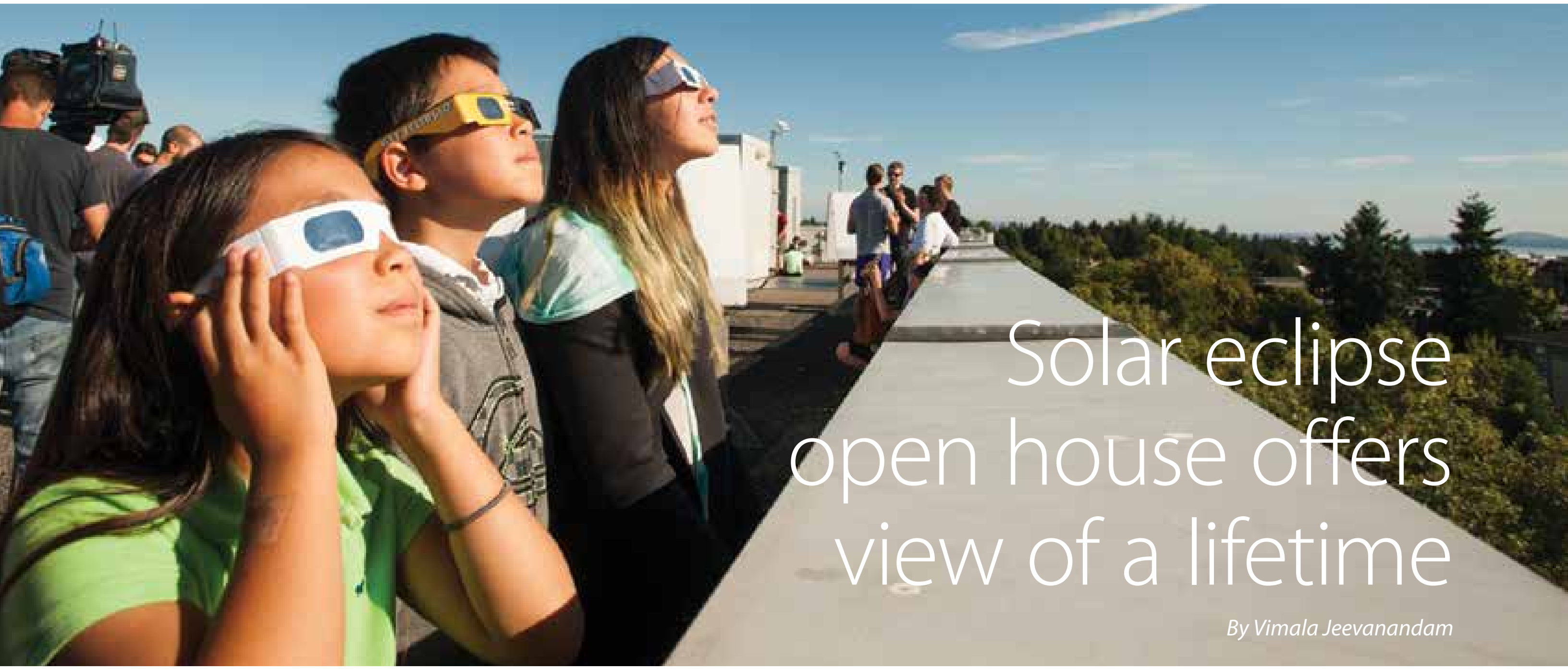
University of Victoria

# ScienceMatters

University of Victoria, Canada / Vol. 11 No. 2 / Fall 2017



# Solar eclipse open house offers view of a lifetime

By Vimala Jeevanandam

In the quiet of mid-August, over one thousand people gathered in and around the Bob Wright Centre at the University of Victoria in the largest event the Observatory has seen.

Astronomy enthusiasts of all ages were on campus to watch the solar eclipse.

The moon passes between the Earth and Sun on average once every 18 months. But on August 21, 2017, for the first time since 1979, the shadow cast was visible across a band of the North America continent as a total eclipse. With ninety per cent coverage, Victoria was the best place in Canada to view the event.

"During a total eclipse, the sun, moon and Earth are perfectly lined up so that the sun is blocked out completely when viewed from a band that is approximately 80 kilometers wide called the 'Path of Totality,'" says Karun Thanjavur, an instructor in the department of Physics and Astronomy, as well as the organizer of the eclipse event.

This time, the total eclipse stretched from Oregon south eastwards to South Carolina. "Here in Victoria, the shape of the sun became a beautiful thin crescent."

To safely watch, eclipse viewers could use protective eclipse glasses or specialized telescopes, which were set up within the Bob Wright Observatory.

With the Observatory at capacity, volunteers handed out safety eclipse glasses to the crowd around the building to share.

Fortunately, the eclipse could also be indirectly watched by looking through pinhole cameras or using anything else that had small holes in it and could be used to cast a shadow or a reflection. In and around the observatory, people shared their homemade devices for viewing the eclipse, ranging from a disco ball to pinhole cameras made from cereal boxes.

"The turnout was incredible," says Thanjavur. "It was a joy to see so many people excited about astronomy. We are hoping we'll have the chance to meet many of them again at our weekly open house or the many other public events we host.

## DEAN'S MESSAGE

As you flip through this issue of Science Matters, I hope you enjoy reading about a few of the recent discoveries made by our world-class researchers. I'm constantly inspired by how the Faculty of Science is expanding our understanding of everything from microscopic algae to supermassive black holes at the center of galaxies. I hope you find yourself similarly inspired as you consider the many ways that the Faculty of Science is shaping our understanding of the world and beyond.

The Faculty continues to receive significant levels of support from the Natural Sciences and Engineering Research Council of Canada (NSERC). Just this September the Federal Minister of Science was on campus to announce that thirty-two UVic Science researchers were being awarded $5.5 million in NSERC Discovery grants and accelerator supplements. Many of our graduate students also received scholarships and fellowships to support their studies.

UVic recently released its first Indigenous Plan, building on the University's longstanding commitment to and relationships with Indigenous communities, both local and national. The Faculty of Science is committed to finding and supporting educational opportunities for Indigenous students interested in STEM. For example, working with the Office of Indigenous Academic and Community Engagement, we have invested in the Indigenous Mini-University Summer Camp, which provides BC Indigenous high-school students with an all-encompassing experience of University life. We are also placing Math Teaching Assistants in the First Peoples' House.

I hope that you keep in touch and that we see you on campus soon.

Sincerely,
Rob Lipson

# $9.5 million in grants to UVic researchers will have vital impact

*By Jody Paterson*

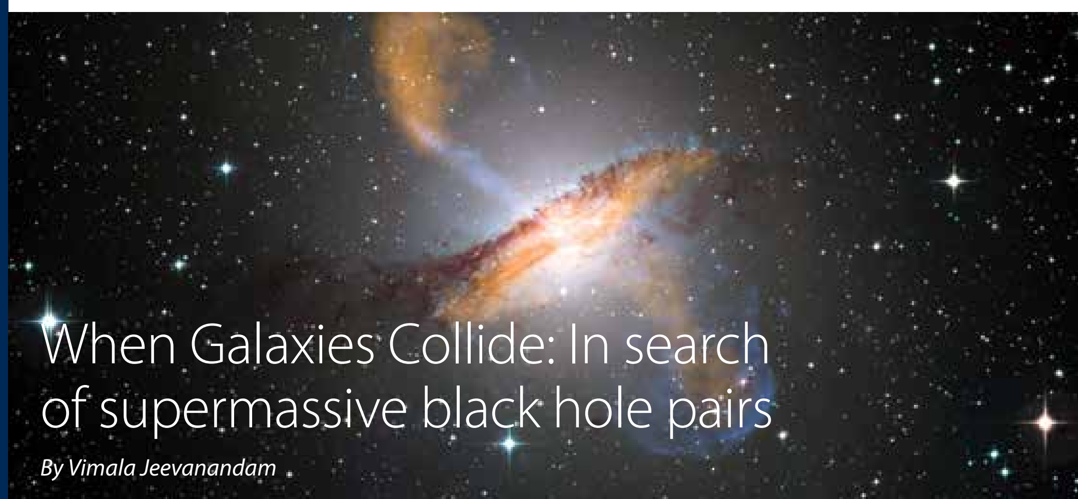
Science research at the University of Victoria received a major boost this fall through $9.5 million in Natural Sciences and Engineering Research Council (NSERC) grants awarded to UVic researchers in 15 faculties and departments.

Individual grants totaling $7.8 million were awarded to 48 UVic researchers, including 32 in the sciences. Another $1.7 million was awarded in scholarships, fellowships and Accelerator supplements, such as the $120,000 supplement awarded to Earth and Ocean Sciences researcher Edwin Nissen for his work illuminating the northern Cascadia earthquake faulting, using satellite and airborne geodesy.

Federal Science Minister Kirsty Duncan and NSERC President Mario Pinto were both on campus to make the Sept. 8 announcement, one of several announcements across Canada that day announcing a total of $515 million in NSERC grants. The grants have supported basic research in Canada for the past century in the areas of natural sciences and engineering.

"These awards recognize that creativity and innovation drive research advances," said UVic President Jamie Cassels. "We appreciate NSERC's vital ongoing support for fundamental research and the training of the next generation of our leaders in natural sciences and engineering."

Four UVic researchers were selected to present their work to Minister Duncan as part of the announcement. They included Dean Karlen, a particle researcher in UVic's Department of Physics and Astronomy and physicist with the TRIUMF project; and chemistry professor Fraser Hof, Canada Research Chair in Supramolecular and Medicinal Chemistry.



# When Galaxies Collide: In search of supermassive black hole pairs

*By Vimala Jeevanandam*

A University of Victoria astronomer has discovered an inspired method of finding the elusive pairing of supermassive black holes that mark merging galaxies.

As galaxies near each other, they distort in shape, breaking and reforming the orbits of the billions of stars within them. The two galaxies then spiral toward each other, eventually colliding. The supermassive black holes that are at the center of each galaxy are drawn together in the collision and ultimately form a single bigger supermassive black hole.

But before they merge, the two black holes exist in relatively close proximity, feeding from nearby matter. The formation is known as a dual active galactic nucleus (AGN).

"Supermassive black hole mergers take place over hundreds of millions of years," says Sara Ellison. "The more pairs that are found, the better we can understand how these formative interactions happen."

But dual AGNs have been frustratingly difficult to spot. After a decade of systematic searching by researchers across the globe, only 10 had been discovered and confirmed with X-ray observations.

Seeking a more effective method to find dual AGNs, Ellison and her collaborators analyzed data from sky surveys, looking for dust and gas that are stirred up in the late stages of a black-hole merger, in combination with the bright light produced by dual AGNs. That work, backed up by observations from the NASA Chandra X-Ray Observatory, led to the identification of five new AGN pairs in the last six months.

Ellison's work was funded through a Natural Sciences and Engineering Research Council Discovery grant.

Photo credit: ESO/WFI (Optical); MPIfR/ESO/APEX/A. Weiss et al. (Submillimetre); NASA/CXC/CfA/R.Kraft et al. (X-ray)

# Protein modelling brings hope for dementia treatment

*By Jody Paterson*

Unraveling the mysteries of proteins whose changed structures cause conditions such as Alzheimer's and Parkinson's disease is key to developing new drug treatments for devastating neurological disorders, says a University of Victoria biochemist whose findings are attracting an international audience.

Science has only recently acquired the tools to do the molecular modelling needed to determine a protein's structure, says Christoph Borchers. His research establishes a mechanism for doing that.

Borchers has developed a method for creating three-dimensional models of cellular proteins. That work, done in collaboration with computational biochemist Nikolay Dokholyan from the University of North Carolina, will shed new light on proteins that change their structure and cause neurological conditions including Alzheimer's, Parkinson's, and Creutzfeldt-Jakob disease.

Being able to create a model of these tiny structures for the first time clears the way for custom drug treatments for proteins that change their structure in ways that cause disease.

"What happens with a disease like Alzheimer's is that the protein changes its structure and starts to build a chain that then leads to the plaque in the brain that causes this condition," says Borchers. "We can interrupt that chain, but we first need to know the 'key and lock' that would let us do that. If you know the structure that leads to Alzheimer's, then you can develop drugs that fit with that structure."

Until now, scientists could only study a chain of amino acids and make their best guess as to the structure of the protein created by that chain, as proteins are too small to be seen under a microscope. Every gene in human cellular DNA contains the code for a protein structure, the term used for the sequence of

amino acids unique to that protein.

"If you know the structure, you can understand the function," says Borchers. "We've always dreamed about this, and now we have shown it's possible. But now we want to apply it. The next stage is to use this technology to elucidate the structure of disease-involved proteins."

# UVic chemist develops energy-efficient computer memory

*By Vimala Jeevanandam*

A University of Victoria chemist has developed a breakthrough material that will make computers and smartphones faster, more durable and more energy-efficient.

The new material allows computer chips to exist at a molecular level, with a technology known as light induced magnetoresistive random-access memory (LI-RAM). Developed by materials chemist Natia Frank, the invention is part of an international effort to reduce the power consumption and heat produced by modern computer processors. Known as the "power wall," the problem of heat and electrical consumption is creating an environmental concern and limiting the development of faster computers.

Compared to the current standard, LI-RAM uses 10 per cent less power, creates almost no heat and has higher durability—all while processing information faster.

Using light rather than electricity as the conductor of information is what makes LI-RAM unique. "The material in LI-RAM has the unusual quality of rapidly changing magnetic properties when hit with green light," says Frank. This means that information can be processed and stored at the single molecule level, allowing for the development of universal memory—a technology that has, until now, been hypothetical.

The PCT (Patent Cooperation Treaty) Patent Application for LI-RAM was filed in partnership with GreenCentre Canada, who named their work on the technology as a top achievement for 2016. Frank is now working with international electronics manufacturers to optimize and commercialize the technology, which could find its way to consumers in the next 10 years.

Data storage for mobile phones, computers and electronics is just one way this technology can be used. "Potentially, this material could have other uses in medical imaging, solar cells and a range of nanotechnologies," says Frank. "This is just the beginning."

Frank received funding from the Natural Sciences and Engineering Research Council for the development of this technology.

Natia Frank (right) with PhD student Aiko Kurimoto with early stage prototype devices. The coloured flasks to the far right contain two versions of the switchable material.

# Tiny life forms, big impact

*By Vimala Jeevanandam*

## Every spring, as the rest of us are admiring the daffodils, Dr. Diana Varela has her eye on a different type of bloom.

The University of Victoria biological oceanographer is studying the marine diatoms of Saanich Inlet, just north of campus. As the days lengthen and the sun gets brighter, nourished with the abundant nutrients that have built up over the past winter, the diatoms burst into algal blooms.

These unicellular lifeforms are the crux of ecosystems both aquatic and terrestrial. Part of a larger group of microscopic algae known as phytoplankton, diatoms drift across the top layer of oceans, seas and lakes.

Phytoplankton as a whole produce about half of Earth's oxygen, cycle elements such as carbon, silicon and nitrogen throughout the ocean, all while providing a primary food source for marine animals. And like plants, phytoplankton trap atmospheric carbon dioxide, making them a powerful influence in global climate change.

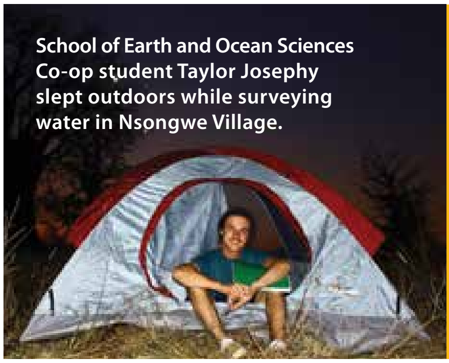
"Because they're microscopic and rarely seen with the naked eye, it's easy to overlook phytoplankton. But they're fundamental to so much of life," says Varela, who is a scientist and professor in UVic's Department of Biology and School of Earth and Ocean Sciences. "Understanding what influences phytoplankton and, in turn, their impact on its environment, is essential to understanding the planet as a whole." This has been the focus of her research for the past 20 years, where she couples field studies with laboratory work. In her search to clarify the complex relationship between phytoplankton and their environment, she's gone on expeditions to some of the planet's most extreme climates—from the Arctic Ocean to Antarctic marine waters.

There she has examined the dramatic seasonal effects of polar conditions, as well as the burgeoning impact of climate and habitat change on the productivity of sensitive planktonic communities.

Closer to home, Varela has been examining the role of diatoms in Saanich Inlet. Each year, after the diatoms bloom, they die off in huge numbers as part of their bloom-and-bust cycle. As they die, they fall to the inlet's ocean floor. Here, in the depths of the inlet, the intensity of the diatom seasonal die-off causes low oxygen levels, creating a natural seasonal dead zone.

"The inlet is a unique habitat—dynamic and with constantly changing conditions," says Varela. The variations it experiences over a year make it an excellent place to study the role of diatoms on carbon capture, oxygen content and the overall ecosystem, using the abundant nutrients in seawater that had built up over the winter."

As the global climate changes, we're seeing an increase in the number and size of low or no-oxygen areas, dramatic increases in phytoplankton productivity in some regions, and a decrease in others. The information that Varela's team gathers on phytoplankton processes can be used to explain and predict changes that are happening in marine ecosystems throughout the world.



**School of Earth and Ocean Sciences Co-op student Taylor Josephy slept outdoors while surveying water in Nsongwe Village.**

"I'm tenting in Nsongwe Village. Surveying water infrastructure in rural areas means many nights like this: Nshima (boiled corn meal), Zambian stars (incredible), and campfire chats with welcoming Zambians (even more incredible). The culture remains vibrant despite severe hardship. The people are honestly the most resilient and kind individuals I've ever met. Spending time with them is a very special experience."

## Giving Back

Our alumni make a difference by volunteering at events, speaking to classes, hiring co-op students or supporting scholarships. To help change the lives of our current students, you can make a donation today **uvic.ca/givingtouvic** or by contacting the Development Coordinator, at 250-472-4210 or **devtcoor@uvic.ca.**

## Planning a reunion?

The UVic Alumni Association can help by promoting your event to classmates, arranging speakers or providing door prizes. Network and keep involved by exploring the list of groups and upcoming events to find something that's right for you. **uvic.ca/alumni/connect**

## Alumni Newsletter

Science Matters is published twice yearly by the Faculty of Science to communicate the faculty's goals, strategic direction and activities in order to connect alumni with each other and the university. Send your story ideas and feedback to Julia Keenan at jkeenan@uvic.ca

University of Victoria

**FACULTY OF SCIENCE**
PO Box 1700 STN CSC
Victoria, BC V8W 2Y2
sciealum@uvic.ca
uvic.ca/science

**GET CONNECTED:** Reconnect with classmates, share stories, and learn about upcoming special events by joining a group today.

@uvicscience University of Victoria Science Alumni uvicscience

**MOVING?** Let us know and we'll make sure your record is updated.