Michael Sekatchev

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Education

University of British Columbia (UBC) — **Vancouver, BC, Canada**
Masters of Science in Physics — September 2023 - April 2025
- **Research**: Computational Dark Matter.
- **Thesis**: *Axion Quark Nuggets: A Recipe for a Glowing Milky Way?*
- **Awards**: Bryan Wayne Statt Bursary in Physics (March 2025, **$850**), BC Graduate Scholarship (December 2024, **$17,500**), Vantage College Teacher's Assistant Award (July 2024, **$200**).

University of British Columbia (UBC) — **Vancouver, BC, Canada**
Bachelor of Science in Honours Physics, Minor in French — September 2019 - April 2023
- **Research**: Experimental Neutrino Physics, Computational Astrophysics.
- **Thesis**: *An explanation of the observed excess emissions in our galaxy using the Axion Quark Nugget dark matter model*.
- Graduated with distinction. Dean's Honour List, all terms.

Sir Winston Churchill Secondary School — **Vancouver, BC, Canada**
Secondary school grade 12 — September 2018 - June 2019
- **Awards**: BC Achievement Scholarship (June 2019, **$1,250**). Graduated with honours.

Ecole Internationale Provence-Alpes-Côte d'Azur — **Manosque, France**
Secondary school grades 4-11, European Baccalaureate program — September 2010 - July 2018

Skills

Languages: Fluent in English, French and Russian. Basic knowledge of Spanish.
Programming Languages: C, C++, Python, MATLAB, R, ROOT, HTML, CSS, JavaScript, SQL, LaTeX.
Software: SolidWorks, Blender, Unity, Jupyter Notebook, ImageJ, GIMP, Adobe Photoshop, PrusaSlicer, Git

Work Experience

UBC Department of Physics and Astronomy (PHAS) — Apr 2022 - **Current**
Research Assistant — (3 years 2 months)
Skills: Python · MCMC Analysis · Numerical Integration · Curve Fitting · Sky Maps · Satellite Data Interpretation · Data Analysis
- Researching an annihilation interaction within the Axion Quark Nugget (AQN) model, a dark matter candidate.
- Demonstrated that the signal from AQN-baryon annihilation may explain the observed excess in Galactic radio emissions.
- Created simulated sky maps of the expected far-ultraviolet (FUV) and radio emissions from the AQN-baryon annihilation.

TRIUMF, Hyper-Kamiokande (Hyper-K) Collaboration — Jul 2019 - Aug 2019 | May 2020 - Aug 2022
Research Assistant | Young Engineers and Scientists (YES!) Fellow — (2 years 4 months)
Skills: Python · C++ · Machine Learning · Photogrammetry · SolidWorks · 3D-printing · Engineering Design · Camera Calibration
- Winner of YES! fellowship, a summer research experience offered to five nominated high school applicants across BC.
- Member of the photogrammetry group working on geometrical calibration of Hyper-K's water Cherenkov detectors in Japan.
- Automated the identification and matching of photomultiplier tubes from a drone image survey of the Super-K detector.
- Lead camera calibration, light propagation studies and 3D simulations for photogrammetry systems in neutrino detectors.
- Designed, built and tested an underwater camera housing for built-in photogrammetry in the WCTE neutrino detector.

UBC Department of Materials Engineering (MTRL) — Sep 2018 - Apr 2019 | Sep 2019 - Apr 2020
Research Assistant — (1 year 4 months)
Skills: SolidWorks · Engineering Drafting · 3D-printing · Scanning Electron Microscopy · Image Processing · Mechanical Assembly
- Contributed to electron beam additive manufacturing research: creating a 3D printer based on an electron beam welder (EBW).
- Created SolidWorks designs and engineering drawings for 3D-printed parts of the system.
- Designed and assembled a custom motorized steel z stage for the electron beam welder.
- Prepared and studied sintered titanium powder samples using a scanning electron microscope, to inform EBW calibration.

TRIUMF, Vacuum and Cryogenics Group — Jul 2018 - Aug 2018
Vacuum and Cryogenic Engineering Trainee — (2 months)
Skills: Helium Leak Detection · Residual Gas Analysis · Mehcanical Assembly · Database Management · Documentation
- Performed helium leak detection and outgassing spectrum studies using a Residual Gas Analyser (RGA).
- Experimented with novel vacuum seal types (indium and PEEK seals) and assisted with operation of helium liquefiers.
- Documented TRIUMF's Isotope Separator and Accelerator (ISAC) Vacuum system controls interlocks.

ITER International Organization, France — Jun 2016
Vacuum Engineering Trainee — (1 month)
Skills: Vacuum Technology · Helium Leak Detection · Residual Gas Analysis · Database Entry
- Assembled and tested vacuum flanges, performed leak detection, outgassing tests, and materials database data entry.
- Obtained experience working in a large international (35 nations) collaboration.

Selected Technical Projects

Numerical Simulation of 2D Schrödinger Equation in a Box Videos | GitHub | Report

Skills: MATLAB · Finite Difference Methods · Alternating-Direction Implicit (ADI) Method · Partial Differential Equations (PDEs)

- Simulated numerical solutions to the 2D Schrödinger Equation in a box using an ADI finite difference method in MATLAB.
- Generated videos of the evolution of the probability density with time for different initial conditions and potential barrier types.
- Performed convergence testing and other numerical experiments to ensure robustness of solution.

Chaotic Dynamics of a Dripping Water Faucet arXiv Paper

Skills: Python · Time Series Analysis · Chaos Dynamics · Statistical Uncertainties · Curve Fitting · Headless Data Collection

- Studied the bifurcations and transition to chaos of the time interval between successive drops from a variable flow water faucet.
- Performed statistical analysis to correct for droplet size, study uncertainties, and measured both Feigenbaum constants.

Programmable Drawing Robot Videos | GitHub | Report | Presentation

Skills: C · Launchpad MSP430 microprocessor · Machining · Electronics · Engineering Design

- Designed, built and programmed a 3-wheeled drawing robot capable of creating any programmed 2D drawing with a Sharpie.

UBC ThunderBikes Engineering Student Design Team Sep 2019 - May 2022

Skills: Leadership · SolidWorks · Engineering Design · Carbon Fibre · Aerodynamics · 3D-Printing · Electronics · Accounting

- Lead multiple technical subteams with dozens of students working on several electric bike and electric motorcycle projects.
- Served as Team Captain for Campus Commuter Challenge, a project to design and build an e-bike for UBC president Santa Ono.

Work Experience – Open Education Resources (OER)

UBC Department of Statistics (STAT) June 2025 - **Current**
Statistics Problem Developer, Open Education Resource (OER) Project (1 month)

Skills: Regression · Machine Learning · Quarto · Python · R · Git

- Developing exercises for The Regression Cookbook, an open source textbook teaching regression techniques using python and R from two perspectives: (inference and prediction), setting a common-ground between machine learning and statistics.

UBC Vantage College April 2024 - **Current**
Course Project Developer, VANT 140 APSC 160 Course Project (2 months)

Skills: C · Linguistics · Python · Git · LaTeX

- received a Bootstrap Grant from Vantage College to work on developing a concordancing software course project for APSC 160, a first-year programming course in Engineering.

UBC Vantage College Mar 2024 - **Current**
Physics Editor, Open Education Resource (OER) Project (1 year 3 months)

Skills: Mechanics · Linguistics · Python · Git · LaTeX

- Co-author & editor for OER textbook, Speaking and Writing Physics 101: The Language of Solving First-year Physics Problems.
- This textbook explores the role of language in problem-solving, aiding students' understanding of physics concepts and enhancing communication skills in scientific English.

UBC Department of Mechanical Engineering (MECH) Mar 2021 - May 2023
Mechanics Problem Developer, Open Education Resource (OER) Project (2 years 2 months)

Skills: Mechanics · WebWorK · Technical Illustration · Database Management · Python · Git · LaTeX

- Developed over 100 novel mechanics problems with illustrations and solutions for an open-source textbook, replacing the required textbook in UBC's mechanical engineering dynamics (MECH 221) course and in first-year engineering across Canada.

Teaching Experience

Teaching Assistant, 15 Courses, UBC

Award winner – UBC Vantage College Teacher's Assistant Award	Jul 2024
ENPH 257 – Heat and Thermodynamics	May 2025 - **Current** (1 month)
PHYS 310 – Machine Learning for Physics and Astronomy Data Analysis	Jan 2024 - Apr 2025 (4 months)
VANT 140 – Language Enrichment for APSC 160 and PHYS 117	Sep 2024 - Apr 2025 (8 months)
SCIE 113 – First-Year Seminar in Science	Sep 2024 - Apr 2025 (8 months)
PHYS 118 – Electricity, Light and Radiation	Jul 2024 - Aug 2024 (2 months)
ENPH 270 – Mechanics II	May 2024 - Jul 2024 (2 months)
VANT 140 – Language Enrichment for APSC 178, Electricity, Magnetism, and Waves	Jan 2024 - Apr 2024 (4 months)
PHYS 310 – Machine Learning for Physics and Astronomy Data Analysis	Jan 2024 - Apr 2024 (4 months)
SCIE 113 – First-Year Seminar in Science	Sep 2023 - Apr 2024 (8 months)
PHYS 210 – Introduction to Computational Physics	Sep 2023 - Dec 2023 (4 months)
APSC 160 – Introduction to Computation in Engineering Design	Sep 2023 - Dec 2023 (4 months)
PHYS 131 – Energy and Waves	May 2023 - Jun 2023 (2 months)
PHYS 229 – Intermediate Experimental Physics II	Jan 2023 - Apr 2023 (4 months)
PHYS 157 – Introductory Physics for Engineers I	Sep 2022 - Dec 2022 (4 months)
CPSC 110 – Computation, Programs, and Programming	Sep 2022 - Dec 2022 (4 months)
CPSC 100 – Computational Thinking	Jul 2022 - Aug 2022 (2 months)
PHYS 159 – Introductory Physics Laboratory for Engineers	Jan 2022 - Apr 2022 (4 months)
APSC 160 – Introduction to Computation in Engineering Design	Sep 2021 - Apr 2022 (8 months)

Tutor

Independent Physics Tutor — UBC Students	Mar 2022 - Aug 2022 (6 months)
Math Tutor Network — High School Students	Mar 2021 - Aug 2022 (1 year 6 months)

Publications

- **M. Sekatchev**. Axion Quark Nuggets: A Recipe for a Glowing Milky Way?. *Master's thesis*, April 2025.
- **M. Sekatchev**, X. Liang, F. Majidi, B. Scully, L. Van Waerbeke, A. Zhitnitsky. The Glow of Axion Quark Nugget Dark Matter: (III) The Mysteries of the Milky Way UV Background. April 2025. *submitted to JCAP, in review.*
- F. Majidi, X. Liang, L. Van Waerbeke, A. Zhitnitsky, **M. Sekatchev**, J. Sommer, K. Dolag, T. Castro. The Glow of Axion Quark Nugget Dark Matter: (I) Large Scale Structures. *JCAP*, August 2024.
- **M. Sekatchev**, Z. Zhengxiang. Stochastic Approaches to Asset Price Analysis. *Math 605E, Applied Stochastic Analysis, UBC*, May 2024.
- **M. Sekatchev**. An explanation of the observed excess emissions in our galaxy using the Axion Quark Nugget dark matter model. *Undergraduate honours thesis*, May 2023.
- **M. Sekatchev**. Chaotic Dynamics of a Dripping Water Faucet. *Phys 409, Experimental Physics, UBC*, December 2022.
- **M. Sekatchev**, G. Dockrill, A.G. d'Entremont. Impact of student problem creation on self-reported confidence in mechanics. *2022 American Society for Engineering Education (ASEE) Zone IV Conference*, April 2022.

Presentations

- M. Sekatchev. Axion Quark Nuggets: A Recipe for a Glowing Milky Way? *Dark Interactions 2024*, October 2024.
- M. Sekatchev. Axion Quark Nuggets: A Recipe for a Glowing Milky Way? *ICTP Summer School on Cosmology*, Trieste, Italy, June 2024.
- M. Sekatchev. Axion Quark Nuggets: A Recipe for a Glowing Milky Way? *Canadian Astronomical Society (CASCA) 2024 annual general meeting*, Toronto, Canada, June 2024.
- M. Sekatchev. Axion Quark Nuggets: A Recipe for a Glowing Milky Way? *Three Minute Thesis (3MT) Semi-Finals*, March 2024. **People's choice award**. See on YouTube. Also presented at UBC's Science Rendezvous 2024 event.
- M. Sekatchev. Axion Quark Nuggets Versus Excess Galactic Radio Background. *Canadian Astronomical Society (CASCA) 2023 annual general meeting*, Penticton, Canada, June 2023.
- M. Sekatchev. Exploring Dark Energy Models. *Astr 403, Cosmology, UBC*, April 2023. **Best poster award**.
- M. Sekatchev. Angular Dependence of Cosmic Ray Muon Flux. *Phys 409, Experimental Physics, UBC*, November 2022.
- M. Sekatchev. Axion Quark Nugget Annihilation With Baryon Gas Versus Observed Excess Diffuse Ultraviolet Radiation. *2022 Canadian Astro-Particle Physics Summer Student Talk Competition (CASST)*, August 2022.
- M. Sekatchev. Simulations and Imaging Hardware Optimization for Photogrammetry in the Water Cherenkov Test Experiment (WCTE) and Hyper-Kamiokande (Hyper-K) Detectors. 6^{th} *Hyper-K Collaboration Meeting*, June 2022. **Best poster award**.
- M. Sekatchev. Automated Feature Detection and Camera R&D for Photogrammetry in Super-K and Future Water Cherenkov Neutrino Detectors. *2021 Canadian Association of Physicists (CAP) Congress*, June 2021.
- M. Sekatchev. Photogrammetry in Super-K and Future Water Cherenkov Neutrino Detectors. 49^{th} *Advisory Committee on TRIUMF (ACOT)*, April 2021.
- M. Sekatchev. Photogrammetry in Super-K and Future Water Cherenkov Neutrino Detectors. *2021 Multidisciplinary Undergraduate Research Conference (MURC)*, March 2021.
- M. Sekatchev. HK-IWCD-SK Geometrical Calibration Camera System for Monitoring Photomultiplier Detector Vessels in the T2K Long Baseline Neutrino Water Cherenkov Experiments. *YES! Fellowship Program Poster Session*, August 2019.

Outreach and Volunteer Experience

UBC Physics and Astronomy Equity, Diversity and Inclusion (EDI) Committee Member — May 2024 - **Current** (1 year 1 month)
- Working on projects and policy changes to promote inclusivity in the department.
- Organizing mental health response training for teaching assistants and faculty within the department.

UBC Science Rendezvous Volunteer — Mar 2023, Mar 2024
- Volunteer at the annual Science Rendezvous event. Presented Three Minute Thesis talk, and assisted at various booths.

UBC Physics and Astronomy Faculty Candidate Interviewer — Feb 2024 - Mar 2024 (2 months)
- Lead graduate student interviews of faculty candidates. Presented summary of interviews at faculty meeting.

Brownies and Girl Scouts Physics Demonstrations Volunteer — Jan 2023 - Apr 2023 (4 months)
- Lead physics demonstrations and presentations for several Brownies and Girl Guide groups in Vancouver. Organized through the UBC Physics & Astronomy outreach department.
- Sparked an interest in physics in Girl Guide groups of 20-30, ages 7-11.

Cypress Mountain Slope Safety — Nov 2022 - Apr 2023 (6 months)
- Weekly volunteer supporting ski patrol on Cypress Mountain. Patrolling ski trails and enforcing speed limits.

Yearbook Club, Ecole Internationale Provence-Alpes-Côte d'Azur, France — Sep 2013 - Jun 2018 (4 years 9 months)
- Helped organize and create the structure of the school's yearbook. Assisted in selling and distribution.
- **Student director of club** (2017-2018). Organised the club's activities and milestones, publishing and selling over 600 copies.

Finance

MITx MicroMasters in Finance — Program Description

Skills: Quantitative Finance · Modern Finance · Corporate Finance · Risk Management · Financial Analysis
- Completed Mathematical Methods for Quantitative Finance: Probability distributions, time-series modelling, continuous-time stochastic processes, Monte Carlo simulation, model optimization, Black–Scholes model.

UBC Trading Group — Sep 2023 - **Current**
Quantitative Analyst — (1 year 9 months)

Skills: Tactical Allocation · Black-Litterman Model · Multi-Factor Portfolio Optimization · View-Adjusted Allocations
- Developing a scalable portfolio management algorithm in consultation with Connor Clark & Lunn and UBC Sauder School of Business Faculty. Using the Black-Litterman model to find optimal asset allocation weights.

Questrade Retail Trading

Skills: Market Analysis · Risk Assessment · Investment Management · Trade Execution
- Actively trading personal funds on the Questrade platform since March 2021. Focus on technology, energy and materials sectors.