UNIVERSITY OF WATERLOO | IQC Institute for Quantum Computing

IQC DIRECTOR'S REPORT

KEVIN RESCH,

INTERIM EXECUTIVE DIRECTOR

OUR MISSION

TO DEVELOP AND ADVANCE QUANTUM INFORMATION SCIENCE AND TECHNOLOGY AT THE HIGHEST INTERNATIONAL LEVEL THROUGH THE COLLABORATION OF COMPUTER SCIENTISTS, ENGINEERS, MATHEMATICIANS AND PHYSICAL SCIENTISTS.

CORE RESEARCH AREAS

QUANTUM COMPUTING

Using atoms, molecules and particles of light to create new bits of computer information – qubits, which can be 0 and 1 at the same time – for computing.

QUANTUM COMMUNICATION

Developing ultrasecure communication channels, low-noise transmission protocols and satellite-based global networks by harnessing the power of the quantum world.

QUANTUM SENSING

Using the laws of quantum mechanics to develop new sensors with exponential precision, sensitivity, selectivity and efficiencies.

QUANTUM MATERIALS

Engineering materials that exhibit quantum properties for robust quantum information processors and other devices.

IQC Institute for Quantum Computing

FACULTY

Michal Bajcsy
Electrical and Computer Engineering

Jonathan Baugh
Chemistry

Raffi Budakian
Physics and Astronomy

Kyung Soo Choi
Physics and Astronomy

Richard Cleve
Cheriton School of Computer Science

David Cory
Chemistry

Joseph Emerson
Applied Mathematics

K. Rajibul Islam
Physics and Astronomy

Thomas Jennewein
Physics and Astronomy

Na Young Kim
Electrical and Computer Engineering

Raymond Laflamme
Physics and Astronomy

Debbie Leung
Combinatorics and Optimization

Adrian Lupaşcu
Physics and Astronomy

Norbert Lütkenhaus
Physics and Astronomy

Matteo Mariantoni
Physics and Astronomy

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Electrical and Computer Engineering

Michele Mosca
Combinatorics and Optimization

Christine Muschik
Physics and Astronomy

Ashwin Nayak
Combinatorics and Optimization

Vern Paulsen
Pure Mathematics

Dmitry Pushin
Physics and Astronomy

Michael Reimer
Electrical and Computer Engineering

Kevin Resch
Physics and Astronomy

Crystal Senko
Physics and Astronomy

William Slofstra
Pure Mathematics

Wei Tsen
Chemistry

John Watrous
Cheriton School of Computer Science

Christopher Wilson
Electrical and Computer Engineering

Jon Yard
Combinatorics and Optimization

IQC Institute for Quantum Computing

FACULTY HIRES SINCE 2016

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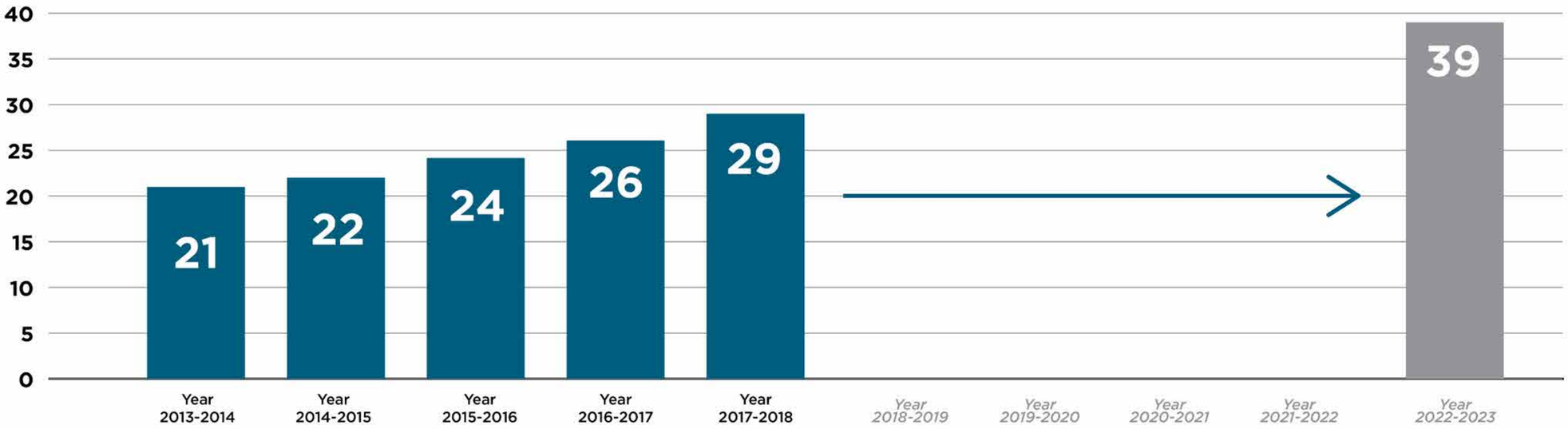
Institute for Quantum Computing

FACULTY GROWTH

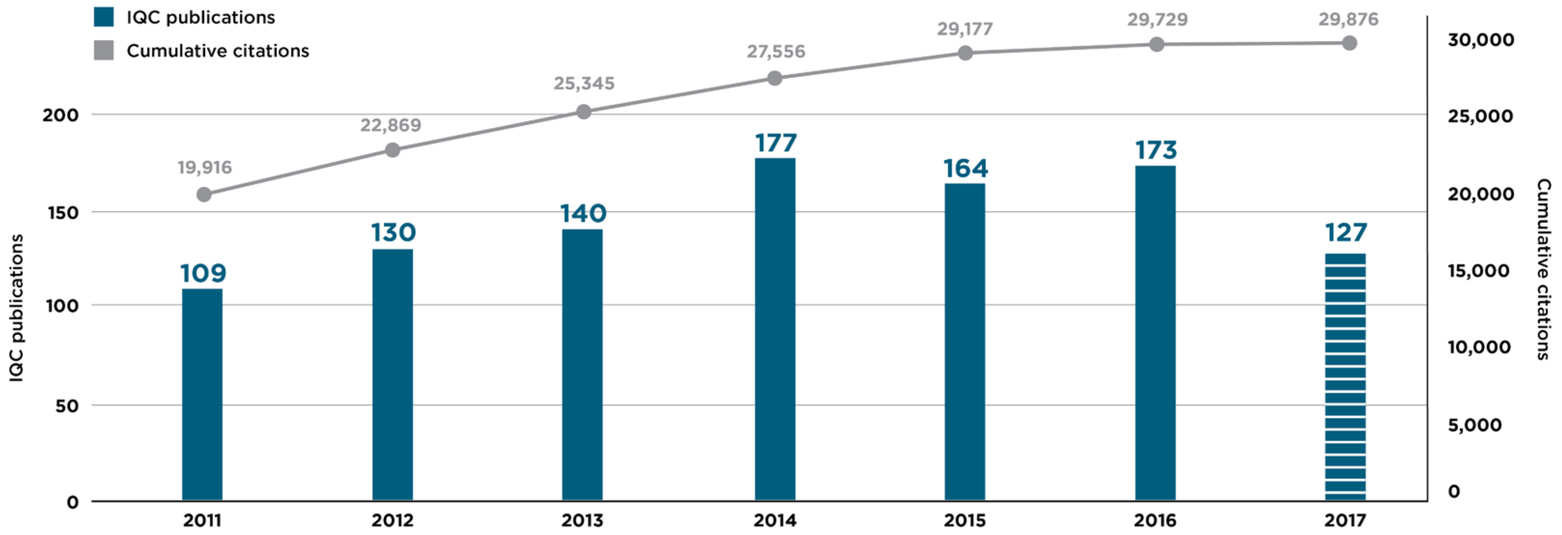


INFRASTRUCTURE

RESEARCH EXCELLENCE

29 Faculty **153** Graduate Students **39** Postdoctoral Fellows

Annual publications and cumulative citations



1,501 publications since 2002

173 publications in 2016

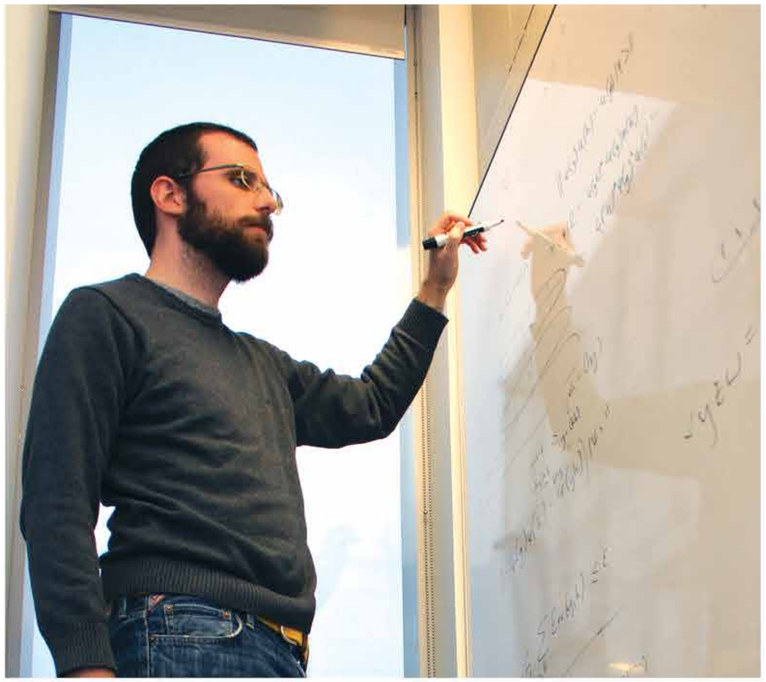
29,876 cumulative citations

138 publications since 2012 in *Science, Nature Family of Journals, Physical Review Letters, FOCS* and *STOC*

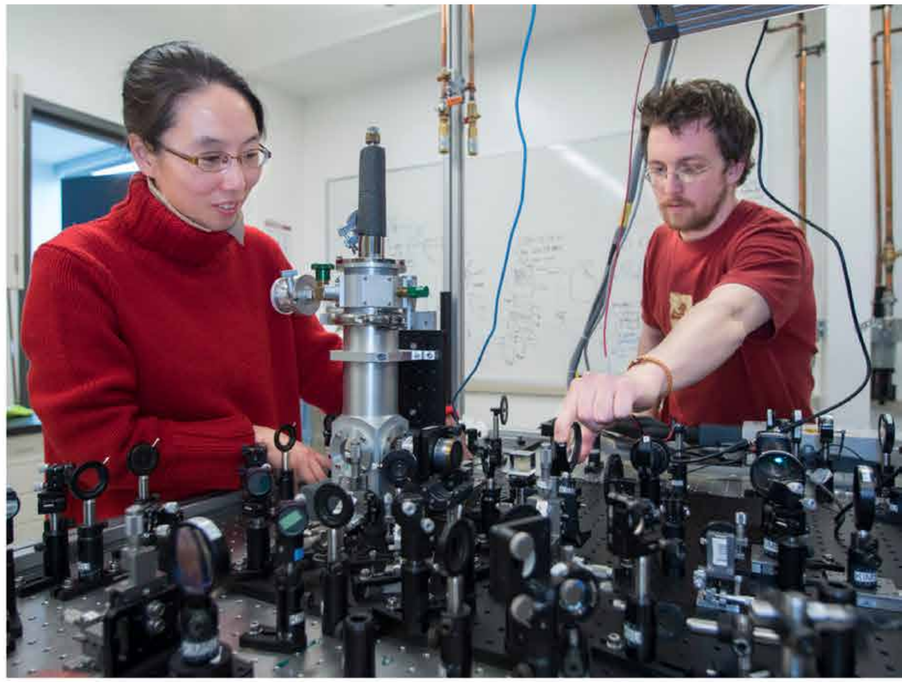
RECENT RESEARCH HIGHLIGHTS

RESEARCHERS SUCCESSFULLY DEMONSTRATE PROTOTYPE FOR SPACE-BASED QUANTUM-SECURED COMMUNICATION

SOLVING TSIRELSON'S PROBLEM



ESTABLISH QUANTUM INNOVATION (QUIN) LAB FOR SEMICONDUCTOR AND NANOSCALE QUANTUM DEVICES



RESEARCH AWARDS

200+ ACTIVE GRANTS

INCLUDING:

41 NSERC FUNDED RESEARCH GRANTS

6 CFI FUNDED RESEARCH GRANTS

1 CFREF GRANT

NOTABLE AWARDS

6 EARLY RESEARCHER AWARDS

3 AMERICAN PHYSICAL SOCIETY FELLOWS

3 OUTSTANDING PERFORMANCE AWARDS

3 FELLOWS OF THE ROYAL SOCIETY

1 CAP-CRM PRIZE IN THEORETICAL AND MATHEMATICAL PHYSICS

7 RESEARCH CHAIR APPOINTMENTS

CANADA EXCELLENCE RESEARCH CHAIR LAUREATE
DAVID CORY (June 2017)

CANADA RESEARCH CHAIR
KEVIN RESCH (2013-2018)
RAYMOND LAFLAMME (2002-2022)

UNIVERSITY RESEARCH CHAIR
DEBBIE LEUNG (2015-2022)
MICHELE MOSCA (2012-2019)

MIKE AND OPHELIA LAZARIDIS "JOHN VON NEUMANN" CHAIR IN QUANTUM INFORMATION
RAYMOND LAFLAMME (2017-2027)

NANOTECHNOLOGY (WIN) ENDOWED CHAIR IN SUPERCONDUCTIVITY
RAFFI BUDAKIAN (2014-2019)

INTERNATIONAL COLLABORATIONS

Over 70% of co-authored papers are with international collaborators

NATIONAL
COLLABORATIONS

RESEARCH

POWERED BY INTERDISCIPLINARY COLLABORATION

IQC Institute for Quantum Computing + UNIVERSITY OF WATERLOO FACULTY OF SCIENCE

PAPER

ENTANGLEMENT AREA LAW IN SUPERFLUID ^{4}HE

IQC Institute for Quantum Computing + UNIVERSITY OF WATERLOO FACULTY OF ENGINEERING + WATERLOO INSTITUTE FOR nanotechnology

PAPER

GROWTH AND CHARACTERIZATION OF EPITAXIAL ALUMINUM LAYERS ON GALLIUM-ARSENIDE SUBSTRATES FOR SUPERCONDUCTING QUANTUM BITS

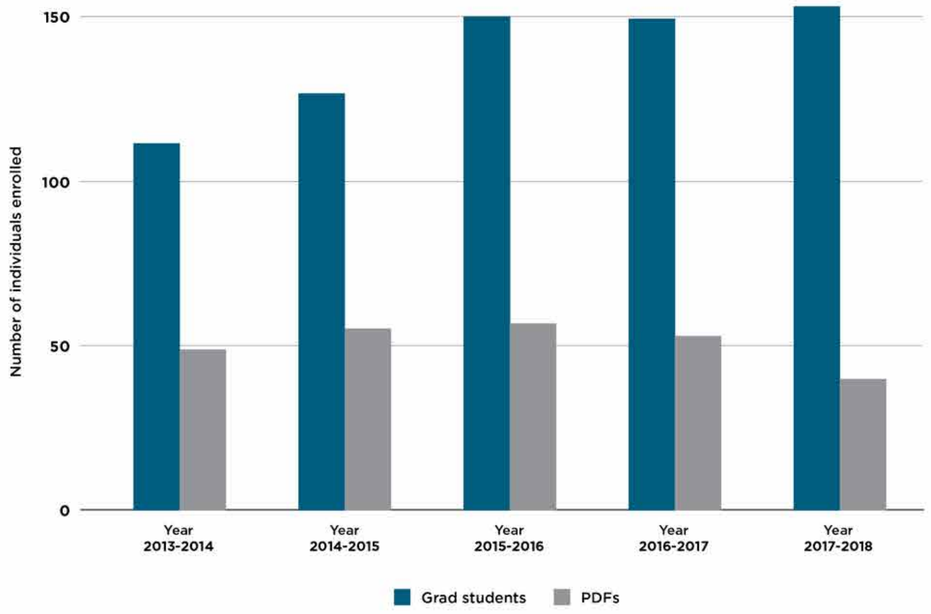
IQC Institute for Quantum Computing + UNIVERSITY OF WATERLOO FACULTY OF MATHEMATICS + UNIVERSITY OF WATERLOO FACULTY OF SCIENCE

PAPER

DYNAMICAL CASIMIR EFFECT IN CIRCUIT QED FOR NONUNIFORM TRAJECTORIES

GRADUATE
AND PDF PROGRAMS

MORGAN MASTROVICH
MASTER'S STUDENT (PHYSICS, QI)



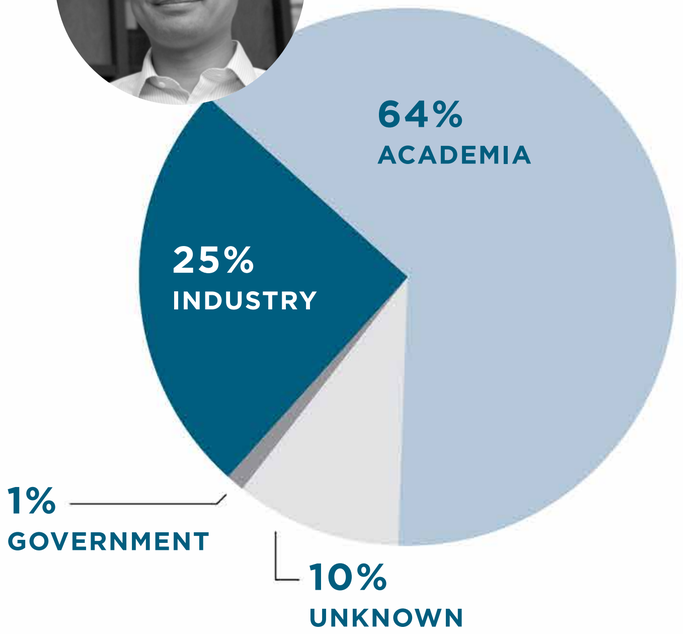
JEAN-PHILIPPE BOURGOIN
POSTDOCTORAL FELLOW

38 courses offered through the Quantum Information Graduate Program

IQC ALUMNI

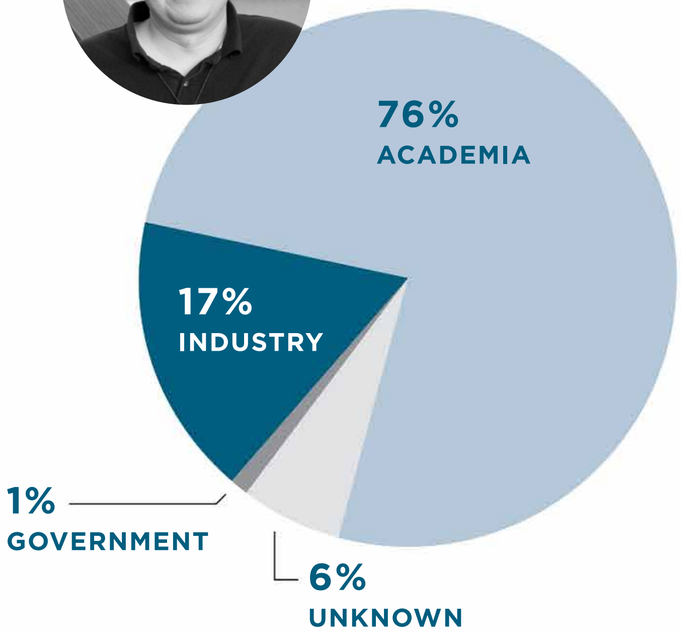
Master's Program

DONNY CHEUNG
MASTER'S 2002, PhD 2007
Now at Google Canada



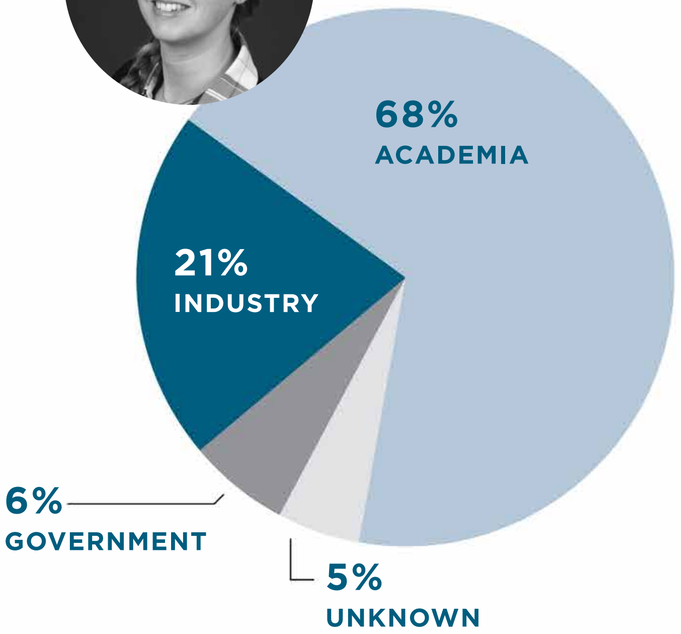
PhD Program

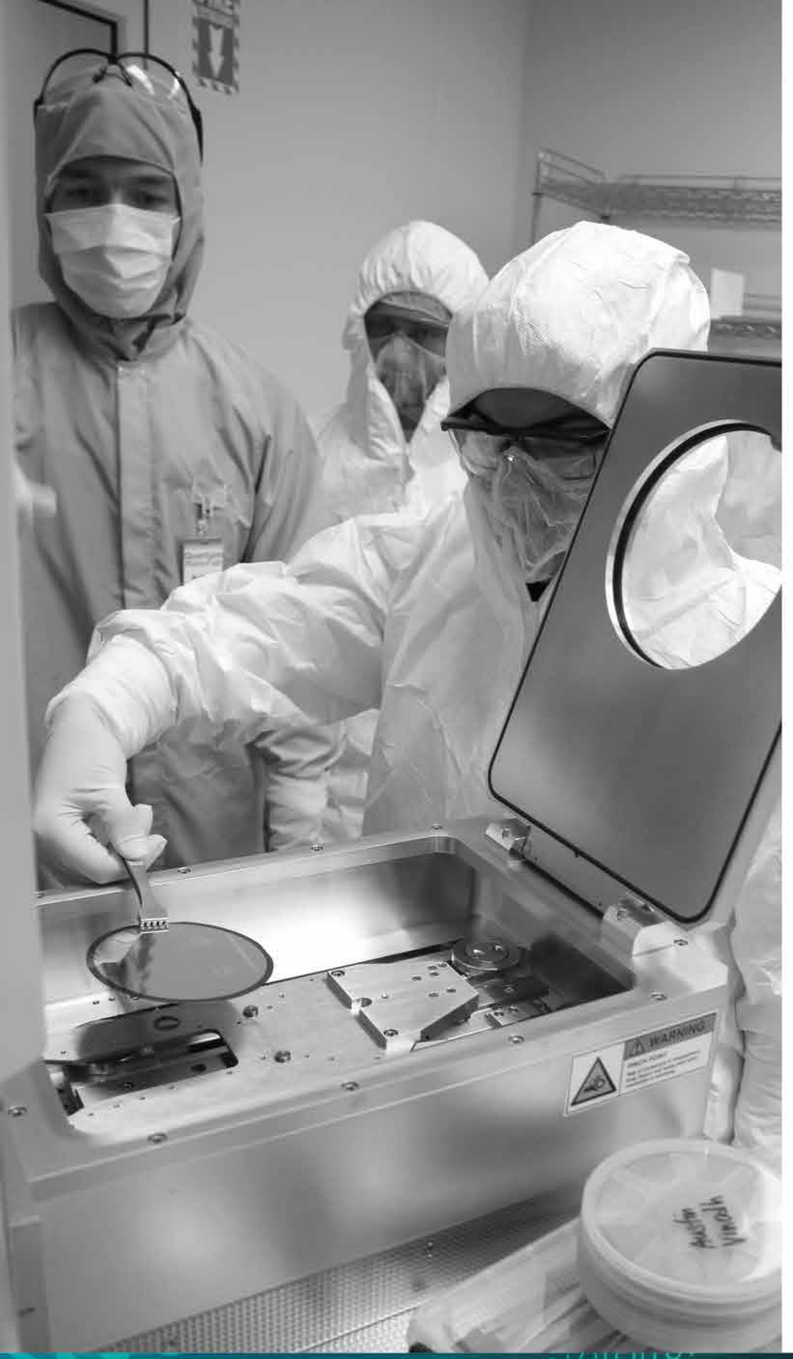
CHRIS PUGH
PhD 2017
Now at Brandon University



PDF Program

ANNE BROADBENT
PDF 2013
Now at the University of Ottawa





UNDERGRADUATE
RESEARCH ASSISTANTS

URAs supervised by IQC faculty

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377 URAs since 2012

70%+ of USEQIP students stay for a URA (2016; 2017)

SCIENTIFIC OUTREACH

QCSYS

Quantum Cryptography
School for Young Students

318 participants since 2012

USEQIP

Undergraduate School
on **Experimental Quantum**
Information Processing

135 participants since 2012

QKD

Quantum Key Distribution
Summer School

173 participants since 2012

QI

Quantum
Innovators

230 participants since 2012

SC

Schrödinger's
Class

82 participants since 2015

TAKING QUANTUM
BEYOND BORDERS

QUANTUM EXHIBITION AND POP-UPS

151,443
visitors across Canada

5,000+
visitors in **5** overseas countries

1,000

EARNED MEDIA

NATIONAL POST

TORONTO STAR

CTV

CBC news

769

MEDIA MENTIONS

SINCE APRIL 2017

MOTHERBOARD

GIZMODO

PHYS.ORG

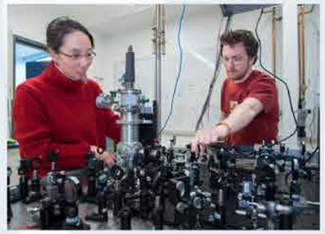
THE WALL STREET JOURNAL.

SCIENTIFIC AMERICAN

WIRED

THE GLOBE AND MAIL













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