researcher November 2012-April 2013

- Studied *H. sapiens* histone proteins, supervised by Dr. Iva Ugrinova. Performed restriction reactions in plasmid vectors, precipitation of nucleic acids, SDS-PAGE, and Western blots.

EXTRACURRICULAR LEADERSHIP & ENGAGEMENT

Astrobiology Graduate Conference (AbGradCon) **Remote/Japan**
External Organizer September 2019-September 2021

- Discussion leader and chair on the second day of the conference
- Reviewed abstracts and participated in organizational meetings
- Organizer for the Proposal Review Panel

Fulbright Student Association at Georgia Institute of Technology **Atlanta, GA**
Vice-president; President January 2016-May 2017

- Helped organize a two-day symposium titled "Utilizing Fulbright Experience in the Context of Social Entrepreneurship and Global Talent Mobility". Helped with the logistics for bringing 70 Fulbright scholars from South-Eastern states to Georgia Institute of Technology. Helped in writing the program, organized logistics of people needing place to stay, and organized a daytrip to the MLK center.
- Led monthly meetings of the executive board.

- Drafted, proposed, and organized voting on new constitution.
- Organized meetings for the members with day trips to the Atlanta Zoo and the MLK center.

Bulgarian Red Cross **Sofia, Bulgaria**

Volunteer January 2007-December 2010

- Participated in blood donation campaigns, fund raising, orphanage visits, sport events.

PUBLICATIONS

- **Penev P.I.**, Alvarez-Carreño C., Eric Smith, Petrov A.S., and Williams, L.D. "**TwinCons: conservation score for uncovering deep sequence similarity and divergence**", PloS Comp Biol (2021).
- **Penev P.I.**, McCann H.M., Meade C.D., Maddala A., Bernier C.R., Chivukula V.L., Ahmad M., Gulen B., Sharma A., Alvarez-Carreño C., Williams L.D., Petrov A.S. "**ProteoVision: web server for advanced visualization of ribosomal proteins**", NAR (2021).
- **Penev P.I.**, Fakhretaha-Aval S., Patel V. J., Cannone J.J., Gutell R.R., Petrov A.S., Williams L.D., Glass J. B. "**Supersized ribosomal RNA expansion segments in Asgard archaea**", GBE (2020).
- McCann H.M., Meade C.D., Banerjee B, **Penev P.I.**, Williams L.D., Petrov A.S. "RiboVision2: a web server for advanced visualization of ribosomal RNAs", Journal of Molecular Biology (2024)
- Shi L.D., West-Roberts J., Schoelmerich M.C., **Penev P.I.**, Chen L.X., Amano Y., Sachdeva R., Lei S., Banfield J.F. "Methanotrophic Methanoperedens archaea host diverse and interacting extrachromosomal elements", bioRxiv (2023)
- Nissley A.J., **Penev P.I.**, Watson Z.L., Banfield J.F., and Cate J.H. "Rare Ribosomal RNA Sequences from Archaea Stabilize the Bacterial Ribosome", NAR (2023)
- Schoelmerich M.C., Oubouter H.T., Sachdeva R, **Penev P.I.**, Amano Y, West-Roberts J., Welte C.U., Banfield J.F. "A widespread group of large plasmids in methanotrophic Methanoperedens archaea", Nature Communications (2022)
- Jia, T.Z., Johnson-Finn, K.N., Osama M.A., Bonati I., Fujishima K., Grefenstette N., Heenatigala T., Li Y., Noda N., **Penev P.I.**, Prondzinsky P., and Smith H.B. "AbGradCon 2021: lessons in digital meetings, international collaboration, and interdisciplinarity in astrobiology", International Journal of Astrobiology (2022)
- Borges A.L., Lou Y.C., Sachdeva R., Al-Shayeb B., **Penev P.I.**, Jaffe A.L., Lei S., Santini J.M., and Banfield J.F. "Widespread stop-codon recoding in bacteriophages may regulate translation of lytic genes", Nature Microbiology (2022)
- Chen L-X, Jaffe A.L., Borges A.L., **Penev P.I.**, Nelson T.C., Warren L.A., and Banfield J.F. "Phage-encoded ribosomal protein S21 expression is linked to late-stage phage replication", ISME Communications (2022)
- Alvarez-Carreño C., **Penev P.I.**, Petrov, A.S., and Williams, L.D. **"**Fold Evolution before LUCA: Common Ancestry of SH3 Domains and OB Domains**",** MBE (2021)
- Mascuch S.J., Fakhretaha-Aval S., Bowman J.C., Minh Thu H.Ma, Thomas G., Bommarius B., Ito C., Zhao L., Newnam G.P., Matange K.R., Thapa H.R., Barlow B., Donegan R.K., Nguyen N.A., Saccuzzo E.G., Obianyor C.T., Karunakaran S.C., Pollet P., Rothschild-Mancinelli B., Mestre-Fos S., Guth-Metzler R., Bryksin A.V., Petrov A.S., Hazell M., Ibberson C.B., **Penev P.I.**, Mannino R.G., Lam W.A., Garcia A.J., Kubanek J., Agarwal V., Hud N.V., Glass J.B., Williams L.D., Lieberman R.L. "A blueprint for academic laboratories to produce SARS-CoV-2 quantitative RT-PCR test kits", JBC (2020)
- Bowman J.C., Petrov A.S., Frenkel-Pinter M., **Penev P.I.**, Williams L.D. "Root of the Tree: The Significance, Evolution, and Origins of the Ribosome", Chem. Rev. (2020)
- Mestre-Fos S., **Penev P.I.**, Richards J.C., Dean W.L., Gray R.D., Chaires J.B., Williams L.D. "Profusion of G-quadruplexes on both subunits of metazoan ribosomes", PLoS ONE (2019)
- Mestre-Fos S., **Penev P.I.**, Suttapitugsakul S., Hu M., Ito C., Petrov A.S., Wartell R.M., Wu R., Williams L.D. "G-Quadruplexes in Human Ribosomal RNA", J. Mol. Biol. (2019)

- Kovacs, N.A., **Penev, P.I.**, Venapally, A., Petrov, A.S., and Williams, L.D. "Circular Permutation Obscures Universality of a Ribosomal Protein", J. Mol. Evol. 581-592 (2018)
- Bernier, C.R., Petrov, A.S., Kovacs, N.A., **Penev, P.I.**, and Williams, L.D. "Translation: The Universal Structural Core of Life", Mol. Biol. Evol. 35, 2065–2076 (2018)

AWARDS, HONORS, SCHOLARSHIPS, AND FELLOWSHIPS

- Fulbright Scholarship, August 2015 - December 2016 (78,000$)
- Earth-Life Science Institute's (ELSI) 8th International Symposium, January 2020 (travel grant 2850$)
- Origins of Life Gordon Research Seminar, January 2020 (travel grant 250$)
- Invited talk, Origins of Life Gordon Research Conference, January 2020 (travel grant 1410$)
- First place, Proposal Writing Retreat (PWR), Astrobiology Graduate Conference (AbGradCon), July 2019
- AbGradCon, July 2019 (travel grant 250$)
- Astrobiology Science Conference (AbSciCon), June 2019 (travel grant 2000$)
- XVI International School of Astrobiology "Josep Comas i Sola", July 2018 (travel grant 2482$)
- ELSI 6th International Symposium, January 2018 (travel grant 2000$)
- MSc research assistantship, Georgia Institute of Technology, August 2016 - December 2016 (3680$)
- Internship at the Institute of Plant Physiology and Genetics funded by the European Social Fund, September 2013- October 2013

PRESENTATIONS

- *Quantifying active microbiomes and mineral carbon persistence with depth and time in California grasslands* [Poster session]. AGU Annual Meeting (2023), San Francisco, CA, United States.
- *ProteoVision: web server for advanced visualization of ribosomal proteins* [Talk hybrid]. AbSciCon conference (2022), Atlanta, GA, United States.
- *Supersized ribosomal RNA expansion segments in Asgard archaea* [Poster session] Origins Center Conference (2021) Netherlands (online).
- *Supersized ribosomal RNA expansion segments in Asgard archaea* [Talk session] Astrobiology Graduates in Europe (AbGradE) conference (2020) (online).
- *Ribosomal Phylogeny: A Perspective Including Coevolution* [Poster session] ELSI 8th International Symposium (2020) Tokyo, Japan.
- *Eukaryotic-like ribosomal RNA region in Lokiarchaeota* [Talk session] ExplOrigins symposium (2020) Atlanta, GA, USA.
- *Ribosomal Phylogeny: A Perspective Including Coevolution* [Talk session] Origins of Life Gordon Research Conference & Seminar (2020) Galveston, TX, USA
- *New alignment score for studying ancestry of ribosomal proteins* [Poster session] AbGradCon (2019) Salt Lake City, UT, USA.
- *Discovering ancient ribosomal protein paralogs* [Poster session] AbSciCon (2019) Bellevue, WA, USA.
- *New alignment score for studying ancient ancestry* [Talk session] Evolution of Complex Life (2019) Atlanta, GA, USA.
- *Novel alignment-based method for uncovering protein homologies* [Poster session] ExplOrigins symposium (2019) Atlanta, GA, USA.
- *Ribosomal proteins show high conservation in ancient regions* [Poster session] NASA Astrobiology Institute symposium (2018) Atlanta, GA, USA.
- *Origin of domain-specific ribosomal proteins* [Poster session] ELSI 6th International Symposium (2018) Tokyo, Japan.

ADDITIONAL SKILLS AND CERTIFICATIONS

Languages: Bulgarian (native) and English (proficient).

Technology: Office suite (proficient), Python (advanced), Snakemake (intermediate), shell (intermediate), source control (git), PyMOL (advanced), Illustrator (intermediate), MySQL (intermediate), JavaScript (basic), Perl (basic).

Lab: DNA extraction, soil incubations with stable isotopes, gas sampling, soil edaphic measurements.