

Michael Sekatchev

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EDUCATION

University of British Columbia (UBC)

Vancouver, BC, Canada

Masters of Science in Physics

- Research: Computational Dark Matter.
- Thesis: *Axion Quark Nuggets: A Recipe for a Glowing Milky Way?*
- Awards: [BC Graduate Scholarship](#) (December 2024, \$17,500), [Vantage College Teacher's Assistant Award](#) (July 2024, \$200).

September 2023 - Current

University of British Columbia (UBC)

Vancouver, BC, Canada

Bachelor of Science in Honours Physics, Minor in French

- 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.

September 2019 - April 2023

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

(2 years 9 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 · Mechanical 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.
- Labelled and assembled vacuum lines for the Advanced Rare Isotope Laboratory (ARIEL).

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 Vantage College

Mar 2024 - **Current**

Physics Editor, Open Education Resource (OER) Project

(10 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, 14 Courses, UBC

Award winner – UBC Vantage College Teacher's Assistant Award

Jul 2024

PHYS 310 – Machine Learning for Physics and Astronomy Data Analysis	Jan 2024 - Current (1 month)
VANT 140 – Language Enrichment for APSC 160 and PHYS 117	Sep 2024 - Current (4 months)
SCIE 113 – First-Year Seminar in Science	Sep 2024 - Current (4 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**, F. Majidi, L. Van Waerbeke, A. Zhitnitsky. Axion Quark Nugget Annihilation With Baryon Gas Versus Observed Excess Diffuse Ultraviolet Radiation. *To be published in Monthly Notices of the Royal Astronomical Society (MNRAS)*, in progress.
- 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 605F, 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 (CASA) 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 (CASA) 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. *6th 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](#). *49th 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

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|---|---------------------------|
| UBC Physics and Astronomy Equity, Diversity and Inclusion (EDI) Committee Member | May 2024 - Current |
| ◦ Working on projects and policy changes to promote inclusivity in the department. | (8 months) |
| ◦ 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 |
| ◦ Lead graduate student interviews of faculty candidates. Presented summary of interviews at faculty meeting. | (2 months) |
| Brownies and Girl Scouts Physics Demonstrations Volunteer | Jan 2023 - Apr 2023 |
| ◦ Lead physics demonstrations and presentations for several Brownies and Girl Guide groups in Vancouver. | (4 months) |
| ◦ 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 |
| ◦ Weekly volunteer supporting ski patrol on Cypress Mountain. Patrolling ski trails and enforcing speed limits. | (6 months) |
| Yearbook Club, Ecole Internationale Provence-Alpes-Côte d'Azur, France | Sep 2013 - Jun 2018 |
| ◦ Helped organize and create the structure of the school's yearbook. Assisted in selling and distribution. | (4 years 9 months) |
| ◦ Student director of club (2017-2018). Organised the club's activities and milestones, publishing and selling over 600 copies. | |

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 4 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.