



Quantum leap for Waterloo's women in science

Scientist Electra Eleftheriadou among the role models for girls at the Institute for Quantum Computing

BY MARTIN VAN NIEROP
PHOTOGRAPHY • CRESTINA MARTINS

On a brilliant winter morning, as sunlight glints off the stainless steel-trimmed halls of the University of Waterloo's Institute for Quantum Computing, an energy source named Electra is busy at work.

Electra Eleftheriadou radiates enthusiasm in her capacity as the institute's scientific outreach officer. She's part of a team in the outreach department under manager Martin Laforest that is tasked with explaining the institute's work to the community and the world.

The 27-year-old Eleftheriadou embodies what is possible for young women in the world of science. A big part of her job as a "STEM ambassador" is to encourage more girls to pursue these disciplines — science, technology, engineering and mathematics. High-profile organizations such as the United Nations have recently made fast-tracking gender equality, including in STEM studies, a priority.

Here at home, the University of Waterloo has partnered with the United Nations on the HeForShe campaign to promote gender equality, but the university has for years been investing heavily in equality initiatives such as Engineering Science Quest and its "girls clubs."

Eleftheriadou, a native of Nicosia, Cyprus, understands the importance of role models. Her only source of encouragement

growing up was her music teacher, Ioanna Satrazami, "who is the most inspiring teacher I ever met; she loved her subject so much and her passion was contagious."

Eleftheriadou knew she wanted to study a subject "that will make my face light up like hers when I explain it. . . . I felt this would be possible with physics."

She openly muses about the connection between music and physics: "I am very passionate about tango!" a spare-time activity that allows her to "de-stress."

"In an ideal world I would teach physics through dancing," she says with a laugh, although that connection would not be impossible considering she "knows a group that teaches math through movement."

Eleftheriadou was 15 when she realized she wanted to study physics abroad. "I liked both maths and physics and I thought if I study physics I will get to do both!"

Since she already understood English it made sense to prepare to study in the United Kingdom by taking the A-level university entry exams for math and physics. She says Cyprus's school system "did not have any programs to encourage female participation in maths and science." In fact, "I was the only girl in my extra-curricular physics class" and it was based on a British system covering much more than Cyprus offered.

She was 18 when, with her family's support, she struck out on her own for

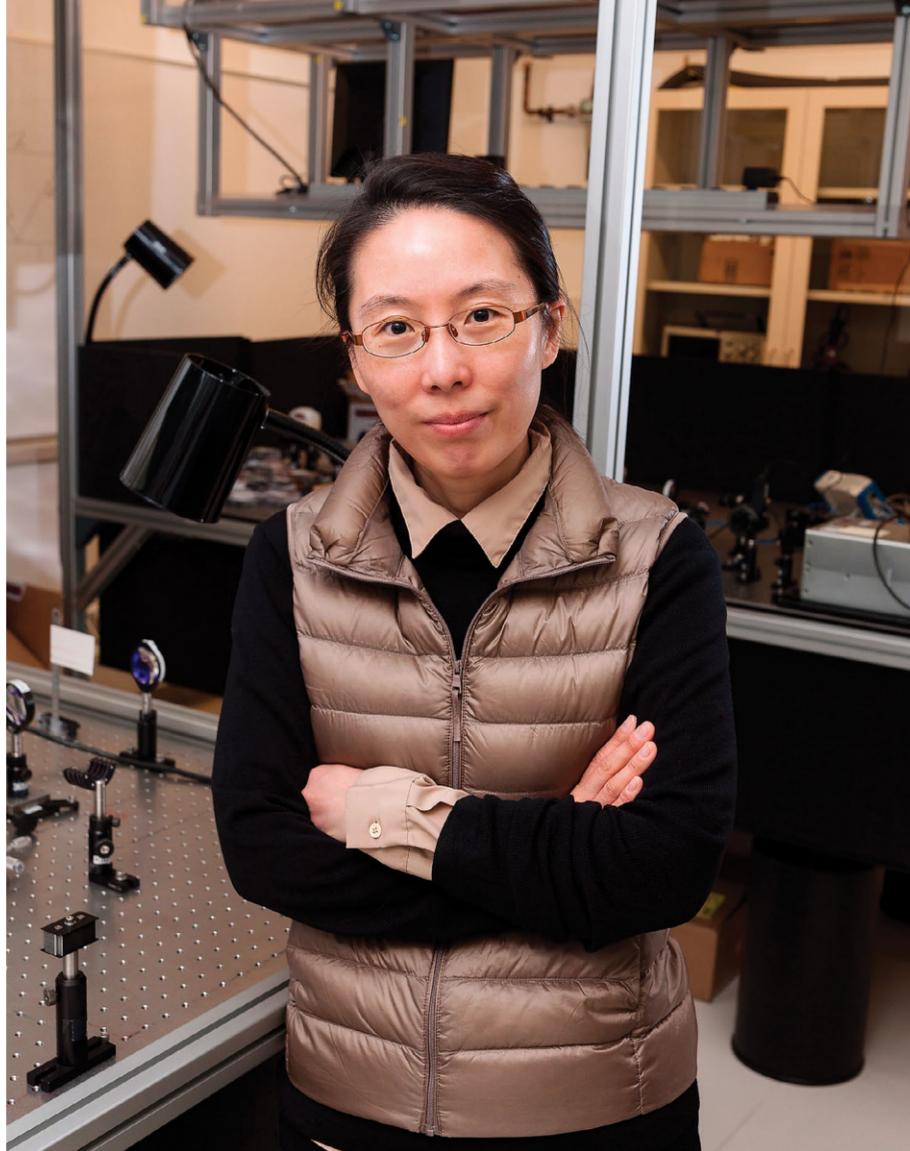
sisters
ON HURON



SARAH PACINI

WAREHOUSE SALE
AUGUST 25, 26 & 27

sistersonhuron.com
SOUTHAMPTON | ONTARIO



ing face-to-face scientific outreach activities to youth, from kindergarten through Grade 12, as well as the general public.

When schools visit the institute she gives an introduction on quantum mechanics and the research done in Waterloo. She leads hands-on activities and guides lab tours.

When she visits schools, she may give a keynote talk or offer a hands-on workshop. She also develops modules for teachers.

She also worked with the institute's outreach team in developing and delivering the special programming content offered to high school students in step with "QUANTUM: The Exhibition," which ran last fall at Themuseum in Kitchener and is now touring the country as part of Canada's 150th anniversary celebrations.

On that brilliant winter morning at the institute, Eleftheriadou was about to demonstrate "quantum trapping" in a planning session that included two teachers and three female students from Oshawa. The lead emissary from Oshawa was Lisa Lim-Cole, the Durham District School Board's science and technology program facilitator. The meeting's objective was to come up with a plan on an outreach program tailored to several hundred Durham students scheduled for later in the spring.

Eleftheriadou says quantum trapping uses a superconducting material, ultra-cooled to -200 C, so it floats above a magnet, shrouded in liquid nitrogen mist that draws oohs and aahs from school kids, regardless of age.

She is convinced "kids need to have fun with science from a young age," as early as kindergarten. "We need to encourage them to be curious about the world around them. Parents shouldn't be frightened when their five-year-old asks a science question." She encourages parents to say: "Actually, I do not know! This is an interesting question; why don't we find out together?"

She notes there are many science and math websites and YouTube channels designed for kids and parents, so the answers are often readily available. She also volunteers in off hours mentoring students such

as with the FemPhys Club – feminist physics.

"Whenever a kid says, 'This is so cool,' I feel that what I do is worth it."

Lim-Cole says programs that spark students' imaginations and support teachers "are critical and we need more to train and support our classroom teachers."

"Our visit to the IQC was fabulous. Electra is full of energy and passion, which is quite contagious," she says. "Electra's vibrant personality and her ability to explain complex concepts in a manner that is accessible for students and educators makes the experience inspiring and engaging."

Lim-Cole says the students who attended the planning session were in Grades 11 and 12, and all three intend to pursue a STEM-based career. "They were definitely excited to meet Electra and visit the IQC."

Lim-Cole runs a number of the board's programs aimed at encouraging girls to study physics and STEM subjects, but acknowledges it's going to take more time and a lot more effort. "For example, physics is required for many STEM programs and yet very few students in general sign up for physics and, even more alarmingly, few are girls."

She says teachers who can inspire students are worth their weight in gold. "Most STEM professionals can name one teacher who inspired them. . . . I would like to make sure that every student has an opportunity to become inspired by many educators."

The Institute for Quantum Computing has three female faculty members as well as seven postdoctoral fellows and 29 graduate students.

Professor Debbie Leung is the longest serving since she came aboard in 2005. A graduate of Stanford University and California Institute of Technology, Leung holds a prestigious Canada Research Chair with research specialties including quantum cryptography and quantum communications.

In the last couple of years the quest to boost female faculty at the Institute for Quantum Computing gained traction.

The institute hired Na Young Kim from Apple Inc. An associate professor, Kim

"Big governments, big companies, universities are all doing research in these areas, paying attention to quantum computing exploration."

NA YOUNG KIM

Scotland after secondary school. She didn't require a scholarship to study abroad as Scotland at the time offered free tuition to European Union citizens.

An annual recipient of scholastic awards of excellence, her high marks in high school allowed her to skip the first year of her undergraduate degree in physics at Heriot-Watt University in Edinburgh. She graduated with the highest grades in her class, her performance so outstanding her admission to starting a PhD at the University of Strathclyde in Glasgow was fast-

tracked, allowing her to skip the master's degree level.

That accelerated academic schedule meant she was younger than others when she received her PhD at age 24.

Then life took another twisting path when she came to Waterloo for post-doctoral research at the Institute for Quantum Computing. Here she got involved in the physics outreach programming and got hooked. Turns out she's a natural.

As a scientific outreach officer Eleftheriadou is responsible for developing and deliver-

Turning your *dreams* into reality.



JWS
Woodworking & Design Inc.
1986

Custom built-ins, outdoor landscape and woodworking.
519-886-0444 | Waterloo, ON | www.jwswoodworking.com

Livable Luxury Design Services



Sandi Loreen Duclos Interiors
Interior Design Consultant

519-897-3061



slduclos@rogers.com | sandiloreenduclosinteriors.ca

REDUCE
HEAT &
GLARE

after

before

Say hello to the view. Say goodbye to UV Rays!

Professionally Installed **WINDOW FILMS:**

- Reject up to 79% of solar heat, reducing energy costs
- Reject 99% of UV rays, while maintaining ambient light
- Prevent fading of furnishings, rugs and decor

TRI-CITY Solar Solutions

COMMERCIAL & RESIDENTIAL WINDOW FILMS

1486 VICTORIA ST. N. www.tricitysolar.com 519.743.0163

heads the Quantum Innovation laboratory, aiming to build large-scale quantum processors based on novel materials and advanced technologies. She is cross-appointed to Electrical and Computer Engineering, Physics and the Waterloo Institute for Nanotechnology and specializes in artificial intelligence, quantum security, quantum materials and semiconductors, among other fields.

Kim firmly believes that telling the story of her research to others is an important role at the institute, not just in terms of what she is doing but also why and how it may benefit society and spur girls to study physics.

She says research is moving ahead steadily and quantum computers that will potentially change the world are about 20 years away from being realized.

“We now have a 12-qubit computer (at IQC) – we didn’t even imagine it 10 years ago,” she says, cradling her hands as if several quantum devices might fit there.

One definition of a qubit is it’s a shortened form of the term “quantum bit.” A traditional computer bit can store information in states of either 1 or 0 (“on” or “off”), while a quantum bit can store information in states of 1, 0, and as a combination of both states simultaneously due to quantum superposition.

Whenever quantum computers fully arrive many experts believe they will haringer the next revolution in humankind’s progress, similar to the invention of the printing press, the industrial revolution, or when microchips and computers were first invented and the World Wide Web came along.

Although she is enthusiastic about quantum computing research and the progress it will bring, Kim believes it is not without risk.

She stresses she is not setting herself up as a spokesperson for this research and the ethical questions being posed. But she says she thinks deeply about why change is happening.

Researchers like Kim are acutely aware of the implications that quantum computers pose, such as the ability to easily break encryption codes or passwords of information thought to be totally secure. Quantum



Crystal Senko is one of three full-time female faculty members at the University of Waterloo’s Institute for Quantum Computing.

technology could potentially do in minutes or hours what would have taken years, decades, if ever, using today’s computing power. The possible effects in society would be massive. It could threaten basic privacy, or influence whole political and social structures.

“Big governments, big companies, universities are all doing research in these areas, paying attention to quantum computing exploration.”

“What are the potential implications,” she asks. “We must continue to think about such things... Can you be a good citizen and contribute to society?” adding that “humbleness” is required but “sometimes this escapes scientists.”

Down the hall, the institute’s third full-time female faculty member, assistant professor Crystal Senko, is settling in. The young California native arrived via Duke University (undergrad), the University of Maryland (PhD), and Harvard, where she was a postdoctoral

follow.

Chatting in her spartan office, Senko projects youthfulness. “I’m 29 so perhaps a couple of years younger than the median age for starting assistant professors, but I don’t think unusually so. I was a couple of months shy of 18 when I started at Duke.”

On this sunny day she is in a good mood. She is tickled to be holding a sketch of her new lab. In the world of academia it takes months to set up a proper scientific laboratory so she is resigned but highly anticipatory.

Home-schooled, her encouragement to study physics came from her parents – her dad, a software engineer, and especially her mom, who attended medical school. Both were highly “invested in their children’s education.” Senko has two brothers, one studying engineering, the other still making up his mind.

Both parents “very much encouraged us to take math and physics.” Senko then expanded her knowledge in physics through “high school enrichment programs” and taking online courses.

She says her alma mater, the University of Maryland, has a very strong quantum research department that helped to launch her on to Harvard and then, finally, Waterloo. Her research at the Institute for Quantum Computing includes manipulation of quantum systems with trapped ions, and quantum computing applications.

She has this advice for students thinking about the future: “As you make important choices like what field to study, learn everything you can about what your options are. I learned from experience that I loved physics classes and loved day-to-day work in certain types of physics labs, and I think enjoying the day-to-day work is the most important thing to know if you’re going to spend years of your life in something.”

More information about University of Waterloo’s STEM programs for kids, especially girls, can be found at:

- uwaterloo.ca/stem-opportunities-girls/
- uwaterloo.ca/magazine/fall-2015/features/changing-face-stem-education

BIG STYLE

VIVAH JEWELRY

ROYAL DOULTON

SAMSONITE

LEVI’S OUTLET

LAURA

SPANNER

PADERNO

TRENDS FOR MEN

OXFORD MILLS

ROCKPORT

NATURALIZER

BIG SAVINGS

RED CORAL

NORTHERN REFLECTIONS

TOY BUILDING ZONE

CORNINGWARE

COTTON WAVE

TOOTSIES

SKECHERS

REEBOK

COUNTRY BLUE

BABYS ROOM WAREHOUSE

OLDE TYME KETTLE KITCHEN

CELL TECH

St. Jacobs Outlets

Open daily; weekday nights to 9 pm
Open holidays 25 Benjamin Road Waterloo

StJacobsOutlets.com