Mikhail PETROV
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SKILLS SUMMARY

- Extensive working experience with deep learning: one paper published.
- Experience in various machine learning algorithms: logistic regression, SVM, decision trees, etc. Two papers published.
- Experience in Condensed Matter Physics: three papers published.
- Experience in Optical Spectroscopy: one paper is published.
- Solid knowledge of Density Functional theory and DFT codes such as Quantum Espresso and ABINIT.
- Hands-on experience in parallel computing on supercomputing clusters.
- Programming experience: 5+ years of modeling in Python, MATLAB,. Limited experience with Fortran. Basic knowledge of object-oriented programming (Java).
- Extensive experience in data science and statistics.

EDUCATION

Tufts University   **Boston, USA**
PhD in Mechanical Engineering   *in progrss*

University of Antwerp   **Antwerp, Belgium**
M. Sc. with Honors of Nanophysics.   *July 2018*

Peter the Great St. Petersburg Polytechnic University   **St Petersburg, Russia**
B. Sc. of Physics.   *June 2016*

WORK EXPERIENCE

Advanced methods of surface characterization of materials.   **Medford, MA, USA**
Research Assistant (*Grad*)   *January 2022 - Now*

- Working towards obtaining a PhD in Mechanical Engineering.
- Performed AFM(atomic force microscope) imaging of biological cells and various materials (e.g. polymers, nanoparticles).
- Developing machine learning models for novel methods of surface characterization: cancer detection based on surface properties of biological cells, characterization of polymer mixtures based on precise mapping of their constituents, surface defects detection on nanoparticles. Methods include deep neural networks, baesian machine learning algorithms, decision trees, etc.
- Developing a new method for studying the origins of bladder cancer on cellular level using machine learning models.
- Performing statistical screening and analysis of the measured data.

Superconductivity in low-dimensional materials   **Antwerp, Belgium**
PhD student in Physics (*discontinued*)   *September 2018 - January 2022*

- Performed *ab initio* calculations of various two-dimensional materials, including electronic and phononic properties.
- Actively investigated the method of Wannier functions for effective interpolation of electronic eigenstates and electron-phonon coupling matrix elements in application to 3D and low-dimensional materials.
- Developed a code for calculation of band-resolved Eliashberg function for more precise description of milti-band superconductors.

three articles published

Superconductivity in low-dimensional materials   **Antwerp, Belgium**
Master student in Physics   *September 2016 - July 2018*

- Performed *ab initio* calculations of various two-dimensional materials, including electronic and phononic properties.
- Actively investigated the method of Wannier functions for effective interpolation of electronic eigenstates and electron-phonon coupling matrix elements in application to 3D and low-dimensional materials.
- Developed a code for calculation of band-resolved Eliashberg function for more precise description of milti-band superconductors.
- Developed solid knowledge of high-performance computing.
- Created an extensive framework for analysis of the relevant data as well as various graphical visualisation tools (e.g. visualisation of lattice vibrations).

Master thesis

Experimental research on singlet oxygen and amorphous silicon   St Petersburg, Russia
Bachelor student in Physics   *September 2012 - June 2016*

- Participated in development of an experimental setup for studying photoluminescence processes in the water solution of the photosensitizer Radachlorin. Performed analysis of the measured data.
- Actively participated in a project dedicated to crystallisation of amorphous silicon using femtosecond laser pulses.

Bachelor thesis, one article published

Summer internship in the university of Antwerp   Antwerp, Belgium
Undergraduate summer intern   *July - August 2015*

- Performed calculations of quantum mechanical properties of carbon nonotubes using Tight biding method.
- Acquired basic hands-on experience on experimental work using an electron microscope and a Raman spectrometer.

AWARDS AND ACHIEVEMENTS

- Personal PhD scholarship from Flemish government (FWO), Antwerp university, Belgium, 2019.
- Scholarship for the master program in the university of Antwerp as a result of well working performance during the summer internship, Antwerp university, Belgium, 2016.
- Scholarship of distinction and summer internship as a result of high distinction in the academic results, St. Petersburg polytechnic university, Russia, 2013-2015.

PUBLICATIONS

- "Crystallisation of hydrogenated amorphous Si films (a-Si : H) under irradiation of femtosecond laser pulse". V. Belik, O. Vasytinski, A. Kuznetsov, M. Petrov, R. Popov, E. Terukov. *Technical Physics Letters*, 15(36), 2016.
- "Hydrogen-Induced High-Temperature Superconductivity in Two-Dimensional Materials: The Example of Hydrogenated Monolayer MgB_2". M. Petrov, J. Bekaert et al. *Phys. Rev. Lett.* 123, 077001 – Published 13 August 2019.
- "Superconductivity in gallenene."M. Petrov, J. Bekaert et al. *2D Mater.* 8, 035056 - Published 25 June 2021.
- "High-temperature multigap superconductivity in two-dimensional metal borides". C. Sevik, J. Bekaert, M. Petrov et al. *Phys. Rev. Materials* 6, 024803 – Published 28 February 2022
- "Identification of Geometrical Features of Cell Surface Responsible for Cancer Aggressiveness: Machine Learning Analysis of Atomic Force Microscopy Images of Human Colorectal Epithelial Cells". M. Petrov, I. Sokolov. *Biomedicines* 2023, 11(1) - Published 12 January 2023.
- "Machine Learning Allows for Distinguishing Precancerous and Cancerous Human Epithelial Cervical Cells Using High-Resolution AFM Imaging of Adhesion Maps". M. Petrov, I. Sokolov. *Cells* 2023, 12(21), 2536 - Published 28 October 2023.
- "A Replication Study of Transfer Learning with Informative Priors: Simple Baselines Better than Previously Reported". Ethan Harvey, Mikhail Petrov, Michael C Hughes. *Transactions on Machine Learning Research* - accepted at TMLR.

LIST OF THE MOST ADVANCED COURSES TAKEN

Below are the graduate-level courses taken at the University of Atwerp.

- **Bayesian deep learning**. Gaussian processes, Bayesian neural networks, MCMC, SHHMC, Variational methods, Generative models (Variational Autoencoders). Implementing deep learning algorithms in Pytorch and JAX.
- **Introduction to Machine Learning**. Linear regression and classification, Neural networks, Trees ensembles, Kernel methods.
- **Quantum Field theory**. Classical Lagrangian field theory, Quantum fields and application to Many-body Physics.
- **Path integrals in Quantum Mechanics**. The concept of path integration and methods of path integration: quadratic path integrals, fourier methods, the WKB method and the methos of images.
- **Solid State Physics**. The second quantization formalism and its applications: electron-electron and electron-phonon interactions. Perturbation theory: Gell-Man & Low theorem, Wick's theorem and vacuum polarization. Diagrammatics applied to various Solid State Physics problems.
- **Electronic structure calculations**. Hartree and Hartree-Fock methods, Density functional theory and Tight-binding method.
- **Device Physics**. Essential concepts and tools from Statistical Physics and field theory for studying transport of mobile electric charges in semiconductors: phase space, the density matrix or statistical operator, the classical Liouville equation and its quantum counterpart, distribution functions.
- **Statistical and Mathematical Physics**. Complex analysis, stochastic dynamics, Dynamics of liquids and gases, Linear response theory.
- **Superconductivity and superfluidity**. Weakly interacting Dose gases (the Gross-Pitaevskii equation). The Bogoliubov theory, Feynmans papers on liquid helium and the lambda transition. Superconductivity: BCS and Ginzburg-Landau theories.

OUTREACH

- During the years spent in the university of Antwerp, I have actively participated in the Antwerp Young Minds group dedicated to organisation of physical colloquia about modern research in physics. http://www.youngminds.uantwerpen.be