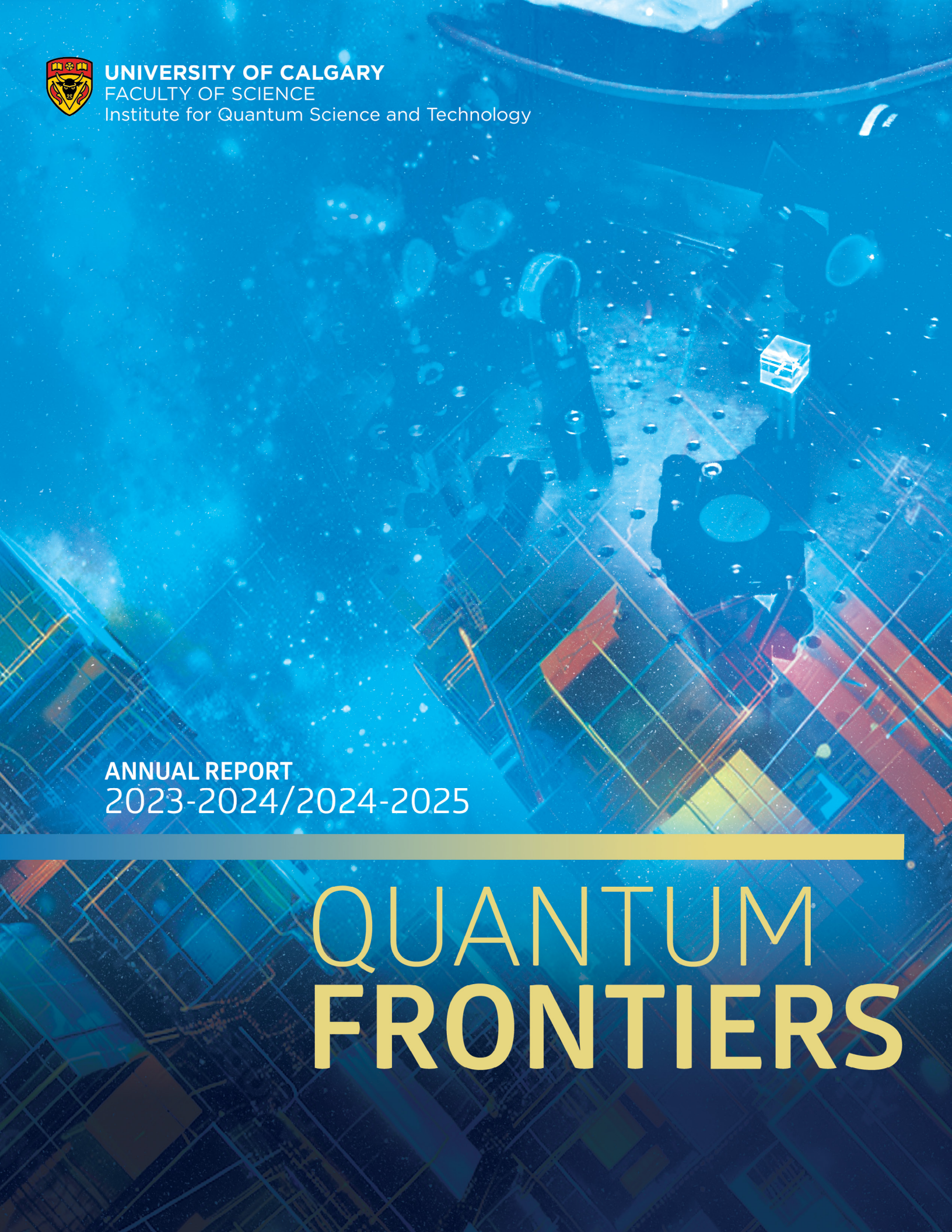


UNIVERSITY OF CALGARY
FACULTY OF SCIENCE
Institute for Quantum Science and Technology

ANNUAL REPORT
2023-2024/2024-2025

QUANTUM FRONTIERS

Vision

To be a world leader in research and education in pure and applied quantum science and technology.

Mission

To advance quantum science and technology through interdisciplinary research, teaching, and outreach.

Key Facts

30 postdoctoral associates

134 graduate students

55 undergraduate students

184 publications in refereed journal and conference proceedings including *Nature* (2), *Nature Physics* (2), *Physical Review Letters* (7), *PRX Quantum* (4), *Optica* (1), *Nano Letters* (1), *ACS Catalysis* (1) and *ACS Materials Letter* (1)

69 invited talks at national and international conference/ workshops including seven keynotes and four plenary talks

9.5 million dollars in research funds in 2023/24

13.3 million dollars in 2024/25

Contents

Director's Report

The Institute for Quantum Science and Technology (IQST) provides a platform for quantum researchers at the University of Calgary to elevate their research locally, nationally, and internationally. In doing so, it strives to create a vibrant research environment for more than 100 members, who include faculty, postdoctoral scholars, and graduate and undergraduate researchers. This is achieved by hosting visiting scholars and speakers, by organising events that connect researchers and external stakeholders, and by supporting researcher-led activities. IQST members also play key roles into other quantum related initiatives at the University of Calgary, including Quantum City and Quantum Horizons Alberta (QHA), collaborate with researchers across the province through Quantum Alberta, and engage with stakeholders across Canada developing the National Quantum Strategy.

During the past two years (2023/24 and 2024/25), the Institute has continued upon a trajectory of growth, and as of April 2025 is home to 24 research groups in the Faculty of Science and the Schulich School of Engineering. New faculty hired during this period include Erika Janitz, Shahpoor Moradi, Viki Prasad, Urbasi Sinhai, and Aninda Sinha. Dr. Erika Janitz has a unique background at the intersection of electrical engineering and physics and joins Schulich's Department of Electrical and Software Engineering as Canada Research Chair (Tier II) in Quantum Hardware Engineering. Dr. Janitz completed her bachelor's and master's degrees in electrical engineering at the University of Waterloo and Waterloo's Institute for Quantum Computing and completed her PhD in Physics at McGill University. Dr. Prasad is a quantum chemistry researcher who joined IQST from the University of Toronto, where he was a postdoctoral fellow. Dr. Prasad completed a PhD at the University of British Columbia. Urbasi Sinha is a Canada Excellence Research Chair (CERC) in Quantum Interfaces and joins IQST from the Raman Research Institute where she leads a quantum photonics and communications group. Dr. Sinha received a PhD in Physics from the University of Cambridge and was a postdoctoral scholar at the University of Waterloo, and is the second CERC recruited by the University of Calgary. Dr. Aninda Sinha is an inaugural member of QHA and joined IQST from the Indian Institute of Science. Dr. Sinha received his PhD in Physics from the University of Cambridge. These new members have joined at a time of continued recruitment of new faculty, including several in-progress hires supported by Quantum City, the Faculty of Science, and the Schulich School of Engineering. This growth reflects strong investment from the University of Calgary, private donors, and all levels of government

in quantum science and technology research. In addition to these crucial investments in personnel, major infrastructure upgrades are in progress. These include the planning of new student and faculty offices on the 10th floor of the ES building, the construction of Quantum City's qHub in the ARTC building, and the investment in Quantum City's qLab, a quantum nanofabrication facility that is in its final architectural and engineering planning phases.

During the past two years, IQST members have played a major role in new initiatives to train the next generation of quantum talent. Notably, Dr. Daniel Oblak is leading the NSERC IQuCode CREATE program, a multi-institution effort based out of the University of Calgary. Dr. Shahpoor Moradi is leading the newly launched Professional Master's of Quantum Computing program at the University of Calgary that aims to prepare professionals from a wide range of non-quantum backgrounds for future quantum related technology developments. IQST's research and training efforts are feeding into the QAI Ventures quantum technology accelerator, which opened a Calgary node based at Quantum City's qHub in 2024 that has already supported several IQST based startup companies.

The Institute for Quantum Science and Technology has enjoyed a successful year of research and training during the past two years. Members of the Institute had 110 (2023/2024) and 74 (2024/2025) papers published in refereed journals and proceedings including 19 papers appearing in the top-tier journals of *Nature, Nature Physics, Physical Review Letters, PRX Quantum, Optica, Nano Letters* and etc. The Institute attracted 28 new students into quantum graduate studies programs in 2023/2024 and 20 in 2024/2025. 18 master's students graduated and 9 doctoral students completed their degrees. The Institute hosted 30 postdoctoral researchers with five being recipients of national and provincial postdoctoral fellowships including e2i Fellowship, MITACS Accelerate Entrepreneur, PIMS Postdoctoral Fellowship, Eyes High Postdoctoral Fellowship, and Swiss National Science Foundation's Postdoc Mobility.

On an administrative front, IQST leadership has been engaged with the Faculty of Science and Quantum City to chart a course towards renewing IQST within Calgary's evolving quantum ecosystem, with the goal of further advancing its mission to create a vibrant quantum research environment for IQST members. These discussions are continuing and have offered an opportunity to identify IQST activities that fall outside of the umbrellas of other quantum related initiatives in Calgary.

A core IQST activity is its tradition of hosting high profile quantum researchers to speak at a Public Lecture series. In 2023, Dr. Jun Ye, an award winning atomic physicist and quantum metrology pioneer presented a joint IQST-Quantum City Public Lecture at the qConnect conference located at the Telus Convention Centre in downtown Calgary. In 2024, Nobel Prize winner and groundbreaking laser physicist Dr. Donna Strickland delivered an inspiring talk at Calgary's Central Public Library. Both events were supported by the Faculty of Science, in addition to the VPR through Quantum City (2023) and the Visiting Scholars (2024) program. Support from Quantum City also allowed the IQST Colloquium series to restart its efforts to bring expert researchers to campus to share their latest advances and meet with IQST members.

Looking forward, IQST is well positioned to benefit from the many new quantum initiatives in Calgary, and to build upon the tremendous achievements of its members that are described throughout this report.

Dr. Paul Barclay
Director

Message from the Chair

Calgary is fast becoming a global hub in quantum technology commercialization and adoption. UCalgaryis proud to be at the forefront of quantum technology research, Getting Science Done in a way that radically changes our understanding of nature's basic elements, deepens our knowledge of the universe, and drives technology innovation.

Since our last report, UCalgary has established a quantum technology accelerator and forged partnerships with international and national organizations and hubs through UCalgary's Quantum City initiative. Their global accelerator has provided entrepreneurs and innovators with premium access to top technology, expert guidance, and tailored mentorship as they take their project from the lab to market and develop quantum startups.

UCalgary has continued to build relationships with other institutions, fostering a community of researchers and future technology leaders. As a leading institution in the iQuCode CREATE program, UCalgary works alongside the University of Alberta, McGill, Université de Sherbrooke, and Polytechnique Montréal to develop industry-ready quantum talent. Annual hackathons and workshops give students the opportunity to connect, collaborate, and use quantum computing to solve real-world challenges —just as they would in the business world.

Other examples of the many ways that IQST members are strengthening UCalgary's impact include:

- Expanding the quantum workforce needed by the growing quantum computing sector through our Professional Graduate Program, which continues to collaborate with the quantum and deep tech ecosystem so that graduates gain the knowledge and skills needed to succeed in this nascentindustry.
- Reaching out to the general public through events like the public lecture from Dr. Donna Strickland of the University of Waterloo (Nobel laureate, physics, 2018). Dr. Strickland's lecture dove into how lasers are transforming our world, from eye surgery to the glass on our cell phones.
- Expanding research capacity through the hiring of world-renowned scientist, Dr. Urbasi Sinha, as a Canada Excellence Research Chair in Photonic Quantum Science, and Technologies.

I can't wait to see what comes next for quantum at UCalgary and across Alberta.

Dr. Kristin Baetz
Chair, Board of Directors
Dean, Faculty of Science

Research Highlights

Research Achievements

The Institute for Quantum Science and Technology (IQST) has made significant research achievements over the past year. The following exposition of achievements provides a sample of the kinds of activities and breakthroughs seen within IQST.

Drs. Tim Friesen and Rob Thompson published a milestone study of the effect of gravity on the motion of anti-hydrogen in Nature **621**,716 (2023). They also contributed to a study of the fine structure of anit-hydrogen published in Nature Physics **21** 201 (2025). These are two of several major results from the CERN based alpha-G collaboration that in recent years have elucidated the fundamental properties of anti-matter using techniques from atomic and optical physics.

Dr. Erika Janitz demonstrated advances in quantum sensing using electron and nuclear spins through both nanofabrication (Nano Letters **23**, 10110 (2023)) and new spectroscopy techniques (Physical Review Letters **132**, 133002 (2024). These results are steps towards using quantum systems to study the properties of single molecules. Dr. Janitz also reported on realisation of Purcell enhanced emission from germanium defects in diamond (PRX Quantum **5**, 030308 (2024)).

Dr. Barry Sanders and collaborators made several notable advances in quantum optics research. His team led a theoretical study of a new approach for implementing device independent quantum key distribution was published Physical Review Letters **131**, 080801 (2023). In a collaboration with experimentalists from the Pan group, in Physical Review Letters **131**,133601 (2023) studied the topological properties of photonic quantum states engineered to possess Berry curvature. In a collaboration with the Morello group Dr. Sanders generated and studied Schrödinger cat states of silicon spin qudits (Nature Physics **21**, 201 (2025)).

Dr. Shabir Barzanjeh's theoretical research into the nonreciprocal properties of quantum batteries was published in Physical Review Letters **132**, 210402 (2024). Dr. Barzenjeh also reported experimental studies of bistability of superconducting qubits in PRX Quantum **5**, 010327 (2024) and the creation of quantum optical light sources from topological photonic circuits (PRX Quantum **5**, 040331 (2024)).

Dr. Urbasi Sinha reported on the theoretical proposal and experimental demonstration of a secure scheme for semi-device-independent quantum random number generation within a loophole-free photonic architecture (Physical Review Letters **133**, 020802 (2024)).

Dr. Carlo Maria Scandolo showed that measurement outcomes in classical theory are not predetermined by the state of an underlying reality by theoretically studying the measurement of classical systems that are entangled with quantum systems (Physical Review Letters **132**, 190201 (2024)).

Dr. Christoph Simon and collaborators reviewed the state-of-the-art of quantum memories for entanglement distribution in Optica **10**, 1511, (2023), and engaged with a startup company based in Japan (Nanofiber Quantum Technologies) that is developing communication and computing technologies based on quantum memories. He also collaborated with researchers at SFU to propose and analyse approaches for sorting quantum information and transducing quantum information between different mediums using defects in silicon (PRX Quantum **4**, 020308 (2023)). His lab's work on quantum neuroscience was featured in New Scientist.

Funding Successes

Institute of Quantum Science and Technology members have been recipients of funding from a variety of funding sources. Highlights include: Dr. Simon Trudel and Dr. Pierre Kennepohl were awarded funding from the CFI Innovation Fund to build in-situ X-ray materials analysis infrastructure; Dr. Daniel Oblak led, together with Dr. Barry Sanders and collaborators across Canada the NSERC CREATE: Innovators for Quantum Computing Deployment (IQuCodem $1.65M for 6 years); Dr. Paul Barclay and Dr. Erika Janitz were awarded an NSERC Alliance Quantum grant ($1.5M for 5 years, with additional support from DRDC and Aria Labs) and from Alberta Innovates to develop diamond quantum sensors; Drs. Barclay, Barzanjeh, Oblak, Sanders and Simon were awarded funding as co-applicants on five different multi-institution NSERC Alliance Quantum Consortia awards; Dr. Claudia Gomes da Rocha was awarded a Transdisciplinary Connector Grant to support research with colleagues across the University of Calgary.

Awards

International Awards

SWISS NATIONAL SCIENCE FOUNDATION (SNSF) POSTDOC_MOBILITY

Sigurd Flågan

National Awards

MITACS-ACCELERATE GRADUATE RESEARCH INTERNSHIP PROGRAM

Fariba Hosseinynejad Khaledy

Seyed Shakib Vedaie

MITACS ACCELERATE ENTREPRENEUR

Sourabh Kumar

MITACS GLOBALINK INTERNSHIP

Chinmay Giridhar

Simran Kumari

Om Mihani

Dhruvit Parmar

Patricia Sesma

Heli Shah

MITACS GLOBALINK RESEARCH AWARD

Filobateer Ghaly

Pouya Heidari

Lieli Isameilifar

Farhad Rasekh

Jay Suh

Abbygale Swadling

Alberto Uribe Jimenez

Sean Wilson

NSERC CANADA GRADUATE SCHOLARSHIPS – MASTER'S PROGRAM

Marcus Kasdorf

Abby Swadling

NSERC POSTGRADUATE SCHOLARSHIPS – DOCTORAL PROGRAM

Linh Ly

NSERC USRA

Ibu Adeleke

Trace Harms

Sean Wilson

Albert Zhang

PIMS POSTDOCTORAL FELLOWSHIP

Thomas Theurer

Provincial Awards

ALBERTA GRADUATE EXCELLENCE SCHOLARSHIP (AGES)

Marcus Kasdorf

Pradeep Kumar

Brendan MacKay

Eduardo Miguel Martinez Garcia

Anuj Sethia

Amirhossein Sotoodehfar

Elia Zanoni

ALBERTA INNOVATES GRADUATE STUDENTS SCHOLARSHIP

Ahmas El-Hamamsy

Al-Waleed El-Sayed

Mayte Li-Gomez

Pragati Gupta

Linh Ly

Brooke Richtik

Abbygale Swadling

Armin Tabesh

Mathew Yastremski

CARL H. WESTCOTT FELLOWSHIP

Pooja Woosaree

University of Calgary Awards

e2i FELLOWSHIP

Mayte Li Gomez

Sourabh Kumar

EYES HIGH POSTDOCTORAL FELLOWSHIP

Majid Taghavi

Thomas Theurer

Alberto Uribe Jimenez

EYES HIGH INTERNATIONAL DOCTORAL SCHOLARSHIP

Adam Powell

Elia Zanoni

FACULTY OF GRADUATE STUDIES' DOCTORAL SCHOLARSHIP

Leili Esmaeilifar

Armin Tabesh

Pooja Woosaree

GLOBAL OPEN DOCTORAL SCHOLARSHIP

Farhad Rasekh

HELENA ROJEK GRADUATE SCHOLARSHIP

Farhad Rasekh

INDIGENOUS AND BLACK MOMENTUM SCHOLARSHIP IN SCIENCE

Filobateer Ghaly

INTERNTIONAL GRADUATE TUITION AWARD

Doyeong Kim

Durgesh Kumar

Takla Nateeboon

Samuel Boudreaux Steakley

Elia Zanoni

KILLAM DOCTORAL SCHOLARSHIP

Brooke Richtik

PURE AWARD

Abdelrahman Bekhit

Zachary Kokot

Gabe Komo

Aaron Lengyel

Nathan Ngo

Joel Ozeroff

Stefan Sura

T. CHEN FONG DOCTORAL SCHOLARSHIP

Mayte Li-Gomez

PRESIDENT'S DOCTORAL RECRUITMENT SCHOLARSHIP IN TRANSDISCIPLINARY RESEARCH

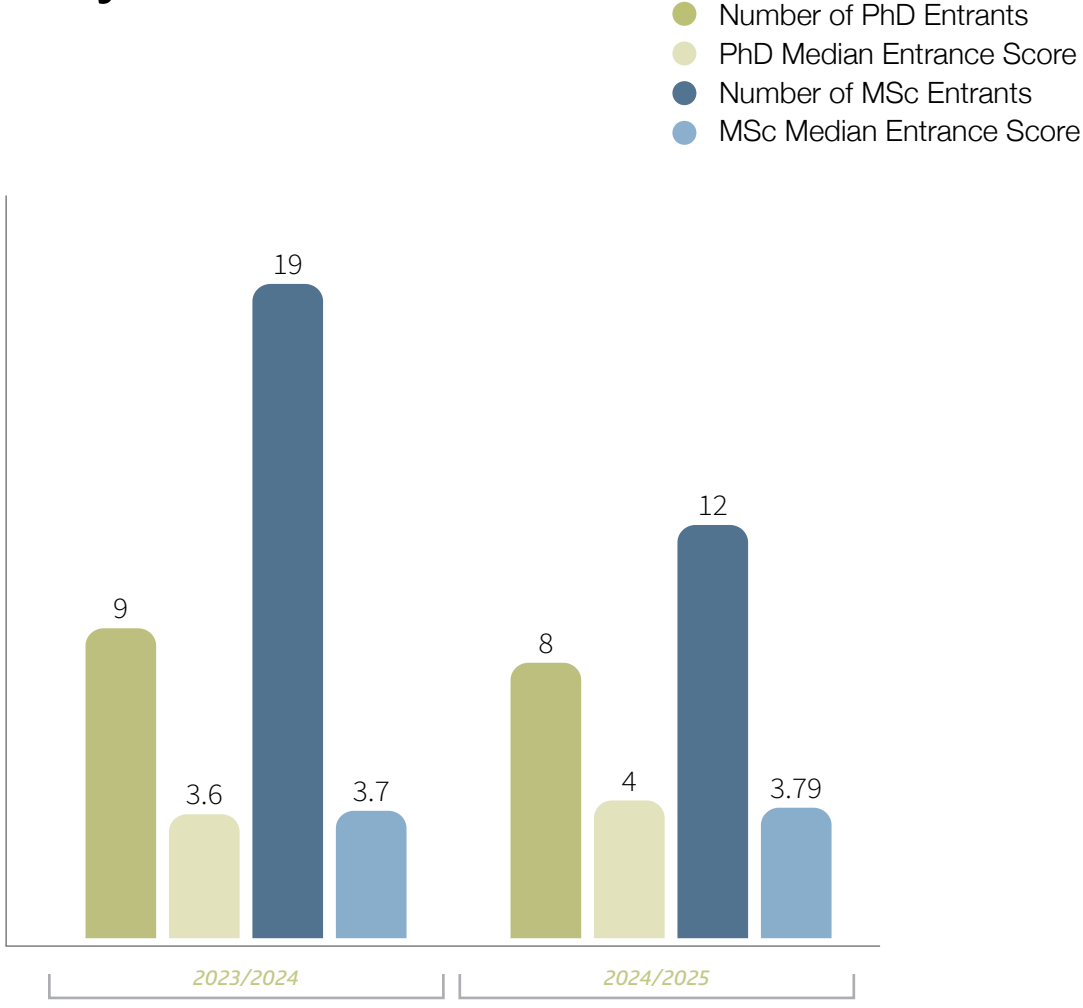
Mahkame Salimi Moghadam

UCALGARY RESEARCH EXCELLENCE CHAIRS (UCREC)

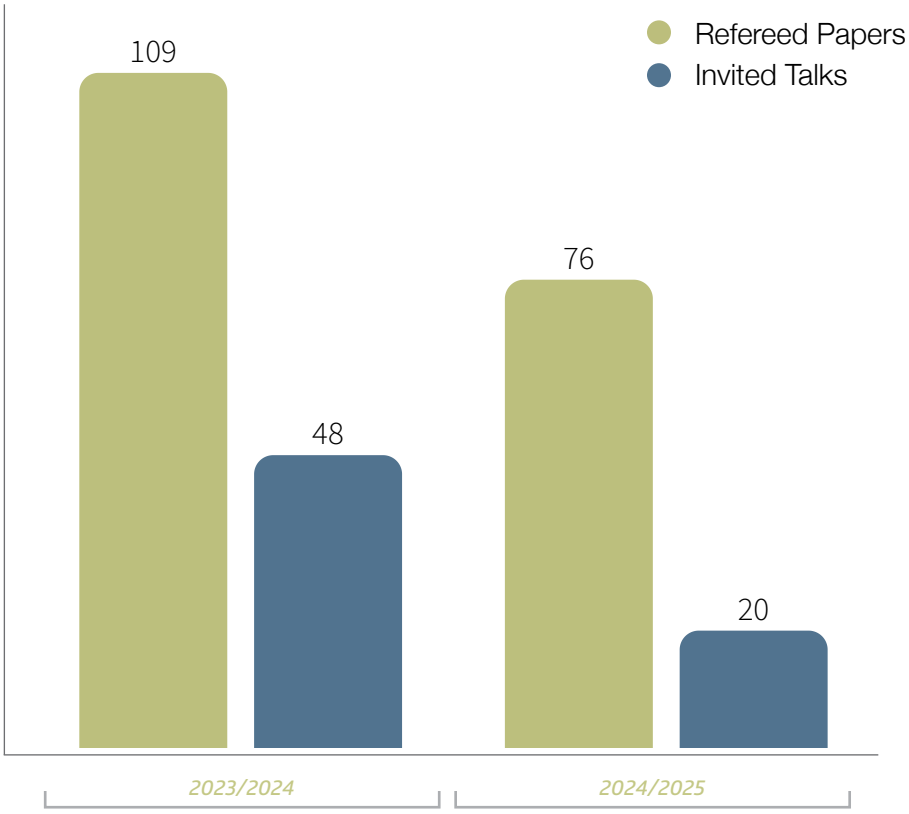
Paul Barclay

Key Performance Indicators

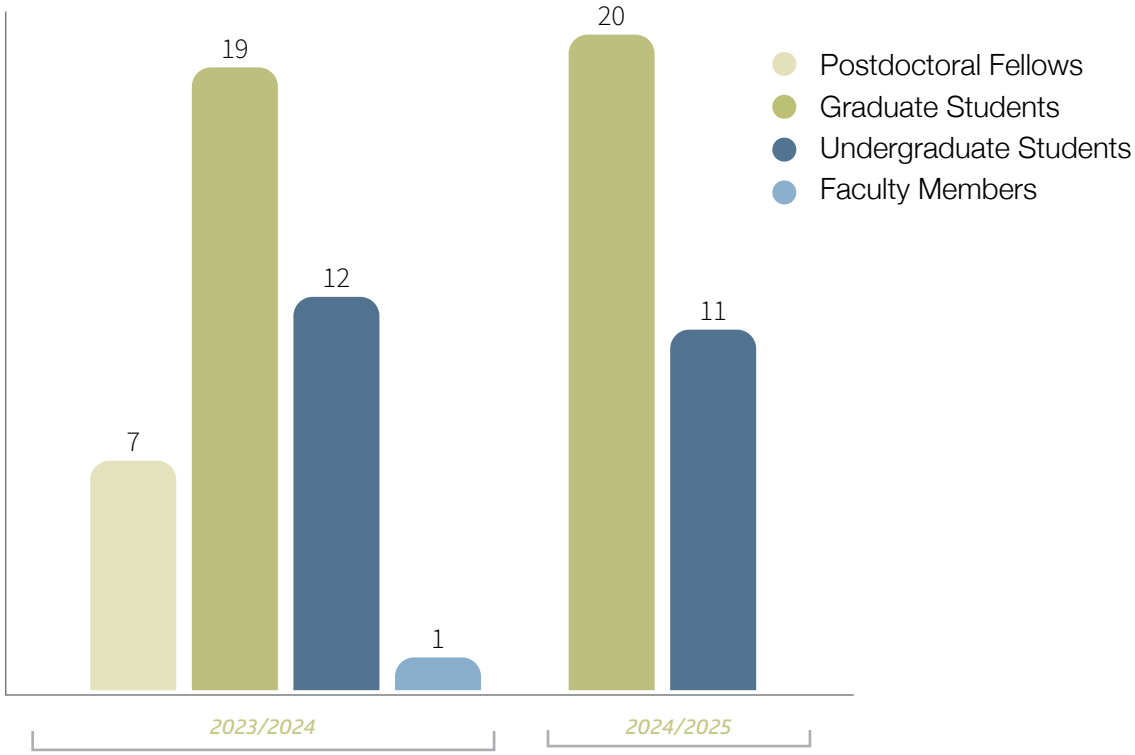
Graduate Students Enrolment and Quality of Entrants



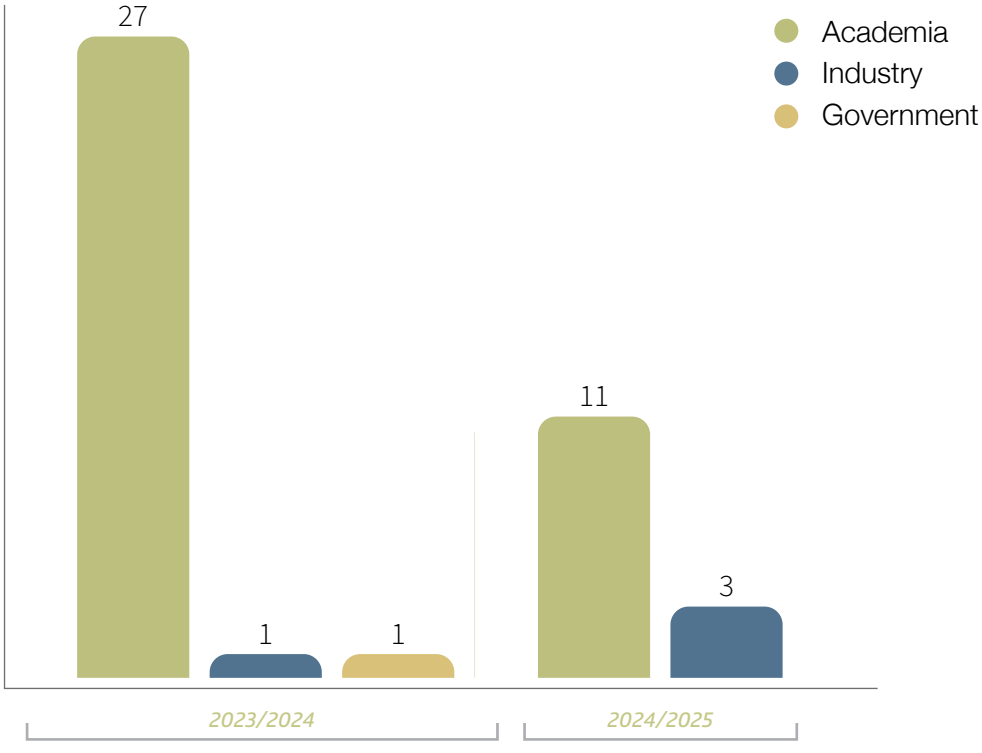
Publications and Presentations



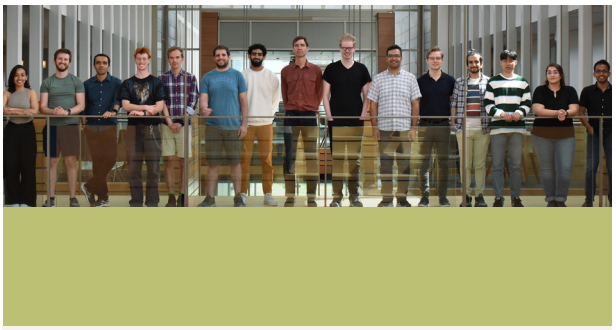
Awards
(Chairs, Fellowships and Scholarships)



Visitors



Research Groups



Paul Barclay

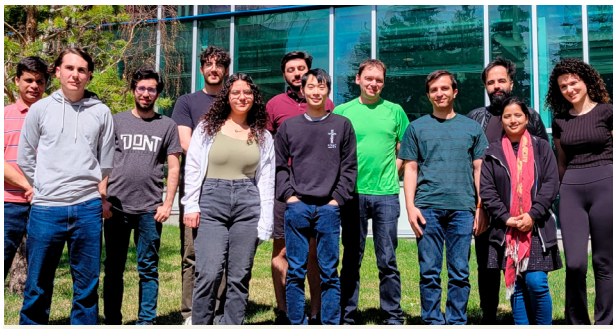
Nanoscale Optics

Explore interactions between light and nanoscale systems such as single atoms, electron spins and nanomechanical structures. Employ nanofabrication methods to engineer optical properties of these systems in order to enhance light-matter coupling. The current focus couples single quantum emitters, or “artificial atoms”, to optical nanocavities. The labs are at the University of Calgary and at the NRC Nanotechnology Research Centre in Edmonton, which has advanced nanofabrication tools plus leading quantum optics and nanotechnology researchers.

Shabir Barzanjeh

Integrated Hybrid Quantum Circuits

Focus on the reversible quantum interface between the superconducting circuits and quantum optical systems. Develop quantum communication technology that is integrable with superconducting processors for building large-scale quantum networks.



Leonid Belostotski

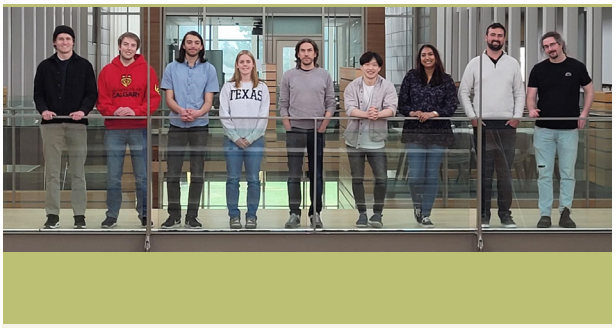
Radio-frequency and Mixed-signal Circuits

Develop integrated circuits and systems for application in wireless systems, radio astronomy, and quantum computing, aiming to realize ultra-low-noise receiver systems in commercial bipolar complementary metal-oxide-semiconductor technologies.

David Feder

Practical Quantum Computation

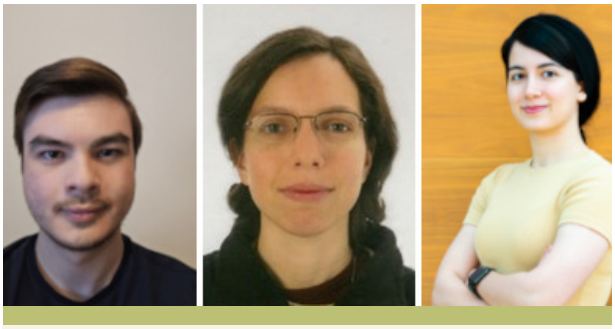
Explore intrinsic properties of physical systems, such as ultracold atomic gases or spin lattices, which can be employed to construct larger devices able to perform quantum computation. Also explore alternative models for the implementation of quantum logic, such as one-way quantum computation, quantum walks, and topological quantum computation.



Timothy Friesen

Testing Fundamental Symmetries with Antimatter

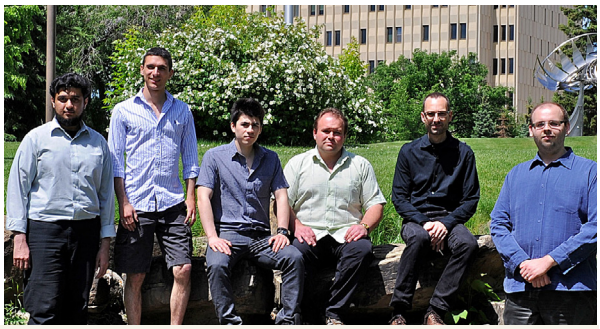
Experimental testing of symmetries between matter and antimatter primarily through study of (anti)hydrogen in collaboration with the ALPHA (Antihydrogen Laser Physics Apparatus) experiment at CERN. Focus on the development of particle traps, microwave techniques, and annihilation detection for highprecision spectroscopy and gravitational mass measurements on antihydrogen.



Claudia Gomes da Rocha

Complex Nano Materials

Computational description and modelling of nanoscale materials for applications to neuromorphic computing, transparent conductors, and sensing. Explore phenomena that emerge when matter is “packed” at the nanoscale at which quantum effects are present.



Peter Høyer

Erika Janitz

Quantum Computing

Explore the potential of quantum systems to develop quantum algorithms, quantum communication protocols, quantum cryptographic protocols, and quantum computer simulations of quantum mechanical systems. Characterize the powers and their limitations by studying quantum complexity theory, non-locality, entanglement, and quantum information theory.

Quantum Technology and Engineering Lab

Fabricating, characterizing, building, and deploying next-generation quantum devices based on optically active defects in solid-state systems for quantum sensing and communication.

Pierre Kennepohl

Molecular and Materials Electronic Structure

Explore the relationship between electronic structure of molecules and materials and their broader chemical properties and study the use of such interactions in molecular electronics and other applications. X-ray spectroscopies are the major tools for our exploration of electronic structure.

Peter Kusalik

Molecular Simulations of Liquids & Solutions, Interfaces and Crystallization

Perform molecular simulations to examine collections of molecules representing solid or liquid systems. Probe the molecular behaviour to understand properties of liquids and solids and their transformations including nucleation and crystallization. Explore behaviour of aqueous nanobubbles and the origins of their stability and mobility. Applications range from atmospheric and materials sciences to molecular biology and water treatment.

Nasser Moazzen-Ahmadi

Spectroscopy of Hydrocarbons and Molecular Clusters and Complexes

Measure forces responsible for formation of atomic and molecular clusters. Investigate the intermolecular potential in the region of the potential minimum. Explore non-additive effects on the interaction energy and to determine possible condensation pathways.

Daniel Oblak

Quantum Cloud Lab

Develop experimental capabilities that will lead to practical implementations of quantum links forming the basis of quantum networks that connect distant quantum devices. Conduct research into quantum-key distribution over fibre and freespace channels, non-classical light sources, and quantum memory based on solid-state materials such as rare-earth ion doped crystals.

Viki Kumar Prasad

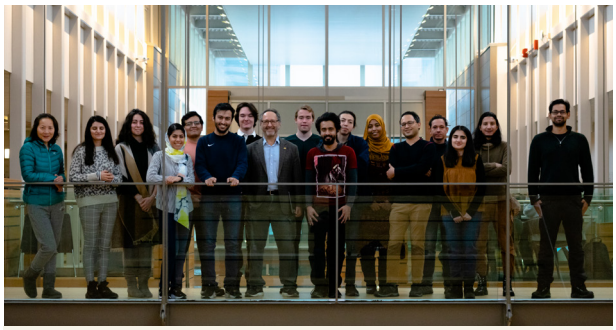
Quantum Chemistry, Quantum Computing, and Machine Learning for Molecules and Materials

Method development in computational chemistry to efficiently model/simulate diverse molecular systems and accurately predict their chemical properties. Design techniques that enhance conventional quantum chemistry methods, leading to physics-aware methodologies. Create quantum machine learning models and develop algorithms for quantum resource utility. Train classical machine learning models with improved generalization and accuracy.

Dennis Salahub

Multiscale Modelling of (Bio) Chemical Reactions in Complex Environments

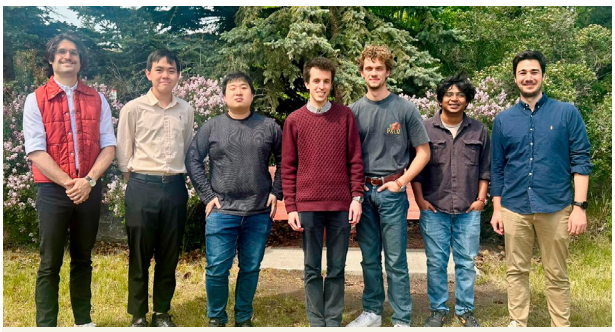
Investigate mechanisms and rates of chemical reactions occurring in complex environments. Model enzymatic catalysis, electron transfer between proteins and/or heavy oil upgrading. Employ multiple techniques, from quantum chemistry, to molecular dynamics, to stochastic network analysis, to stochastic networking analysis, are brought to bear on the problem in the context of high performance computing.



Barry Sanders

Quantum Information Science

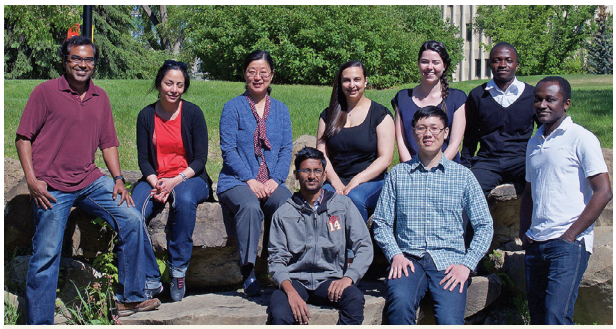
Develop quantum information technologies that have transformative applications and will be feasible divided into five strands: (i) long-distance secure communication, (ii) simulations of complex systems, (iii) implementations of quantum information tasks, (iv) empirical characterization of quantum states and processes, and (v) determining and quantifying all resources for quantum information processing.



Carlo Maria Scandolo

Quantum Information and Foundations

Use mathematical tools, such as matrix and convex analysis, to quantify quantum resources and optimize their use in information-theoretic protocols. Apply informational methods to foundational problems in quantum theory, especially using the framework of general probabilistic theories, which combine convex analysis with categorical methods.



Yujun Shi

Chemical Vapour Deposition Chemistry

Focus on chemical and physical processes underpinning the formation of silicon-containing semiconductor thin film materials using

hot-wire chemical vapour deposition. Apply technically demanding laser ionization mass spectrometric and laser spectroscopic techniques to investigate this process at the molecular level. Explore gas-phase reaction chemistry in the formation of silicon carbide and silicon nitride and perform laser spectroscopy of silicon carbide, clusters generated using pulsed discharge and laser ablation methods. Applications include superior-quality films for industrial applications.

Samira Siahrostami

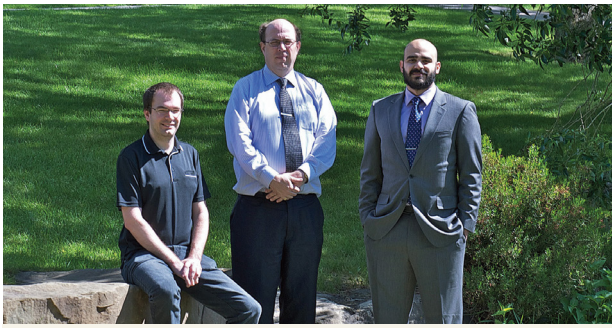
Computational Catalysis for Clean Energy Transformation

Undertake computational catalyst material design for applications to clean-energy technologies such as fuel cells, electrolysers and batteries. Design catalysts from first principles by modelling reactions in silico for a range of electrochemical reaction.

Christoph Simon

Theoretical Quantum Optics

Apply unique quantum phenomena such as superposition and entanglement (e.g. a future “quantum internet”), to probe whether these phenomena are universal, and to investigate whether they could play a role in biology (e.g. in neuroscience).



Robert Thompson

Trapped Ion Physics with Atoms, Molecules, and Exotic Species

Develop and measure low-density trapped atoms, molecules and exotic species, especially anti-matter hydrogen. Collaboration with the Antihydrogen Laser Physics Apparatus (ALPHA) project at CERN involving 40 scientists across 16 institutions. Collaborate with TRIUMF’s Ion Trap for Atomic and Nuclear (TITAN) Science, particularly on sympathetic and evaporative cooling.

Milana Trifkovic

Advanced Material Design

Design and characterize novel materials with applications in the energy sector including polymer nanocomposites, nanoparticle stabilized emulsions, bicontinuous interfacially jammed emulsion gels and newly developed bicontinuous intraphase emulsion gels.

Simon Trudel

Nanoscale Material

Investigate synthesis, characterization, and structure-property relationships in inorganic solid-state nanomaterial, such as metal-oxide thin films and multimetallic nanoparticles. Develop high-performance materials in technologically and commercially relevant focus areas such as clean-energy conversion and spin-based electronics. Characterize materials using state-of-the-art methods, such as electrochemical testing, electron microscopy, X-ray diffraction, and magnetometry based on superconducting quantum interference devices.

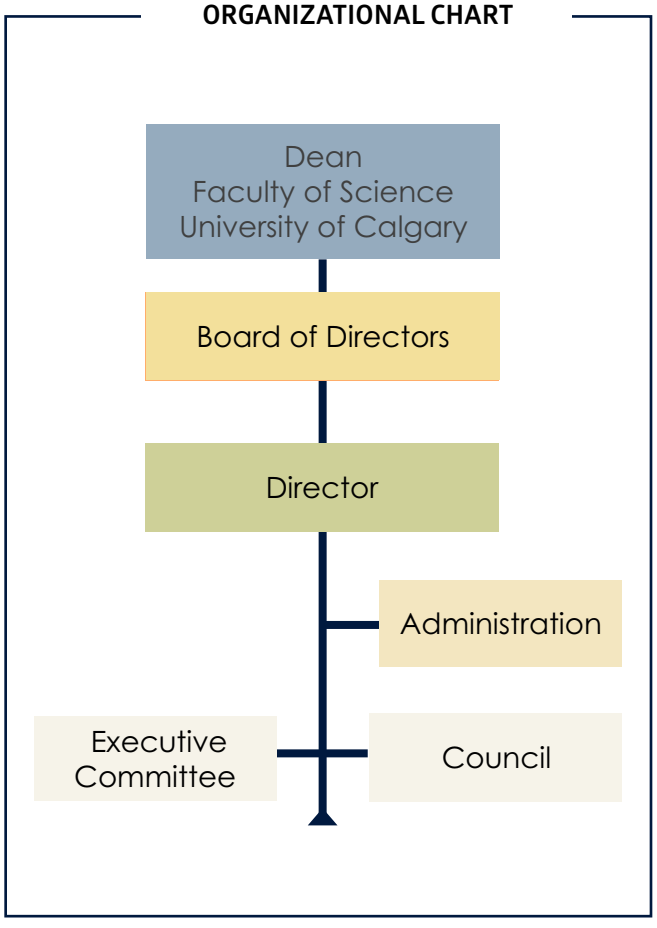
Management and Membership

Institute Structure

The Institute is managed on a day-to-day level by the Institute Director and the Institute Administrator. The Director reports to the Board of Directors and is ex officio a member of this Board. The Board reports to the Dean of Faculty of Science who chairs the Board.

The Director and the Administrator of the Institute work on day-to-day matters of the Institute. The Institute Executive comprises the Director, Administrator and faculty members other than the Director. The Executive meets monthly to discuss and make decisions on executive matters. The Executive receives advice and guidance from the IQST Council, which comprises all full and affiliate faculty members of the Institute and meets three times annually.

All of the Institute's research, teaching, service and outreach activities are conducted by faculty members and their research groups.



Governance

Board of Directors

Kristin Baetz

Dean, Faculty of Science, University of Calgary

Marie D'Iorio

President, Deep Tech Canada

Chip Elliott

Sir Peter Knight

Senior Fellow in Residence, The Kavli Royal Society International Centre

Paul Barclay
(from September 1, 2023)

Professor, Department of Physics and Astronomy, University of Calgary

Barry C. Sanders
(until September 1, 2023)

Professor, Department of Physics and Astronomy, University of Calgary

Carl Williams

President and Chief Executive Officier, CJW Quantum Consulting

Executive Committee

Paul E. Barclay
(from September 1, 2023)

Professor, Department of Physics and Astronomy, University of Calgary

Peter Kusalik

Professor, Department of Chemistry, University of Calgary

Daniel Oblak

Associate Professor, Department of Physics and Astronomy, University of Calgary

Barry C. Sanders
(until September 1, 2023)

Professor, Department of Physics and Astronomy, University of Calgary

Milana Trifkovic
Associate Professor, Department of Chemical and Petroleum Engineering, University of Calgary

Council

FACULTY MEMBERS

Paul Barclay

Professor, Department of Physics and Astronomy, University of Calgary

Shabir Barzanjeh

Associate Professor, Department of Physics and Astronomy, University of Calgary

Leonid Belostotski

Professor, Department of Electrical and Software Engineering, University of Calgary

David Feder

Associate Professor, Department of Physics and Astronomy, University of Calgary

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Claudia Gomes da Rocha

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Gilad Gour
(until February 2024)

Professor, Department of Mathematics and Statistics, University of Calgary

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Peter Kusalik

Professor, Department of Chemistry, University of Calgary

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Shahpoor Moradi

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Daniel Oblak

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Viki Kumar Prasad
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Associate Professor, Department of Chemistry, University of Calgary

Christoph Simon

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AFFILIATE MEMBERS

Robin Cockett

Professor, Department of Computer Science, University of Calgary

Hubert de Guise

Professor, Department of Physics, Lakehead University

Khabat Heshami

Research Officier, National Research Council Canada

David Hobill

Professor Emeritus, Department of Physics and Astronomy, University of Calgary

Reginald Paul

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Rei Safavi-Naini

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Peter Tieleman

Professor, Department of Biological Sciences, University of Calgary

Daniel Trad

Associate Professor, Department of Geoscience, University of Calgary

Richard Zach

Professor, Department of Philosophy, University of Calgary

POSTDOCTORAL FELLOWS

Shirin Afzal

Aaron Barclay (completed September 2024)

Lizandra Barrios Herrera (part-time)

Natália do Carmo Carvalho

Hanen Chenini (completed October 2024 → Firmware Engineer, Quantized Technologies Inc.)

Sigurd Flågan

Lana Frankle

Yunhong Gong

Arash Hejazi (completed December 2024)

Jiri Hostas (completed December 2023 → Research Officer, National Research Council Canada)

Jiawei Ji

Faezeh Kimiaee Asadi (completed December 2024 → Associate Editor, American Physical Society)

Youssef Kora

Sourabh Kumar

Kobra Mahdavipour

Mosayeb Naseri (completed August 2024 → Researcher, National Research Council Canada)

Habib Rastegar

Vinaya Kumar Kavatamane Rathnakara

Gabriela Sanchez-Diaz

Saubhik Sarkar (completed June 2023 → postdoc, University of Electronic Science & Tech of China)

Rishabh Shukla

Ashutosh Singh

Sunaina Sunaina (completed August 2024)

Majid Taghavi Dehaghani (completed February 2025)

Tatek Temesgen Terfasa (completed December 2024 → Postdoc, Clemon University)

Thomas Theurer (completed June 2024 → Postdoc, University of Copenhagen)

Alberto Uribe Jimenez

Deeksha Verma

Pooja Woosaree

Hadi Zadeh Haghighi (completed March 2025 → Research Associate, University of Waterloo)

RESEARCH ASSOCIATES/ASSISTANT

Amir Ahadi (completed September 2024 → System Operations Engineer, AltaLink)

Parisa Behjat Khatouni

Taras Hrushevskyi (completed May 2024)

Nick Kuzmin

Vahid Salari (completed June 2024)

Alireza Tabesh

GRADUATE STUDENTS (PHD PROGRAM)

David Amaro Alcalá

Kavini Kalpadi A. K. Don Amarasinghe

Aradhana Anil

Shudipto Kazi Amin

Bishnupada Behera

Oliver Calderon

Ziheng Chang

Christopher Coutts

Bechara Daou

Katelynn Daly (graduated June 2023 → Scientist, Summit Nanotech)

Danial Davoudi

Sagnik Dutta

Balarama Sridhar Dwadasi

Al-Waleed El-Sayed

Leili Esmaeilifar

Koorosh Esteki (graduated July 2023 → Postdoc, Fordham University)

Aria Jafari

Ujjwal Gautam

Filobateer Ghaly

Sankha Ghosh

Nasser Gohari Kamel

Pragati Gupta

Pouya Heidari

Jiawei Ji (completed April 2023 → postdoc, University of Calgary)

Zahra Kabirkhoo

Amesh Kahloon

Murat Karakoç

Mahsa Karimi

Pirouz Kiani

Fariba Hosseinynejad Khaledy

Thisara Kulatunga

Prasoon Kumar Shandilya

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Laura Maddison

Ismail Majed

Mohsen Mehrani Ardebili

Abdul Mohamed

Eduardo Paez

Adam Powell (graduated September 2024 → Postdoc, CERN)

Mohammad Radpour (graduated September 2023 → Lead Design Engineer, Cadence Design Systems)

Farhad Rasekh

Mina Razavi

Mahdi Rizvandi

Rishabh

Atena Salek

Vishnu Seshan

Anuj Sethia

Seyed Shakib Vedaie (graduated June 2024 → Senior Machine-Learning Engineer, ReplayzIQ)

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Rishabh Shukla (graduated January 2024 → Postdoc, University of Calgary)

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Jay Suh

Brooke Richtik

Abbygale Swadling

Armin Tabesh

Shahrzad Taherizadegan

Lei Wang (graduated October 2023)

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Jiahui (Alex) Xu

Mathew Yastremski

Elia Zanoni

Elham Zohari

Joseph Zsombor-Pindera

GRADUATE STUDENTS (MSC PROGRAM)

Parinaz Abbasi

Snehasis Addy (graduated January 2024 → PhD, University of Massachusetts, Amherst)

Ishra Afroze

Amir Ahadi (graduated September 2024 → System Operations Engineer, AltaLink)

Sabah Ud Din Ahmad

Ismail Akkouche

Jeas Grejoy Andrews

Aradhana Anil (transferred → PhD, University of Calgary)

Sareh Askari

Ashkan Bayat (graduated December 2023 → PhD, University of Alberta)

Parisa Behjat Khatouni (graduated May 2023 → Lab Technician, University of Calgary)

Grace Bohn

Mahdi Bornadel

Asma Farhat

Preeti Gangwani

Travis Gartner

Sye Ghebretnsae

Mahtab Gholami

Ghazaleh Gholizadeh

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Thomas Hujon

Fariba Hosseinynejad Khaledy (transferred April 2024 → PhD, University of Calgary)

Joe Itoi

Chalisa James

Sogol Kalaei

Ali Karimi

Marcus Kasdorf

Doyeong Kim

Durgesh Kumar

Pradeep Kumar

Vikrant Kumar

Chelsea Ladouceur

Janet Leahy (graduated July 2023)

Zhuohao Liu (graduated December 2024)

Brendan MacKay

Zachary Manson

Arsalan Mansourzadeh

Eduardo Martinez Garcia

Kayla McArthur

Sean McNaney

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Ali Moradi

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Peyman Parsa (graduated September 2023 → Researcher, Ki3 Photonics)

Nihari S. P. Pathirannehelage (graduated April 2023 → Researcher, Carbonova Corp)

Ahmad Ramezanpour

Mahdi Rizvandi

Marwa Safa

Mahkame Salini Moghadam

Sohrab Samadi

Anuj Sethia (transferred August 2023 → PhD, University of Calgary)

Mehreen Shabbir (terminated July 2024)

Amit Shalev

Peter Shmerko

Diego Simpson-Ochoa

Aisan Sisani

Amirhossein Sotoodehfar (graduated February 2025 → PhD, Swiss Federal Technology Institute of Lausanne)

Samuel Steakley

Jay Suh (graduated December 2024 → PhD, University of Calgary)

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Armin Tabesh (transferred August 2023 → PhD, University of Calgary)

Owaiss Talbi

Jośe Lesteiro Tejeda

Sean Wilson

Greg Wong

Mathew Yastremski (graduated January 2024 → PhD, University of Calgary)

Tyler Zegray

Yujie Zhang

UNDERGRADUATE STUDENTS

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Nada Haj Ali (CHEM 402)

Fatima Ejaz Aslam

Abdelrahman Bekhit (PURE Award)

Grace Bohn (CHEM 402 and summer research)

Veronica Chmielarski (undergraduate research)

Ethan Davis (PHYS 598)

Marcus Demierre (PHYS 598)

Kelvin Doan (CHEM 502 and summer research)

Harrum Fida (CHEM 502)

Nicolas Fusco-Mushinski (PHYS 598)

Eduarda Gibbert (PHYS 599)
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Gabe Komo (PURE Award & PHYS 598)
Simran Kumari (MITACS Globalink)
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Ibrahim Sultan (MATH 518)
Stefan Sura (PURE Award)
Eve Taplin (MATH 518)
Owaiss Talbi (PHYS 598)
Elijah Thompson (PHYS 598)
Sean Wilson (NSERC USRA & PHYS 598)
Albert Zhang (NSERC USRA)

ADMINISTRATION

Jing (Nancy) Lu (Administrator)
Pradeep Kumar (Part-time Webmaster)

Publications

2023/2024

Refereed Journal Publications (published)

S. Abuhatab, S. Pal, E. P. L. Roberts and M. Trifkovic, "Electrochemical regeneration of highly stable and sustainable cellulose/graphene adsorbent saturated with dissolved organic dye", *Langmuir* **40**: 3606–3616, February 2024.

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E. K. Anderson, C. J. Baker, W. Bertsche, N. M. Bhatt, G. Bonomi, A. Capra, I. Carli, C. L. Cesar, M. Charlton, A. Christensen, R. Collister, A. Cridland Mathad, D. Duque Quiceno, S. Eriksson, A. Evans, N. Evetts, S. Fabbri, J. Fajans, A. Ferwerda, T. Friesen, M. C. Fujiwara, D. R. Gill, L. M. Golino, M. B. Gomes Gonçalves, P. Grandemange, P. Granum, J. S. Hangst, M. E. Hayden, D. Hodgkinson, E. D. Hunter, C. A. Issac, A. J. U. Jimenez, M. A. Johnson, J. M. Jones, S. A. Jones, S. Jonsell, A. Khramov, N. Madsen, L. Martin, N. Massacret, D. Maxwell, J. T. K. McKenna, S. Menary, T. Momose, M. Mostamand, P. S. Mullan, J. Nauta, K. Olchanski, A. N. Oliveira, J. Peszka, A. Powell, C. Ø. Rasmussen, F. Robicheaux, R. L. Sacramento, M. Sameed, E. Sarid, J. Schoonwater, D. M. Silveira, J. Singh, G. Smith, C. So, S. Stracka, G. Stutter, T. D. Tharp, K. A. Thompson, R. I. Thompson, E. Thorpe-Woods, C. Torkzaban, M. Urioni, P. Woosaree and J. S. Wurtele, "Observation of the effect of gravity on the motion of antimatter", *Nature* **621**: 716–722, September 2023.

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C. J. Baker, W. A. Bertsche, A. Capra, C. L. Cesar, M. Charlton, A. Christensen, R. Collister, A. Cridland Mathad, S. Eriksson, A. Evans, N. Evetts, S. Fabris, J. Fajans, T. Friesen, M. C. Fujiwara, D. R. Gill, P. Grandemange, P. Granum, J. S. Hangst, M. E. Hayden, D. Hodgkinson, C. A. Issac, M. A. Johnson, J. M. Jones, S. A. Jones, A. Khramov, L. Kurchaninov, N. Madsen, D. Maxwell, J. T. K. McKenna, S. Menary, T. Momose, P. S. Mullan, J. J. Munich, K. Olchanski, J. Peszka, A. Powell, C. Ø. Rasmussen, R. L. Sacramento, M. Sameed, E. Sarid, D. M. Silveira, C. So, D. M. Starko, G. Stutter, T. D. Tharp, R. I. Thompson, C. Torkzaban, D. P. Van Der Werf and J. S. Wurtele, "Design and performance of a novel low energy multispecies beamline for an antihydrogen experiment", *Physical Review Accelerators and Beams* **26**(4): 040101 (16 pp.), April 2023.

C. J. Baker, W. A. Bertsche, A. Capra, C. L. Cesar, M. Charlton, A. Christensen, R. Collister, A. Cridland Mathad, S. Eriksson, A. Evans, N. Evetts, J. Fajans, T. Friesen, M. C. Fujiwara, D. R. Gill, P. Grandemange, P. Granum, J. S. Hangst, M. E. Hayden, D. Hodgkinson, E. D. Hunter, C. A. Issac, M. A. Johnson, J. M. Jones, S. A. Jones, S. Jonsell, A. Khramov, L. Kurchaninov, H. Landsberger, N. Madsen, D. Maxwell, J. T. K. McKenna, S. Menary, T. Momose, P. S. Mullan, J. J. Munich, K. Olchanski, A. Olin, J. Peszka, A. Powell, P. Pusa, C. Ø. Rasmussen, F. Robicheaux, R. L. Sacramento, M. Sameed, E. Sarid, D. M. Silveira, C. So, G. Stutter, T. D. Tharp, R. I. Thompson, C. Torkzaban, D. P. Van Der Werf, E. Ward and J. S. Wurtele, "Measurements of Penning-Malmberg trap patch potentials and associated performance degradation", *Physical Review Research* **6**(1): 012008 (8 pp.), January 2024.

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P. Behjat Khatouni, P. Parsa, N. C. Carvalho, P. K. Shandilya and P. E. Barclay, "Kerr-optomechanical spectroscopy of multimode diamond resonators", *ACS Photonics* **10**(11): 4014–4021, October 2023.

M. Berta, F. G. S. L. Brandão, G. Gour, L. Lami, M. B. Plenio, B. Regula and M. Tomamichel, "The tangled state of quantum hypothesis testing", *Nature Physics* **20**: 172–175, December 2023.

M. Berta, F. G. S. L. Brandão, G. Gour, L. Lami, M. B. Plenio, B. Regula and M. Tomamichel, "On a gap in the proof of the generalised quantum Stein's lemma and its consequences for the reversibility of quantum resources", *Quantum* **7**: 1103 (29 pp.), September 2023.

S. N. Bonvicini, A. Hoang, V. I. Birss, S. K. Purdy, R. Sammynaiken, T. K. Sham and Y.-J. Shi, "Pt-rich core/Au-rich shell nanoparticle formation using pulsed laser-induced dewetting and their electrochemical characteristics", *Journal of Physical Chemistry C* **127**(28): 13945–13957, July 2023.

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M. M. Elsutohy, B. Fuladpanjeh-Hojaghan, E. P. L. Roberts and M. Trifkovic, "Mechanistic insight into electrode processes by operando visualization of interfacial pH using fluorescent nanosensors", *Environmental Science & Technology* **57**(26): 9865–9873, June 2023.

K. Esteki, D. Curic, H. G. Manning, E. Sheerin, M. S. Ferreira, J. J. Boland and C. Gomes da Rocha, "Thermo-electro-optical properties of seamless metallic nanowire networks for transparent conductor applications", *Nanoscale* **15**: 10394–10411, June 2023.

K. R. Fast, J. E. Losby, G. Hajisalem, P. E. Barclay and M. R. Freeman, "Einstein-de Haas torque as a discrete spectroscopic probe allows nanomechanical measurement of a magnetic resonance", *Physical Review B* **109**(6): 064404 (10 pp.), February 2024.

B. Fu, Z. Yu, H. Wang, Q. Wang, S. Gao, Y. Qu, X. Zhang and Y.-J. Shi, "Anisotropies of structure, optical properties, contact, and epitaxy on (101)- and (001)-Oriented β-Ga_2O_3 Crystal Planes", *ACS Applied Optical Materials* **1**(9): 1566–1574, August 2023.

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A. J. Fulton and Y.-J. Shi, "Arrayed and entangled silicon nanowires using Au nanoparticle catalysts prepared by pulsed laser-induced dewetting", *Canadian Journal of Chemistry* **102**(1): 17–26, September 2023.

P. Ganjeh-Anzabi, H. Jahandideh, S. A. Kedzior and M. Trifkovic, "Precise quantification of nanoparticle surface free energy via colloidal probe atomic force microscopy", *Journal of Colloid and Interface Science* **641**: 404–413, July 2023.

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R. Glorieux, B. M. Hays, A. S. Bogomolov, M. Herman, T. Vanfleteren, N. Moazzen-Ahmadi and C. Lauzin, "Understanding the high-resolution spectral signature of the N_2–H_2O van der Waals complex in the 2OH stretch region ", *Journal of Chemical Physics* **158**(22): 224302 (12 pp.), June 2023.

R. Glorieux, A. J. Barclay, C. Lauzin, A. R. W. McKellar and N. Moazzen-Ahmadi, "Spectra of Rg-water dimers in the region of the D_2O v_3 asymmetric stretch (Rg = Ar, Kr, Xe)", *Molecular Physics* **122**(5): 2259012 (12 pp.), September 2023.

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M. M. Hassan, A. A. Bristi, X. He, M. Trifkovic, G. Bobrov and Q. Lu, "Novel nanoarchitecture of 3D ion transfer channel containing nanocomposite solid polymer electrolyte membrane based on holey graphene oxide and chitosan biopolymer", *Chemical Engineering Journal* **466**(14): 143159 (14 pp.), June 2023.

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J. Hostaš, K.O. Pérez-Becerra, P. Calaminici, L. Barrios Herrera, M. P. Lourenço, A. Tchagang, D. R. Salahub and A. M. Köster, "How important is the amount of exact exchange for spin-state energy ordering in DFT? Case study of molybdenum carbide cluster, Mo_4C_2", *Journal of Chemical Physics* **159**(18): 184301 (14 pp.), November 2023.

X. Hu, K. S. Amin, M. Schneider, C. Lim, D. R. Salahub and C. Baldauf, "System-specific parameter optimization for nonpolarizable and polarizable force fields", *Journal of Chemical Theory and Computation* **20**(3): 1448–1464, January 2024.

J.-W. Ji, F. Kimiaee Asadi, K. Heshami and C. Simon, "Noncryogenic quantum repeaters with hot hybrid alkali-noble gases", *Physical Review Applied* **19**(5): 054063 (12 pp.), May 2023.

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Y. Kora, S. Salhi, J. Davidsen and C. Simon, "Global excitability and network structure in the human brain", *Physical Review E* **107**(5): 054308 (13 pp.), May 2023.

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C. Kumar, Rishabh and S. Arora, "Realistic non-Gaussian-operation scheme in parity-detection-based Mach-Zehnder quantum interferometry", *Physical Review A* **105**(5): 052437 (14 pp.), May 2023.

C. Kumar, Rishabh and S. Arora, "Enhanced phase estimation in parity-detection-based Mach-Zehnder interferometer using non-Gaussian two-mode squeezed thermal input state", *Annalen der Physik* **535**(8): 2300117 (17 pp.), June 2023.

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Refereed Conference Proceedings

S. Afzal, T. J. Zimmerling, V. Van and S. Barzanjeh, "Resonance-enhanced entangled photon pair generation using topological floquet defect mode resonance", FF1L.3, Proceedings of 2023 Conference on Lasers and Electro-Optics (CLEO), San Jose, California, United States of America, 7–12 May 2023.

G. Coccia, S. Shahbazi, Y. Guo, V. K. Kavatamane Rathnakara, A. Kubanek, A. J. Bennett, J. P. Hadden, P. E. Barclay, R. Ramponi and S. M. Eaton, "Development of a diamond platform for quantum sensing", QTh2A.28, Proceedings of Optica Quantum 2.0 Conference and Exhibition 2023, Denver, Colorado, United States of America, 18–22 June 2023.

R. Cockett, I. J. Geng, C. M. Scandolo and P. V. Srinivasan, "Extending resource monotones using Kan extensions", Proceedings of 5th International Conference on Applied Category Theory, pp. 203–223, Glasgow, United Kingdom, 18–22 July 2022.

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S. Flågan, J. Itoi, P. K. Shandilya, W. El-Sayed, E. Zohari, J. E. Losby and P. E. Barclay, "Cavity-enhanced second- and third-harmonic generation from a diamond microdisk", Proceedings of Optica Nonlinear Optics Topical Meeting 2023, Honolulu, Hawaii, United States of America, 10–13 July 2023.

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P. Parsa, P. K. Shandilya and P. E. Barclay, "Feedback enhanced phonon lasing in cavity optomechanics", SF1K.5, Proceedings of CLEO: Science and Innovations 2023, San Jose, California, United States of America, 7–12 May 2023.

A. Sethia, J. Smith, H. Chenini, A. Singh, A. Ahadi, N. Kuzmin and D. Oblak, "Plug and play measurement device independent quantum secure communication", Proceedings of 2023 IEEE Photonics Conference (IPC), Orlando, Florida, United States of America , 12–16 November 2023.

E. Zohari, W. El-Sayed, J. E. Losby, G. Oliviera de Luiz, J. P. Davis and P. E. Barclay, "Diamond X-band optomechanical crystal cavities", FM5B.4, Proceedings of Frontiers in Optics 2023, Tacoma, Washington, United States of America, 9–12 Oct 2023.

Student Theses

S. Addy, "Polar codes for information reconciliation in QKD" (MSc Thesis), January 2024.

A. Bayat, "Reliably quantifying asynchronisation between local representations of UTC" (MSc Thesis), December 2023.

K. M. Daly, "Synchrotron-based investigation of nanoscaled water-splitting electrocatalysts for clean energy storage" (PhD Thesis), June 2023.

K. Esteki, "Thermo-electro-optical properties of disordered nanowire networks" (PhD Thesis), July 2023.

J.-W. Ji, "Novel approaches towards non-cryogenic quantum repeaters" (PhD Thesis), April 2023.

P. B. Khatouni, “High frequency optomechanical and Kerr response of diamond microdisks” (MSc Thesis), May 2023

J. Leahy, “Quantum algorithms for memoryless search and perfect matching” (MSc Thesis), July 2023.

P. Parsa, “Nonlinear cavity optomechanics in diamond” (MSc Thesis), September 2023.

N. S. P. Pathirannehelage, “Molecular dynamic simulations of bulk nanobubbles: Investigation of factors important to their stability” (MSc Thesis), April 2023.

M. Radpour, “Low-noise amplifier and noise/distortion shaping beam former” (PhD Thesis), September 2023.

R. Shukla, “Machine learning assisted study of early-stage MOF self-assembly: Structure characterization and multi-modeling” (PhD Thesis), January 2024.

L. Wang, “Probing nucleation mechanisms of gas hydrates via molecular simulation” (PhD Thesis), October 2023.

Invited Presentations at Workshops/ Conferences

10 May 2023, D. Feder, “Topological physics in ultracold atoms”, Brazil/Canada Workshop on Computational Physics, Niteroi, Brazil, 10–11 May 2023.

10 May 2023, H. Zadeh Haghighi, “Density functional theory applications in quantum networks and quantum biology”, Computational Physics Workshop 2023, Calgary, Alberta, Canada, 10–11 May 2023.

12 May 2023, P. E. Barclay, “Diamond nanophotonics”, Princeton-GIA Diamond Symposium, Princeton, New Jersey, United States of America, 12 May 2023.

15 May 2023, H. Zadeh Haghighi, “Quantum neuroscience”, Computational Neuroscience Annual Meeting, Calgary, Alberta, Canada, 15 May 2023.

22 May 2023, T. Friesen and the ALPHA Collaboration, “Testing fundamental physics with trapped antihydrogen”, International Conference on Precision Physics and Fundamental Symmetries (FFK 2023), Vienna, Austria, 22–26 May 2023.

23 May 2023, D. Salahub, “From quantum chemistry to quantum quantum chemistry”, First meeting of the Canada France Quantum Alliance (CAFQA), Paris, France, 22–24 May 2023.

24 May 2023, D. Oblak, “Large bandwidth light-matter interfaces in rare-earth materials”, First meeting of the Canada France Quantum Alliance (CAFQA), Paris, France, 22–24 May 2023.

26 May 2023, D. Salahub, “Towards ML-accelerated discovery of nanocatalytic materials and mechanisms”, Symposium Artificial Intelligence, Machine Learning and Deep Learning Approaches in Theoretical/Computational Chemistry, Biochemistry, Physical-Chemistry and Materials Science, Institut de Chimie Physique Orsay, France, 26 May 2023.

5 June 2023, D. Salahub, “Spins in biology–the radical-pair mechanism and bio-chemical-physics in magnetic fields”, Symposium on Computational Studies of Biomolecular Systems, Canadian Chemistry Conference and Exhibition (CSC 2023), Vancouver, British Columbia, Canada, 4–8 June 2023.

5 June 2023, C. Simon, “Quantum networks from the quantum internet to the brain” (keynote), SPIE Photonics for Quantum 2023, Rochester, New York, United States of America, 5 June 2023.

7 June 2023, D. Feder, “Hard-core bosons on lattices as the symmetric power of cycle graphs”, Canadian Discrete and Algorithmic Mathematics CanaDAM 2023, Winnipeg, Manitoba, Canada, 5–8 June 2023.

15 June 2023, S. Flågan, “Nonlinear optics in diamond micro- and nano-cavities”, Photonics North 2023, Montreal, Quebec, Canada, 12–15 Jun 2023.

16 June 2023, C. M. Scandolo, “From quantum resource theories to discrete dynamical systems”, Theory Canada 15, Sackville, New Brunswick, Canada, 15–17 June 2023.

18 June 2023, T. Friesen and the ALPHA Collaboration, “Measuring the gravitational free-fall of antihydrogen”, Canadian Association of Physicists Congress 2023, Fredericton, New Brunswick, Canada, 18–23 June 2023.

20 June 2023, C. M. Scandolo, “Quantum City: addressing quantum industry’s needs with new talent development programs”, Canadian Association of Physicists Congress 2023, Fredericton, New Brunswick, Canada, 18–23 June 2023.

20 June 2023, C. M. Scandolo, “Quantum resources in the future of quantum information”, Canadian Association of Physicists Congress 2023, Fredericton, New Brunswick, Canada, 18–23 June 2023.

22 June 2023, C. M. Scandolo, “Quantum resource theories and beyond”, Canadian Association of Physicists Congress 2023, Fredericton, New Brunswick, Canada, 18–23 June 2023.

27 June 2023, D. Salahub, “Towards ML-accelerated discovery of nanocatalytic materials and mechanisms”, 17th International Congress of Quantum Chemistry (ICQC), Bratislava, Slovakia, 26 June–1 July 2023.

28 June 2023, S. Trudel, “Photodeposited metal oxy(hydroxide) thin films for catalysis and optoelectronic applications”, Alberta Sulphur Research Ltd. Chalk Talks and Annual General Meeting, Calgary, Alberta, Canada, 28 June 2023.

4 July 2023, D. Salahub, “Towards ML-accelerated discovery of nanocatalytic materials and mechanisms”, Conference on Computational and Mathematical Methods in Science and Engineering (2023 CMMSE), Rota, Spain, 3–8 July 2023.

17 July 2023, D. Salahub, “Spins in biology–the radical-pair mechanism and bio-chemical-physics in magnetic fields”, 9th Symposium on Theoretical Biophysics (TheoBio 2023), Cetraro, Italy, 16–20 July 2023.

18 July 2023, B. C. Sanders, “Quantum computing for data science”, 48th International Nathiagali Summer College, Activity III: Quantum Optics and Devices, 17–22 July 2023, Nathiagali, Pakistan.

19 July 2023, P. E. Barclay, “Spin-optomechanics”, AWS Quantum Networking Workshop, Boston, Massachusetts, United States of America, 19–21 July 2023.

19 July 2023, B. C. Sanders, “Perspective on electromagnetically induced transparency vs Autler-Townes splitting”, 48th International Nathiagali Summer College, Activity III: Quantum Optics and Devices, 17–22 July 2023, Nathiagali, Pakistan.

20 July 2023, B. C. Sanders, “Kittens, cats and compasses: superposing coherent states for quantum sensing, quantum communication, quantum computing and quantum fun”, 48th International Nathiagali Summer College, Activity III: Quantum Optics and Devices, 17–22 July 2023, Nathiagali, Pakistan.

21 July 2023, B. C. Sanders, “The 2022 Nobel Prize in physics”, 48th International Nathiagali Summer College, Activity III: Quantum Optics and Devices, 17–22 July 2023, Nathiagali, Pakistan.

2 August 2023, D. Oblak, “Quantum network protocols and components”, Annual symposium of Quantum Nanotechnology Training in Alberta (QUANTA), Edmonton, Alberta, Canada, 31 July–1 August 2023.

22 August 2023, C. Simon, “Could quantum entanglement play a role in the brain?” (remote talk), CIHS Summer Symposium , Encinitas,

California, United States of America, 18 August 2023.

23 August 2023, B. C. Sanders, "Kittens, cats, combs and compasses: superposing coherent states for sensing, quantum communication, quantum computing and quantum fun", International Workshop on Quantum Characterisation, Verification and Validation, Shanghai, People's Republic of China, 23–25 August 2023.

26 June 2023, S. Barzanjeh, "Lecture on developing superconducting quantum circuits", CMC Workshop: Build Your Own Superconducting Quantum Device 2023, Jouvence, Orford, Québec, Canada, 26–30 August 2023.

30 August 2023, S. Barzanjeh, "Quantum imaging and sensing", University of Calgary Faculty of Science's Innovation Fair, Calgary, Alberta, Canada, 30 August 2023.

1 September 2023, D. Salahub, "Quantum quantum effects in biology (Could quantum entanglement play a role in the brain)", Transdisciplinary Quantum Neuroscience Workshop, Calgary, Alberta, Canada, 1 September 2023.

1 September 2023, C. Simon, "Introduction to quantum neuroscience" (keynote), Transdisciplinary Quantum Neuroscience Workshop, Calgary, Alberta, Canada, 1 September 2023.

1 September 2023, H. Zadeh Haghighi, "Quantum chemistry for neuroscience", Quantum Neuroscience Workshop 2023, Calgary, Alberta, Canada, 1 September 2023.

11 September 2023, D. Salahub, "Quantum quantum effects in biology", Modeling Interactions in Biology-IX, Prague, Czechia, 10–14 September 2023.

15 September 2023, B. C. Sanders, "Quantum kittens, cats, combs and compasses: superposing coherent states for sensing, communication, computing and pleasure", 2nd International Conference on Emerging Quantum Technology (ICEQT), Hefei, Anhui, People's Republic of China, 18–21 September 2023.

15 October 2023, D. Salahub, "Towards ML-accelerated discovery of nanocatalytic materials and mechanisms", 26th International Workshop on Quantum Systems in Chemistry, Physics and Biology (QSCP-XXVI), Jaipur, Rajasthan, India, 14–20 October 2023.

26 October 2023, E. Janitz, "Molecular sensing with single NV centers", MITACS Quantum Sensing Webinar.

15 November 2023, S. Barzanjeh, "Hybrid Quantum Systems: from superconductivity to quantum sensing", Quantum Alberta Research Showcase, Calgary, Alberta, Canada, 15 November 2023.

15 November 2023, C. Gomes da Rocha, "Modelling nanoscale quantum materials for sensing and neuromorphic applications", Quantum Alberta Research Showcase, Calgary, Alberta, Canada, 15 November 2023.

15 November 2023, S. Flågan, "Diamond nonlinear optics", Quantum Alberta Research Showcase, Calgary, Alberta, Canada, 15 November 2023.

15 November 2023, T. Friesen, "Testing fundamental physics with antimatter", Quantum Alberta Research Showcase, Calgary, Alberta, Canada, 15 November 2023.

15 November 2023, E. Janitz, "Novel diamond defects for building quantum devices", Quantum Alberta Research Showcase, Calgary, Alberta, Canada, 15 November 2023.

15 November 2023, B. Sanders, "Kittens, cats, combs and compasses", Quantum Alberta Research Showcase, Calgary, Alberta, Canada, 15 November 2023.

15 November 2023, C. M. Scandolo, "Quantum resource theories and beyond", Quantum Alberta Research Showcase, Calgary, Alberta, Canada, 15 November 2023.

15 November 2023, C. Simon, “Quantum optics from the quantum internet to quantum biology”, Quantum Alberta Research Showcase, Calgary, Alberta, Canada, 15 November 2023.

4 December 2023, D. Feder, “Two-step perfect quantum state transfer on graphs”, 2023 Canadian Mathematical Society Winter Meeting, Montreal, Quebec, Canada, 1–4 December 2023.

20 February 2024, C. Simon, “Recent results from quantum repeaters to quantum neuromorphic computing”, ARAQNE Consortium Workshop, Calgary, Alberta, Canada, 20 February 2024.

22 February 2024, D. Oblak, “Quantum network protocols and components”, Quantum Days 2024, Calgary, Alberta, Canada, 21–23 February 2024.

2024/2025

Refereed Journal Publications (published)

M. Abbas, M. Arzamasovs, P. Zhang and B. C. Sanders, “Surface plasmon polariton excitation and propagation in metal tripod systems”, *Physics Letters A* **525**(12): 129905 (9 pp.), November 2024.

S. Afzal, T. J. Zimmerling, M. Rizvandi, M. Taghavi, L. Esmaeilifar, T. Hrushevskyi, M. Kaur, V. Van and S. Barzanjeh, “Enhanced quantum emission from a topological floquet resonance”, *PRX Quantum* **5**(4): 040331 (12 pp.), November 2024.

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Student Theses

A. Ahadi, “Innovative hardware implementation for high-speed HOM/BSM analysis in a commercially viable quantum communication system” (MSc Thesis), September 2024

Zhuohao Liu, “Symmetry protected topological order as a requirement for measurement-based quantum gate teleportation” (MSc Thesis), December 2024.

A. Powell, “Magnetic field characterisation for gravitational free fall measurements of antihydrogen in the ALPHA-g experiment” (PhD Thesis), September 2024.

J. Suh, “Towards precision measurements of the hyperfine splitting of antihydrogen” (MSc Thesis), December 2024.

A. Sotoodehfar, “Quantum theory of a potential biological magnetic field sensor: radical pair mechanism in flavin adenine dinucleotide biradicals” (MSc Thesis), February 2025.

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Intellectual Property

D. L. Feder, “Method and system for preparing Gottesman-Kitaev-Preskill non-pauli states of light”, patent application # XQTI101 (India), applied February 2025.

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Invited Presentations at Workshops/ Conferences

15 May 2024, S. Trudel, “Correlating function and structure in photodeposited metal oxy(hydroxides) electrocatalysts”, 27th Canadian Conference on Catalysis, Sherbrooke, Canada, May 12–15, 2024.

2 June 2024, C. M. Scandolo, “Choi-defined resource resource theories”, CMS Summer Meeting, Saskatoon, Canada, 31 May–3 June 2024.

3 June 2024, Y. J. Shi, S. N. Bonvicini, V. I. Birss, “Ligand-free bimetallic nanoparticle array formation on patterned dimpled tantalum substrates by thin film dewetting for direct use in electrochemical characterization”, the 2024 Canadian Chemistry Conference and Exhibition (CSC 2024), Winnipeg, Canada, June 2–4, 2024

9 June 2024, D. R. Salahub, “deMon, quo vadis”, 22nd deMon Developers Workshop, Stockholm, Sweden, 9–14 June 2024.

2 July 2024, D. R. Salahub, “Towards ML-accelerated discovery of nanocatalytic materials and mechanisms”, Conference on Computational and Mathematical Methods in Science and Engineering, Rota, Spain, 2–8 July 2024.

10 July 2024, B. C. Sanders, “Quantum kittens, cats, combs and compasses: superposing coherent states for sensing, computing and pleasure”, Workshop: QuDits for Quantum Technology , 9–10 July 2024.

11 July 2024, C. M. Scandolo, “The power of quantum resources”, Canadian Undergraduate Mathematics Conference, Vancouver, Canada, 8–12 July 2024.

22 July 2024, B. C. Sanders, “Quantum data science” (semi-plenary), 16th World Congress on Computational Mechanics (WCCM2024) and 4th Pan American Congress on Computational Mechanics (PANACM2024), Vancouver, Canada, 21–26 July 2024.

14 August 2024, B. C. Sanders, “Quantum computation” (keynote), Faculty of Engineering Graduate Research Symposium (FEGRS), University of Alberta, Edmonton, Canada, 13–15 August 2024.

28 August 2024, B. C. Sanders, “Harnessing qudits” (keynote), A*STAR Quantum Innovation Centre Symposium on Quantum Science and Technology 2024, Singapore, 28–29 August 2024.

14 August 2024, B. C. Sanders, “Quantum computation” (keynote), Faculty of Engineering Graduate Research Symposium (FEGRS), University of Alberta, Edmonton, Canada, 13–15 August 2024.

28 August 2024, B. C. Sanders, “Harnessing qudits” (keynote), A*STAR Quantum Innovation Centre Symposium on Quantum Science and Technology 2024, Singapore, 28–29 August 2024.

1 September 2024, D. R. Salahub, “Towards ML-accelerated discovery of nanocatalytic materials and mechanisms”, 9th Current Trends in Theoretical Chemistry Conference (CCTC-IX), Krakow, Poland, 1–5 September 2024.

11 October 2024, D. Oblak, “Build your own quantum network–What, why, and how?” (plenary), LXVII Congreso Nacional de Física de la Sociedad Mexicana de Física, Chihuahua, Mexico, 6–11 October 6 2024.

24 October 2024, P. G. Kusalik, “Characterizing structure in liquids: It can be a matter of perspective”, Second BioMat4CAST Workshop, Iasi, Romania, 24–25 October 2024.

25 Oct 2024, P. G. Kusalik, “Nanobubbles: from modelling to applications: The challenges of an apparently simple system”, Second BioMat4CAST Workshop, Iasi, Romania, 24–25 October 2024.

7 November 2024, D. R. Salahub, “From muffin tins to robots – 7 decades of DFT”, DFT in Chemistry -Dispute at Inception and Rise to Prominence (Symposium at The Swedish Royal Academy of Sciences), Stockholm, Sweden, 7–8 November 2024.

12 December 2024, D. L. Feder, “Hard-core bosons on lattices as the symmetric power of cycles”, Winter Meeting of the Canadian Mathematical Society, Richmond, Canada, 29 November–2 December 2024.

3 January 2025, D. R. Salahub, “Multiscale modeling in chemistry, physics, materials science and biology, from (quantum) electrons up (to engineering?)”, 3rd Conference of the Canadian Association for Computational Science and Engineering, Banff, Canada, 3–6 January 2025.

26 February 2025, C. Gomes da Rocha, “Modelling nanoscale quantum materials: From sensing to neuromorphic applications”, The Future of Computing: Perspectives, 13th RIEC International Symposium on Brain Functions and Brain Computer (BFBC2025), Sendai, Japan, 25–28 February 2025.

Linkage

Academic Collaborations

International Institutions

Aarhus University, Denmark

Beihang University, People's Republic of China

Ben-Gurion University of the Negev, Israel

Brookhaven National Laboratory, United States of America

California Institute of Technology, United States of America

Centro de Investigación y de Estudios Avanzados (CINVESTAV), Mexico

Cockcroft Institute, United Kingdom

European Organization for Nuclear Research (CERN), Switzerland

ETH Zurich, Switzerland

Florida International University, United States of America

Indian Statistical Institute, India

Jet Propulsion Laboratory, United States of America

Jiangnan University, People's Republic of China

National Institute of Nuclear Physics – Pisa (INFN), Italy

Open Quantum Institute, CERN, Switzerland

Purdue University, United States of America

Qingdao Institute of Marine Geology, People's Republic of China

Soreq Nuclear Research Centre, Israel

Stockholm University, Sweden

Swansea University, United Kingdom

Techinical University of Denmark, Denmark

Topos Institute, United States of America

Trinity College Dublin, Ireland

Université catholique de Louvain, Belgium

Universidad del Bío-Bío, Chile

Universidad de Antioquia, Colombia

Universidade Federal Fluminense, Brazil

Universidade Federal do Espírito Santo, Brazil

Universidade Federal do Rio de Janeiro, Brazil

Università Ca' Foscari Venezia, Italy

University College Dublin, Ireland

University of Brescia, Italy

University of Cagliari, Italy

University of California at Berkeley, United States of America

University of Hong Kong, People's Republic of China

University of Liverpool, United Kingdom

University of Manchester, United Kingdom

University of Maryland, College Park, United States of America

University of New South Wales, Australia

University of Oxford, United Kingdom

University of Science and Technology of China, People's Republic of China

University of Sydney, Australia

University of Technology Sydney, Australia

University of Warsaw, Poland

Western Michigan University, United States of America

Xi'an Jiaotong University, People's Republic of China

National Institutions

British Columbia Institute of Technology

National Research Council Canada

Simon Fraser University

Southern Alberta Institute of Technology

University of Alberta

University of British Columbia

University of Ottawa

University of Sherbrooke

University of Victoria

University of Waterloo

York University

Industrial/Non-profit/government Collaboration

COLLABORATIVE ENTITY	NAME	ROLE	NATURE				TOPIC
			COLLABORATION	SERVICE	TRAINING	OTHER	
Aria Inc.	Paul Barclay	Project Leader	✓				Diamond material growth
Creative Destruction Lab (LDL)	Barry Sanders	Mentor		✓			Supporting quantum ventures
CMC Microsystems	Shabir Barzanjeh	Scientific Advisory		✓			Quantum computing
Defence Research and Development Canada	Paul Barclay	Collaborator	✓				Quantum sensors
Intelligent Quantum Networks Technologies (INQNET)	Daniel Oblak	Scientific Advisory Board Member	✓				Quantum networks
Katal Energy Inc.	Peter Kusalik	Collaborator/ NSERC Alliance Grant		✓			Nanobubbles in nanoemulsion fuels
National Research Council Canada	Paul Barclay	Project Leader (Nano)	✓				NanoInitiative project Co-PI
National Research Council Canada	Paul Barclay	Project Leader	✓				Quantum sensors
National Research Council Canada	Leonid Belostotski	Principal Investigator	✓				High-speed digitization
National Research Council Canada	Leonid Belostotski	Collaborator	✓				Ultra-high speed ADC
NanoFiber Quantum Technologies	Christoph Simon & Jiawei Ji	Collaborator	✓				Satellite quantum repeater architectures with cold atoms in cavities
Nord Quantique	Pragati Gupta	Intern Scientist	✓				Quantum computing

COLLABORATIVE ENTITY	NAME	ROLE	NATURE				TOPIC
			COLLABORATION	SERVICE	TRAINING	OTHER	
Nuvu Camera	Shabir Barzanjeh	Collaborator (scientific)	✓				Quantum machine learning
Quantized Technologies Inc.	Daniel Oblak	Chief Scientirst			✓		Spin-off in quantum secure communication
Quantum Technologies Inc.	Barry Sanders	Scientific Advisory Board Member		✓			Quantum computing
TRIUMF	Robert I. Thompson & Timothy Friesen	Collaborator	✓				ALPHA project
VivotraQ	Daniel Oblak	Scientific Advisor				✓	Spin-off in biophoton detection
VivotraQ	Vahid Salari	Founder				✓	Spin-off in biophoton detection
Xanadu	Fariba Hosseinynejad Khaledy	MITACS Graduate Internship			✓		Quantum error correction

Visitors

NAME	INSTITUTION
Ismail Akkouche	University Frères Mentouri Constantine 1
Catalina Albornoz	Xanadu
Areeba Arbab	National Center for Physics, Pakistan
Sareh Askari (remote visiting student)	Amirkabir University of Technology
Jacob Barnett	Perimeter Institute for Theoretical Physics
Billy Braasch	National Institute of Standards and Techonolgy
Adolfo del Campo Echevarria	University of Luxembourg
Shuxiang Cao	University of Oxford
Lincoln Carr	Colorado School of Mines
Marco Cavaglia	Politecnico di Torino
Daniel Charlebois	University of Alberta
Aurélia Chenu	University of Luxembourg
Alexandre Choquette	IBM Quantum
Shane Eaton	IFN-CNR and Politecnico di Milano
Luis Fernandez	Universidad del Bío-Bío, Chillán, Chile
Shohini Ghose	Wilfrid Laurier University and Quantum Algorithms Institute
Chinmay Giridhar	Indian Institute of Technology Madras
Paul J. Godin	University of Waterloo
Xuanchen Guo	China University of Mining and Technology
Dmitri Iouchtchenko	Haiqu
Artur Izmaylov	University of Toronto Scarborough
Murat Karakoç	University of Ankara
Jamal Mohammad Khani	University of Victoria
Jing Kong	Middle Tennessee University
David Lake	California Institute of Technology
Nana Liu	Institute of Natural Sciences (University of Michigan and Shanghai Jiao Tong University Joint Institute)
Jan Matas	Centre national de la recherche scientifique (CNRS)
Om Mihani	Indian Institute of Technology Bombay
Matthew Mitchell	Dream Photonics

Robert Myers	Perimeter Institute for Theoretical Physics
Varun Narasimhachar	Institute of High Performance Computing, Agency for Science, Technology and Research (A*STAR), Singapore
Damián Pitalúa-García	University of Cambridge
Paolo Rech	University of Trento
Russ Renzas	Oxford Instruments
Bautista Galo Rodriguez-Robledo	Adrian College in Michigan
Yuval Sanders	University of Technology Sydney
Heli Shah	Niram University India
Rogério de Sousa	University of Victoria
Donna Strickland	University of Waterloo
Sergei Studenikin	National Research Council of Canada
Qiping Su	Hangzhou Normal University
Laura Arango Tabares	University of Antioquia Colombia
Jack Tuszynski	University of Alberta
Chao Wang	Wuhan University of Science and Technology
Jun Ye	National Institute of Standards and Technology & University of Colorado, Boulder
Jaehoon Yu	University of Texas at Arlington
Josep Lumbreras Zarapico	Centre for Quantum Technologies Singapore

Graduate Courses

COURSE NAME	INSTRUCTOR	DESCRIPTION
CHEM 697 Special Topics Molecular Driving Forces	P. Kusalik	In this introduction to statistical mechanics we will explore the basis from which to understand molecular driving forces. We will also examine how this formalism is applied within computer simulations of liquids, solids and solutions. The emphasis will be on physical models and interpretations, with applications to systems of chemical and biochemical interest.
CHEM 697 Special Topics Advanced Mass Spectrometric Techniques	Y. J. Shi	Theoretical and practical aspects of mass spectrometric techniques; instrumentation design, method development, instrument maintenance and troubleshooting aspects; operation of different types of instruments and hands-on experience in mass spectra acquisition; analysis and Interpretation of experimental data; applications in identification of unknown chemical compounds; recent developments in the field of mass spectrometry instrumentation including hyphenated techniques and their applications in multidisciplinary fields.
ENEL 617 RF Integrated Circuit Design	L. Belostotski	Introduction to complementary metal oxide semiconductor (CMOS) wireless communication circuits; computer-aided design; impedance matching concepts; passive circuit elements in monolithic circuits; radio frequency integrated circuit building blocks.
ENEL 647 Analog Integrated Circuit Design	L. Belostotski	Review of static and dynamic models of field effect transistors. Basics of analog integrated circuit design. Computer-aided modelling. Fabrication processes and their influence on analog design. Operational voltage amplifier and transconductance amplifier design techniques. Case studies of complementary metal oxide semiconductor (CMOS) designs.
ENGG 601 Professional Development I	M. Trifkovic	Topics include: health and safety, communication styles, supervisory relationships and respect in the lab, presentation skills including presentation planning and voice projection, reference gathering and management, awareness of plagiarism, and writing abstracts.
ENGG 603 Professional Development II	M. Trifkovic	Topics include: presentation skills, skills for writing scientific manuscripts, peer review process, defence and candidacy, engineering design, intellectual property, and networking basics.

MATH 667 Introduction to Quantum Information	G. Gour	Focus on the mathematical treatment of a broad range of topics in quantum Shannon theory. Topics include quantum states, quantum channels, quantum measurements, completely positive maps, Neumarkís theorem, Stinespring dilation theorem, Choi-Jamiolkowski isomorphism, the theory of majorization and entanglement, the Peres-Horodecki criterion for separability, Shannon's noiseless and noisy channel coding theorems, Lieb's theorem and the strong subadditivity of the von Neumann entropy, Schumacher's quantum noiseless channel coding theorem, and the Holevo-Schumacher-Westmoreland theorem.
PHYS 615 Non-Relativistic Quantum Mechanics	P. E. Barclay	Mathematical formalism of quantum mechanics. Topics may include addition of angular momenta, Clebsch-Gordan coefficients, Wigner-Eckart theorem; charged particles in electric and magnetic fields; quantum operators; approximation methods; scattering; quantum nonlocality, Einstein-Podolsky-Rosen paradox, Bell's theorem.
PHYS 673 Quantum and Non-linear Optics	P. E. Barclay	Theory of dispersion. Fast and slow light. Basics of nonlinear optics. Nonlinear optical crystals, phase matching. Coherence theory. Preparation, manipulation and measurement of quantum optical states and single-photon qubits. Elements of atomic physics, optical Bloch equation, rotating-wave approximation. Two-and three-level systems. Cavity quantum electrodynamics.
PHYS 691.12 Graduate Seminar	D. Feder	Designed to assist students in improving their scientific oral and written communication skills.
PHYS 605 Advanced Data Analysis	C. Gomes da Rocha	Topics include: methods of extraction of significant information from experimental data degraded by noise; parametric and non-parametric statistical methods; curve fitting; spectral analysis; filtering, sampling, convolution and deconvolution techniques.
QUAC 601 Fundamentals of Quantum Computing	D. Oblak	Pure quantum states; unitary maps; projective measurements; quantum algorithms; quantum circuits; quantum resources; quantum complexity.
QUAC 603 Quantum Software I	S. Moradi	Quantum software stack; learning current quantum and hybrid software platforms; comparing with non-quantum software.
QUAC 605 Applications of Quantum Computing	S. Moradi	Combinatorial optimization; linear equation solvers; factorization; searches; simulation; chemistry; and machine learning.
QUAC 611 Quantum Hardware	S. Barzanjeh	Principles of building quantum computers; universal quantum computers; quantum annealers; current commercial quantum computers; roadmap for development of quantum computers.
QUAC 613 Practical Quantum Computing	S. Moradi	Noise; decoherence; loss; imperfect measurement; error mitigation; error correction; fault-tolerance; gate benchmarking.

Services and Outreach

Conferences & Workshops

NAME	COMMITTEE	CONFERENCE/WORKSHOP	LOCATION	DATES
D. Oblak	Topic Chair, Quantum Photonics	IEEE Photonics Conference	Rome, Italy	10–14 November 2024
D. Oblak	Co-Chair, Special Symposium on Quantum Photonic Materials and Devices for Quantum Computing	IEEE Photonics Conference – Special Topic Session	Orlando, United States of America	12–16 November 2023
C. Gomes da Rocha	Chair	International Workshop in Computational Simulations of Nanoscale Materials for Sensor and Quantum Information Applications	Online	10–11 May 2023
B. C. Sanders	Co-chair	8th International Conference on Quantum Techniques in Machine Learning	Melbourne, Australia	25–29 November 2024
S. Trudel	Co-organizer	North American Solid-State Chemistry Conference	Calgary, Canada	2–4 August 2023
S. Moradi	Chair	Workshop of Quantum Software for Industry Applications	Calgary, Canada	14–16 April 2025

Quantum Public Lecture

The Quantum Public Lecture series aims to share groundbreaking advancements in quantum science and technology with the broader public. There is a strong and growing interest among the general public in understanding the latest developments in the quantum realm.

As part of the 2023 qConnect event organized by Quantum City, Professor Jun Ye from National Institute of Standards and Technology and University of Colorado Boulder delivered a public lecture titled “Quantum Science and Atomic Clocks” on 16 November 2023 at the Telus Convention Centre in Calgary. The event attracted approximately 200 attendees and was supported by the Government of Alberta through the Major Innovation Fund Quantum Project.

On 17 June 2024, Nobel Laureate Professor Donna Strickland from University of Waterloo presented a public lecture entitled “Generating High-Intensity, Ultrashort Optical Pulses” at the Calgary Central Library. This lecture was also livestreamed, reaching a total audience of approximately 300 participants.

These public lectures were supported by the Faculty of Science’s Marketing and Communications team as part of a collaborative outreach initiative.

Professional Services

NAME	ROLE	JOURNAL/SOCIETY/INSTITUTION
P. E. Barclay	Member, NSERC Alliance Quantum Evaluation Committee	Natural Sciences and Engineering Research Council of Canada
P. E. Barclay	Member, Banting Postdoctoral Fellowship Program Selection Committee	Natural Sciences and Engineering Research Council of Canada
P. E. Barclay	Topical Editor, Special Issue	*Optics Materials Express*
P. E. Barclay	Mentor	Creative Destruction Lab
P. E. Barclay	Scientific Lead	qLab, Quantum City
L. Belostotski	Editor-in-Chief	*IEEE Journal of Solid-State Circuits*
L. Belostotski	Chair, SCC/CAS Chapter	Institute of Electrical and Electronics Engineer (IEEE)
D. Feder	Review Panelist, Quantum Information Science	Canadian Institute for Advanced Research (CIFAR)
D. Feder	Editor	*PLOS-One*
D. Oblak	Director	NSERC iQuCode CREATE Program
D. Oblak	Member	Quantum Secure Canada
D. R. Salahub	Member, Editorial Board	*Advances in Quantum Chemistry*
D. R. Salahub	College of Reviewers	Canadian Institutes of Health Research
D. R. Salahub	Member, Editorial Board	*Computation*
D. R. Salahub	Vice Chair, Editorial Board	*Interdisciplinary Science: Computational Life Sciences*
D. R. Salahub	Member, Editorial Board	*Journal of Computational Chemistry*
D. R. Salahub	Member, Academic Editorial Board	*PLOS-One*
D. R. Salahub	Interim Director	Quantum Horizons Alberta – Calgary Chapter
B. C. Sanders	Technology and Innovation Advisory Committee, Advanced Research and Knowledge Management	Alberta Securities Commission
B. C. Sanders	Chair, Editor-in-Chief Search Committee	*APL Engineering Physics*
B. C. Sanders	Member, Editorial Advisory Board	*APL Quantum*
B. C. Sanders	Member, Scientific Board	Banff International Research Station
B. C. Sanders	Laboratory Scientist	Creative Destruction Lab –Rockies
B. C. Sanders	Chief Scientist	Creative Destruction Lab –Toronto
B. C. Sanders	Member, Incubation Advisory Board, Open Quantum Institute	Conseil européen pour la Recherche nucléaire (CERN)

NAME	ROLE	JOURNAL/SOCIETY/INSTITUTION
B. C. Sanders	Section Editor, Quantum	*Comprehensive Quantum Physics*
B. C. Sanders	Chair, Board of Directors	Deep Tech Canada
B. C. Sanders	Member, Executive Committee, International Research Network: Canada-France Quantum Alliance (CAFQA)	France Centre National de la Recherche Scientifique
B. C. Sanders	Advisory Board, Quantum	Google XPrize
B. C. Sanders	Section Editor, Section "Quantum Information and Computing"	*Major Reference Works (MRWs) Comprehensive Quantum Physics (published by Elsevier)*
B. C. Sanders	Member, Advisory Committee, Applied Quantum Computing Challenge Program	National Research Council Canada
B. C. Sanders	Member, Global Forum on Technology Committee for Scientific and Technological Policy	Organization for Economic Co-operation and Development
B. C. Sanders	Scientific Director	Quantum City
B. C. Sanders	Mirror Committee Members, ISO/IEC JTC 3 (Quantum Technologies) & ISO/TC 299	Standards Council of Canada
B. C. Sanders	Chair, Catalyst Grants Support Committee	University of Calgary
C. M. Scandolo	Secretary-Treasurer, Division of Quantum Information	Canadian Association of Physicists
Y. J. Shi	Associate Editor	*Canadian Journal of Chemistry*
C. Simon	Associate Editor	*Optica*

Media Coverage

SOURCE	TITLE OF ARTICLE	DATE
UCalgary News	Science prof honoured with fellowship for outstanding contributions to cryptology field: Rei Safavi-Naini	27 April 2023
Analyticsindiamag.com	Quantum computing propels data science into the future: Barry C. Sanders	3 May 2023
GlobalNews	“It's risky”: Calgary researchers explore impacts of quantum computing: Kristin Baetz, Daniel Oblak and Barry C. Sanders	3 May 2023
UCalgaryNews	Quantum research momentum continues with $1.7M investment in research and training: Paul Barclay, Daniel Oblak, Shabir Barzanjeh, Christoph Simon and Barry C. Sanders	7 June 2023
Thestar.com	Top Alberta universities come together to study fundamentals of quantum science: Robert I. Thompson	15 June 2023
UCalgaryNews	$25M Quantum Horizons Alberta establishes world-class research network in Alberta: Robert I. Thompson	15 June 2023
UCalgaryNews	Philanthropy at UCalgary: $182M in action: Quantum Horizons Alberta	22 June 2023
UCalgaryNews	22 UCalgary faculty appointed UCalgary Research Excellence Chairs: Paul Barclay & Milana Trifkovic	30 June 2023
UCalgaryNews	UCalgary researchers make strides toward quantum sensing technology: Shabir Barzanjeh, Mayte Li-Gomez and Taras Hrushevskyi	14 July 2023
Innovation News Network	Quantum Horizons Alberta: Expanding the horizons of quantum science: Barry C. Sanders	21 August 2023
UCalgaryNews	How one UCalgary physicist is trying to solve the universe's great quantum mystery: Timothy Friesen and Adam Powell	30 August 2023
IIT Madras Shaastri Magazine	The quantum edge of technology: Barry C. Sanders	1 September 2023
UCalgaryNews	Does antimatter fall up or down? UCalgary physicists observe 1st gravitational free-fall of antimatter: Tim Friesen and Rob I. Thompson	27 September 2023
CTV Calgary	University of Calgary physicist joins other scientists in quest for anti-matter: Timothy Friesen	1 October 2023
UCalgaryNews	UCalgary to provide hands-on quantum computing opportunities with Xanadu, a global leader in quantum computing: Quantum City, IQST, David Feder, Fariba Hosseinynejad Khaledy	10 October 2023
Si.com	Barry Sanders asks fans for help getting his LinkedIn account back: Barry C. Sanders	26 October 2023

SOURCE	TITLE OF ARTICLE	DATE
Azoai.com	Quantum discord and coherence in DQC1 for machine learning: Christoph Simon	19 November 2023
Hindu.com	Raman Research Institute faculty to receive grant worth $8 million from Canada: Urbasi Sinha	22 November 2023
The Times of India	RRI scientist bags top Canadian award, to receive $8 million over 8 years: Urbasi Sinha	22 November 2023
Physicsworld.com	Researchers grapple with bringing quantum security to the cloud: Barry C. Sanders	12 December 2023
New Scientist	Can quantum hints in the brain revive a radical consciousness theory?: Christoph Simon & Hadi Zadeh-Haghighi	17 January 2024
UCalgaryNews	UCalgary celebrates 25 years of quantum physics: UofC quantum research group	15 February 2024
UCalgary (Youtube channel)	What do people know about quantum?: Erika Janitz	1 March 2024
NanoQT.com	NanoQT and the University of Calgary announce a cavity QED-based quantum repeater research collaboration: Christoph Simon	5 March 2024
TheMetaNews	Quand la quantique échappe aux physiciens: Christoph Simon	22 March 2024
UToday	QAI Ventures launches global quantum technology accelerator and Canadian office in Calgary: Quantum City	3 April 2024
Calgary Herald	U of C partnership with QAI Ventures a ‘game-changer’ for quantum tech sector: Quantum City	3 April 2024
New Scientist	Quantum biology: New clues on how life might make use of weird physics: Christoph Simon	21 May 2024
UToday	Winners of Quantum City Challenge unveil solutions for key energy questions UCalgary competition brings together leading research teams in academia and industry to focus quantum science on big challenges in energy management and environmental remediation: Quantum City	31 May 2024
UToday	Ever wonder about the technology behind laser eye surgery? Now’s your chance to scratch that itch: IQST	11 June 2024
New Scientist	Quantum computers may work better when they ignore causality: Carlo Maria Scandolo	4 July 2024
UToday	UCalgary study advances the frontiers of quantum batteries: Shabir Barzanjeh	19 July 2024
The Quantum Insider	Quantum simulation explained: The next big thing in advanced computing: QAI Ventures	25 July 2024

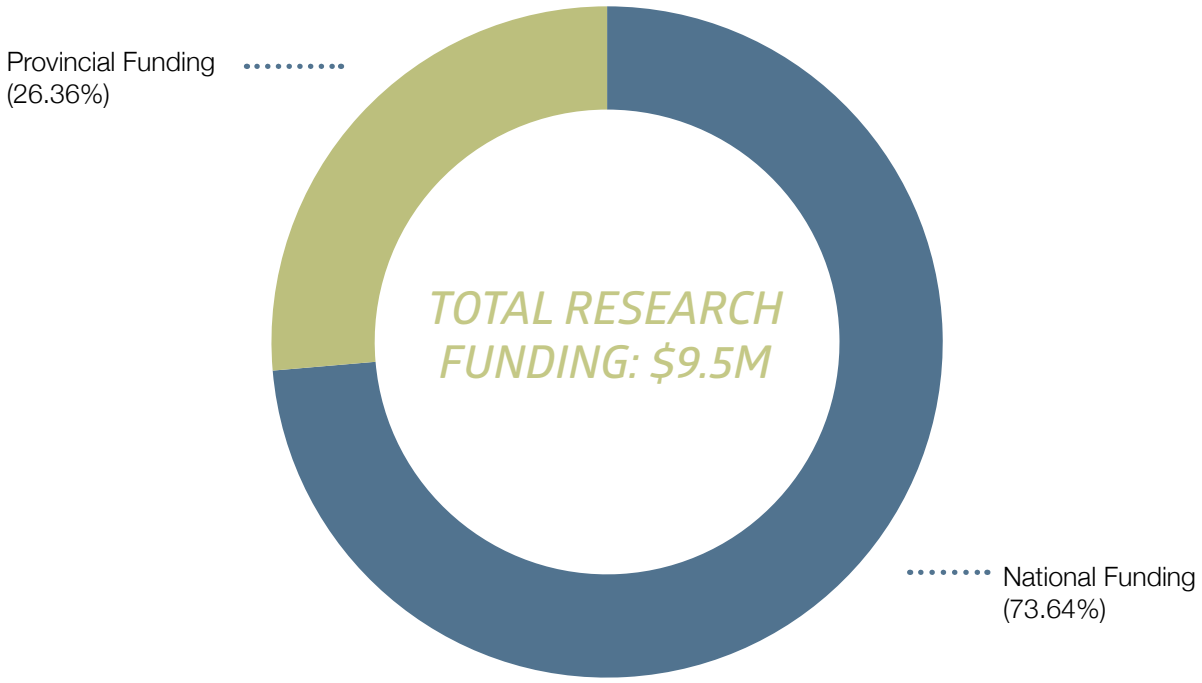
SOURCE	TITLE OF ARTICLE	DATE
Deccan Herald	Rashtriya Vigyan Puraskar for Raman Research Institute professor Urbasi Sinha: Urbasi Sinha	8 August 2024
UToday	qConnect 2024 unites global innovators as Alberta's quantum tech receives $8.4M investment	11 October 2024
The Logic	No, Chinese scientists didn't use a quantum computer to break encryption: Barry C. Sanders	18 October 2024
New Scientist	Quantum "Schrödinger's cat" survives for a stunning 23 minutes: Barry C. Sanders	28 October 2024
OPTICA	Optica fellow profile: Christoph Simon	5 November 2024
UToday	UCalgary researchers achieve breakthrough in quantum light generation: Shabir Barzanjeh	13 December 2024
UToday	This metaphorical cat is both dead and alive - and it will help quantum engineers find computing errors: Barry C. Sanders	14 January 2025
UToday	Milestone in quantum sensing: A prototype quantum optical microscope: Shabir Barzanjeh	21 January 2025
The Globe and Mail	Canadian company Xanadu tests building blocks for commercial quantum computer: Christoph Simon	22 January 2025
UToday	Quantum City internship program helps define Calgary as a hub for quantum technology: Quantum City & Barry C. Sanders	29 January 2025
UToday	Quantum computing has already changed the world. But what does that mean for quantum startups?: Barry C. Sanders	3 February 2025
Electro Optics	Xanadu introduces its modular photonic quantum computer prototype: Christoph Simon	6 February 2025
The Wire China	The quantum panic: Barry C. Sanders	16 February 2025
UToday	100 years of quantum is just the beginning: Barry C. Sanders	18 February 2025
Youtube.com: Ones Changing The World - 1CW	Building a quantum future: Challenges, timelines & Calgary's Quantum City: Barry C. Sanders	16 March 2025
UToday	University of Calgary opens Quantum City qHub: Quantum City	28 March 2025

Research Grant

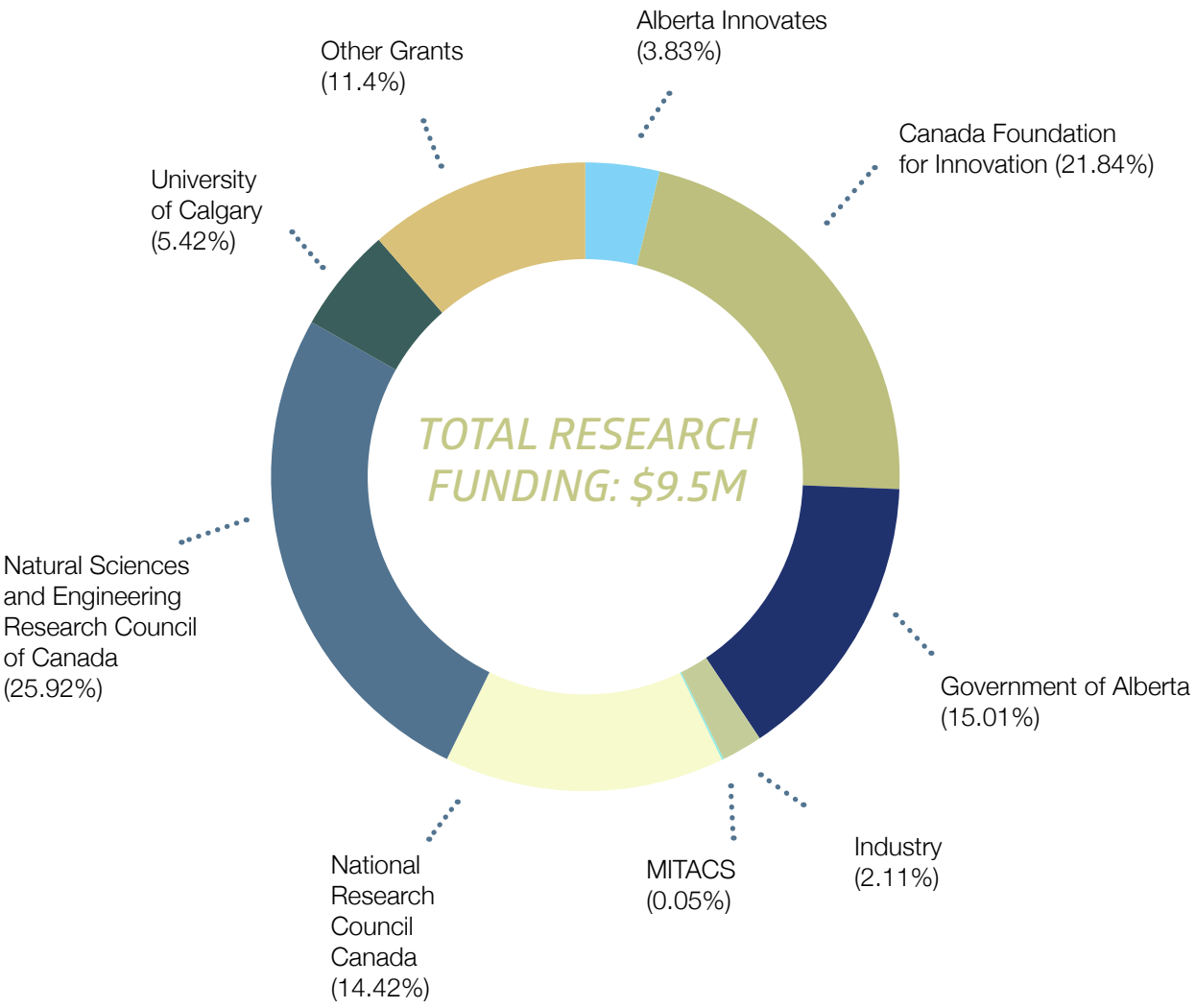
UNAUDITED

2023/2024

By origin



By funding agency

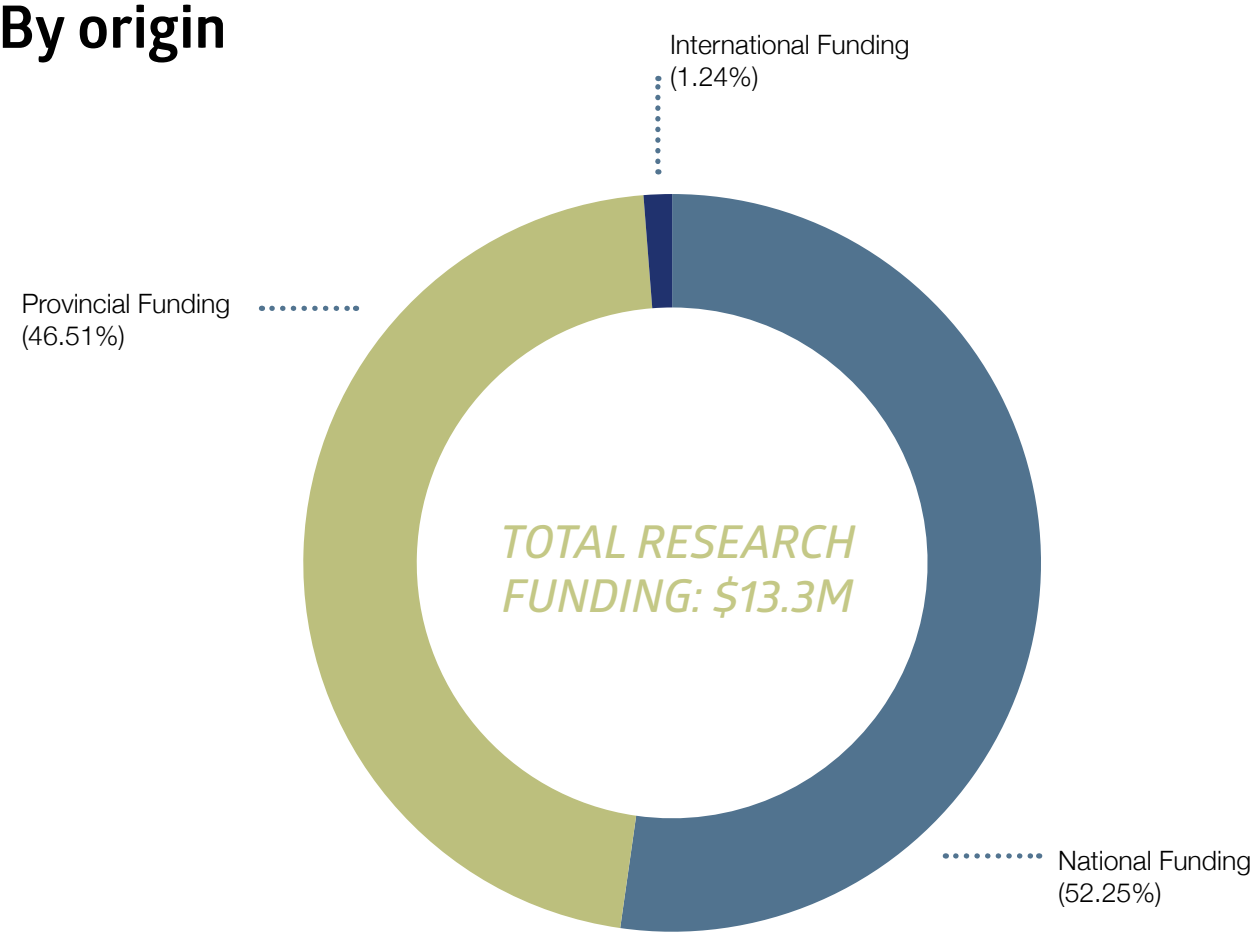


Research Grant

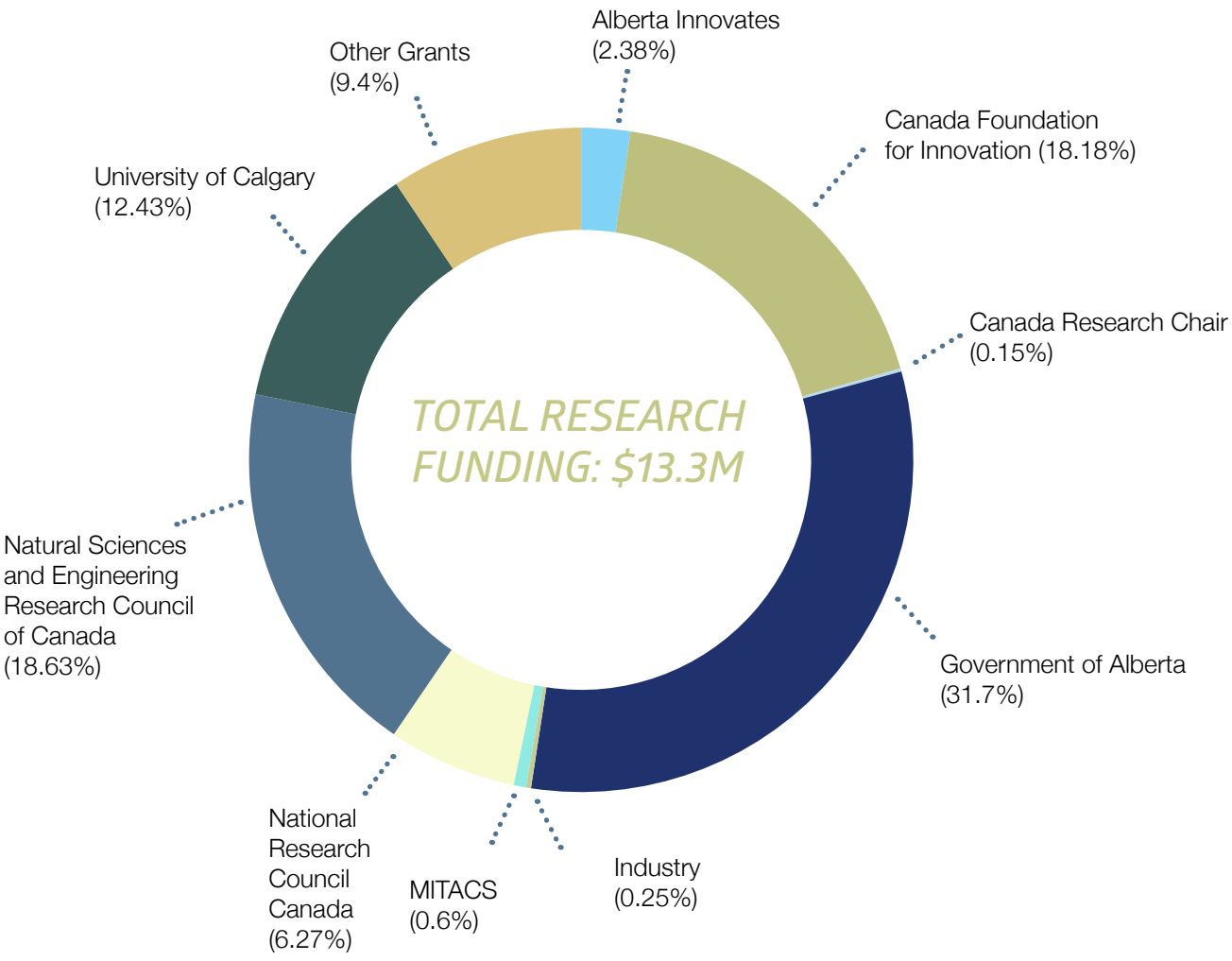
UNAUDITED

2024/2025

By origin



By funding agency



Objectives for Next Year

PAUL E. BARCLAY

- Demonstrate optomechanical frequency combs in X-band optomechanical crystals
- Demonstrate an on-chip diamond magnetometer
- Understand nature of diamond colour center dark states
- Create silicon-on-diamond nanophotonic devices
- Develop optomechanical transducers based on spin-phonon coupling

SHABIR BARZANJEH

- Develop quantum photonic circuits using topological systems
- Build a two-mode amplifier in superconducting systems
- Develop the theory of high-performance quantum batteries

LEONID BELOSTOTSKI

- Continue our investigation into noise source in SOI CMOS processes
- Develop low phase-noise cryogenically cooled oscillators, amplifiers, and analog-to-digital converters

DAVID L. FEDER

- Develop strategies for deterministic universal gate teleportation in photonic Gottesman-Kitaev-Preskill states
- Elucidate the relationship between classical representations of photonic states and their ability to act as resources for universal computation
- Generate a complete inventory of all quantum error correction codes on small numbers of qubits
- Develop a universal strategy for constructing quantum error correction codes with desired properties
- Explore the ability of two-local Hamiltonians to generate topological states via time evolution

TIM FRIESEN

- Perform improved precision hyperfine spectroscopy of antihydrogen
- Develop new microwave resonator and Penning trap electrode to induce antiproton spin flip transitions in antihydrogen
- Improved precision measurements of the free-fall of antihydrogen
- Develop improved particle traps for antimatter experiments

CLAUDIA GOMES DA ROCHA

- Develop computational descriptions of electronic quantum transport in metal-insulating-metal junctions and two-dimensional nanomaterials that can be applied in next-generation neuromorphic systems and chemical sensing
- Characterize the optical transmission, thermal properties, and electrical resistance of metallic nanowire thin films to improve transparent conductor technologies
- Develop architectures for quantum neuromorphic networks and quantum sensor devices

ERIKA JANITZ

- Build experimental quantum optics lab
- Develop quantum-grade diamond growth capabilities at UCalgary
- Measure the quantum efficiency of group-IV defects in diamond
- Develop theory for quantum sensing with novel defect centers

PIERRE KENNEPOHL

- Explore the role of charge transfer processes in the decoherence lifetime of transition metal-based molecular electron spin qubits
- Define the benefits of charge-neutral molecular electron spin qubits (how important are counterions?)

PETER G. KUSALIK

- Develop Markov State models based on key structural events and their transitions during the nucleation processes of ice and gas clathrate hydrates
- Investigate the differences in the solution structure of potassium dihydrogen phosphate (KDP) and ammonium dihydrogen phosphate (ADP) and the dependence on concentration
- Reveal how the aqueous solution structure of potassium dihydrogen phosphate (KDP) impacts its crystal nucleation and growth
- Examine the factors important in the stability and mechanism of formation of nanobubbles in both aqueous and nonaqueous systems
- Investigate the physical origins for the mobility of nanobubbles
- Develop models to explain both the mobility and stability of nanobubbles

NASSER MOAZZEN-AHMADI

- Design and test a photonic gas sensor for use at mid-infrared wavelengths
- Develop accurate global potential energy surfaces for molecular complexes
- Spectroscopic studies of microsolvation of carbon dioxide in in rare gases

SHAHPOOR MORADI

- Focus on quantum education initiatives for high school, undergraduate, and college students including developing accessible learning materials, organizing outreach activities, and fostering early interest in quantum technologies

DANIEL OBLAK

- Determine if magnetic fields affect ultraweak photon emission from plants during various growth stages
- Increase bandwidth and demonstrate single-photon level storage in phase-imprint quantum memory
- Increase efficiency of ytterbium-based transduction protocol by tuning experimental parameters and implementing 2D-microwave resonator setup.
- Demonstrate hole-burning and measure coherence time of molecular lanthanide crystals
- Characterize coherence and lifetime dynamics of Er in a $LiNbO_3$ photonic waveguide

VIKI KUMAR PRASAD

- Train a graph neural network for bond dissociation enthalpy predictions
- Develop quantum kernel models for data-driven coupled cluster theory
- Implement quantum machine learning framework for delta-learning

DENNIS R. SALAHUB

- Develop new quantum chemistry/machine-learning algorithms for molecular dynamics
- Consolidate studies of quantum machine learning
- Advance the design of new nanocatalysts by quantum machine learning
- Coordinate an international collaboration on artificial intelligence for design of new materials producing improved methods and software for classical and quantum computers
- Collaborate with NRC researchers and others to explore quantum chemistry on quantum computers

BARRY C. SANDERS

- Devise pulse engineering for creating highly nonclassical states and processes on a single high-spin nucleus
- Develop a rigorous adversarial model to establish and justify fidelity thresholds for quantum teleportation and other quantum-communication tasks
- Determine the ultimate limits of clock precision arising from background quasi-stochastic gravitational fluctuations of the universe.
- Develop a time-multiplexed version of a spatial partially trusted quantum network of nodes using secret sharing including how to implement experimentally
- Construct, employ and characterize quantum-enhanced computer programs for solving problems in energy and health sectors
- Determine the spectrographic signature that would arise in hydrogen if the proton were in a superposition of locations

CARIO MARIA SCANDOLO

- Develop a systematic theory of quantum supermaps and higher-order quantum theory
- Formulate resource theories for higher-order quantum theory
- Define a new class of quantum hidden-variable models based on measure theory
- Study decoherence phenomena in general physical theories
- Study possibilistic tomography of quantum states

YUJUN SHI

- Apply the method of pulsed laser-induced dewetting for the fabrication of high-entropy alloy nanoparticles
- Apply the techniques of thermal dewetting for the fabrication of noble-metal-based bimetallic nanoparticles
- Explore the metal-nanoparticle-catalyzed chemical vapor deposition of one-dimensional semiconductor nanostructures and their applications

CHRISTOPH SIMON

- Study ultraweak photon emission from plants and animals experimentally and theoretically
- Study magnetic field effects in biological systems with a focus on the radical pair mechanism; studied systems include regeneration in planarians, tubulin polymerization, peroxisome movement in plant cells, lipid membrane properties, pigmentation in tadpoles, and ultraweak photon emission
- Study potential light propagation in axons theoretically and experimentally
- Study quantum gate implementations with solid-state spin-photon interfaces
- Study satellite quantum repeaters with cold atoms
- Study lifetimes and coherence times in Erbium doped fibers
- Study quantum reservoir computing with spin networks and nonlinear oscillators
- Study unwanted amplification in quantum memories

ROBERT I. THOMPSON

- Resolve atomic structures of antihydrogen
- Upgrade the ALPHA-g apparatus for precision gravitational free-fall experiments on antihydrogen in the ALPHA-g apparatus
- Develop laser-based ion-source options for TITAN

SIMON TRUDEL

- Build the Labaratory for In-operando x-ray spectroscopy (CFI project)
- Develop new metal and metal nitride thin film deposition methods
- Explore X-ray spectroscopy of amorphous metal oxides

IQST adds value to the University of Calgary in the following ways

ENABLES MULTIDISCIPLINARY RESEARCH THROUGH FINANCIAL AND LOGISTICAL SUPPORT

BUILDS A QUANTUM SCIENCE AND TECHNOLOGY COMMUNITY THROUGH VISITOR, SEMINAR, AND COLLOQUIUM PROGRAMS

ASSISTS NEW FACULTY MEMBERS TO BECOMING PRODUCTIVE RESEARCHERS RAPIDLY

PUBLISHES REPORTS AND WEB PAGES THAT SHOWCASE THE INSTITUTE AS A LEADER IN QUANTUM INFORMATION SCIENCE

SUPPORTS RECRUITMENT OF OUTSTANDING FACULTY, RESEARCHERS, AND GRADUATE STUDENTS

SPONSORS AND SUPPORTS LEADING CONFERENCES HELD LOCALLY

PARTNERS WITH OTHER QUANTUM INSTITUTES

ENHANCES THE UNIVERSITY'S REPUTATION BY DELIVERING OUTSTANDING RESEARCH RESULTS

BENEFITS THE WIDER COMMUNITY BY CONTRIBUTING NEW KNOWLEDGE IN A STRATEGIC AREA

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