UNIVERSITY of WASHINGTON

CHEMLETTER

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LETTER FROM THE CHAIR

Dear Friend of Chemistry,

Greetings from the chair's office to all of our alumni and friends. As you read this, Spring Quarter is drawing to a close and we are preparing our graduation ceremonies for the Class of 2017. Our students have made us proud again this year. Our department is strongly represented in the second cohort of the Husky 100, by five students who have been recognized for their passion and leadership in applying what they learn on campus in ways that make a difference in their communities and for the future.

This is the time of year when we are working hard to recruit graduate students to join us in September. I am pleased to report that we will welcome 45 new students in the fall. This class of 21 women and 24 men comes from top universities in the U.S. (39) and abroad (6). We are always energized by the arrival of a new cohort of bright young people who bring great enthusiasm to their research and teaching.

Renewal continues among the faculty. We are saddened by the approaching departure of Professor Karen Goldberg, who is leaving us to join the University of Pennsylvania. I am pleased to report that we have appointed Alexandra Velian as assistant professor of chemistry. Alexandra is an inorganic chemist who will establish a research program in materials chemistry for catalysis and energy applications (see page 3 for more about Alexandra).

We do not yet know the details of our state budget, but we anticipate continued modest support. Thus we depend more than ever on the generosity of our donors to provide the funds which make excellence feasible. I am deeply gratified to report that Larry Dalton and Nicole Boand have made a very generous commitment to the Department. This transformative gift is described in greater detail on page 4.

Thank you to all of our supporters; your annual gift of even $10 makes a difference for today's students. We are fortunate that many of our thousands of alumni choose to give back.

Keep in touch. My next update will come in a few months—until then, visit us on Facebook @UWChem and check our news blog on our homepage, http://chem.washington.edu.

Sincerely,

D. M. Heinekey

D. Michael Heinekey
Professor and Chair

IN THIS ISSUE

FACULTY PROMOTIONS

Champak Chatterjee Promoted to Associate Professor with Tenure; Bo Zhang Promoted to Professor

The Department of Chemistry congratulates Champak Chatterjee and Bo Zhang on their promotions, effective September 16, 2017. Assistant Professor Champak Chatterjee was promoted to associate professor with tenure. Associate Professor Bo Zhang was promoted to professor.

Professor Zhang's research focuses on the development and application of electroanalytical measurement tools to study single electrochemical events and processes. The Zhang group uses nanometer-scale electrodes to study electron transfer reactions of single molecules and single metal nanoparticles, electrocatalysis, and mass transport at the electrode/solution interface. This work is being conducted in pursuit of fundamental understanding of heterogeneous electron-transfer reactions and electrode/solution interfaces as well as single-cell chemistry and biological function such as neuronal secretion and brain activity.

To learn more about Professor Zhang and his research, please visit his faculty page (http://depts.washington.edu/chem/people/faculty/zhang.html) or contact him directly at 206-543-1767 or zhang@chem.washington.edu.

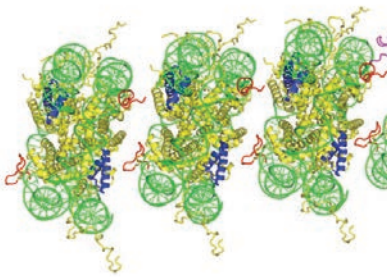
Research in the Chatterjee group focuses on various aspects of protein regulation by reversible chemical modifications. By investigating how the biophysical and biochemical properties of key bacterial and human proteins change with their modification states, the Chatterjee group is uncovering the molecular mechanisms that drive critical events in cell growth and survival, such as gene transcription and protein degradation. This mechanistic knowledge enables the design of therapeutics that selectively target protein-mediated processes that are misregulated in a wide range of human diseases.

Besides building up a nationally respected research program, Champak and his wife have also built up a family in Seattle! Leah, who is a team operations leader in the Human Subjects Division at the University of Washington, and Champak are doting parents to five-year-old Adam and two-year-old Monica.

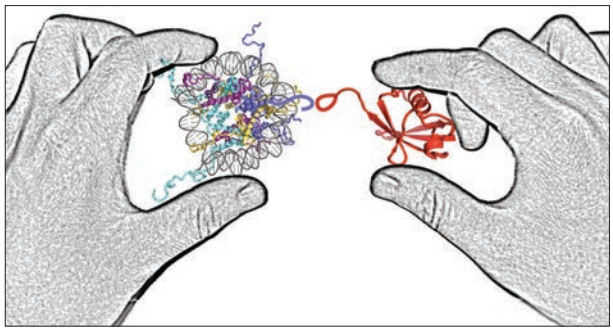
To learn more about Professor Chatterjee's research, please visit his faculty page (http://depts.washington.edu/chem/people/faculty/chatterjee.html) or contact him directly at 206-543-2349 or chatterjee@chem.washington.edu.

Bo Zhang

Champak Chatterjee

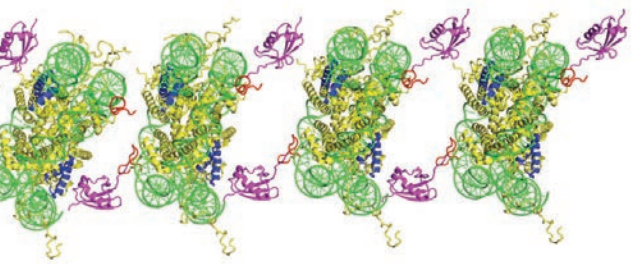


Above: **Summoning gene repression.** The Chatterjee group has demonstrated that the presence of a ubiquitin-like protein, SUMO, near histones can trigger biochemical events that lead to genes being turned *off*. In the cartoon, the protein CoREST binds SUMO, which in turn recruits a histone-modifying enzyme, LSD1, to remove an *on* signal (methyl groups) from genes. Such novel insights, enabled by innovative chemical techniques developed at UW Chemistry, will inspire molecular medicines that target specific cellular pathways associated with the development and progression of human diseases. *artwork: Mary O'Reilly*



Above: **Building biological systems with chemical precision.** The Chatterjee group applies techniques from traditional organic synthesis to produce single proteins and well-defined complex biological systems, such as the fundamental unit of our genes—the mononucleosome. Carefully executed protein chemistry enables "decorating" mononucleosomes with ubiquitin (red) and other ubiquitin-like proteins, in order to study their effects on human gene function.

Below: **Propping genes open.** A structural model for how ubiquitin-like proteins (violet) can open up highly compacted human DNA (green) when appended to the underlying histone proteins (blue and yellow). The image shows a compacted DNA structure on the far left gradually opening up as more ubiquitin-like proteins are added onto the histones, until the open DNA structure on the far right is achieved.



NEW FACULTY HIRE

Alexandra Velian to Join Faculty

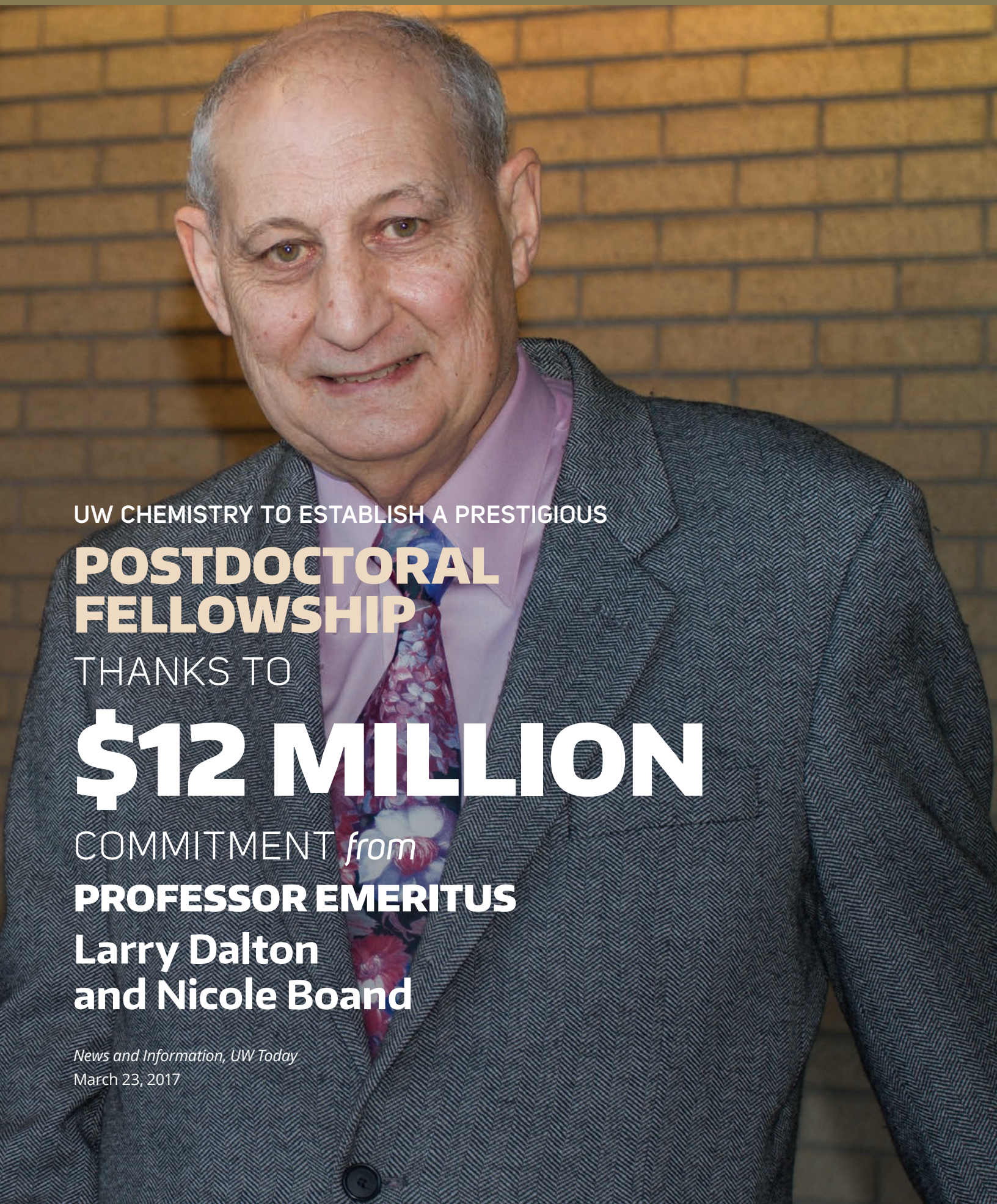
We are delighted to announce that Dr. Alexandra Velian will join us as assistant professor of chemistry.

Dr. Velian completed her undergraduate studies in chemistry at the California Institute of Technology, where she conducted research with Professor Jonas C. Peters prior to developing the synthesis of low-valent mono- and bimetallic complexes supported by a rigid terphenyl diphosphine framework with Professor Theodor Agapie. She received her Ph.D. under the direction of Professor Christopher C. Cummins at the Massachusetts Institute of Technology, where she developed the synthesis of anthracene and niobium-supported precursors to reactive phosphorus fragments and studied their behavior using chemical, spectroscopic, and computational methods. Notably, this work gave rise to the synthesis of the 6π all-inorganic aromatic anion heterocycle $P_2N_3^-$, produced in the "click" reaction of P_2 with the azide ion. She is currently a Materials Research Science & Engineering Center postdoctoral fellow with Professor Colin Nuckolls at Columbia University, where she is working to create well-defined functional nanostructures by linking atomically precise metal chalcogenide clusters.

Dr. Velian will launch her research program at the University of Washington in July 2017. Her independent program will focus on the development of synthetic strategies to access new generations of molecular and heterogeneous inorganic catalysts and electronic materials. In the long term, she seeks to contribute fundamental understanding of chemical processes happening at the surface of semiconductor materials. With a primary foothold in inorganic and organometallic chemistry, her research program will interface with chemical engineering and materials science.

For more information about Dr. Velian and her research, please visit her faculty page (http://depts.washington.edu/chem/people/faculty/velian.html) or contact her directly at avelian@uw.edu.

Alexandra Velian



UW CHEMISTRY TO ESTABLISH A PRESTIGIOUS

POSTDOCTORAL FELLOWSHIP

THANKS TO

$12 MILLION

COMMITMENT *from*

PROFESSOR EMERITUS Larry Dalton and Nicole Boand

News and Information, UW Today
March 23, 2017

Building upon a long legacy of supporting scientific innovation and education, Professor Emeritus Larry Dalton and his wife, Dr. Nicole Boand, have committed $12 million to the UW Department of Chemistry. The majority of the gift will go to establish the Dalton Postdoctoral Fellowship in Chemistry—a postdoctoral fellowship similar to those at the nation's most prestigious research institutions like University of California, Berkeley and Harvard University.

One of only a handful of similarly funded fellowships at public universities across the United States, this fellowship will support researchers in the postdoctoral phase of their training. This is a formative and productive time for early-career scientists as they work to obtain research experience and publications to qualify them for full-time, tenure-track faculty positions. These promising scientists often play a critical role in accelerating fundamental research into real-world applications, as they are able to focus 100 percent on the research challenges before them.

"This postdoctoral fellowship will enable the Department of Chemistry to attract and support the brightest early-career scientists from across the nation, ensuring that the UW is a leader in next-generation research in the chemical sciences," said Michael Heinekey, professor and chair of the Department of Chemistry. "This gift will help to elevate our department to the level of top chemistry departments around the world."

Building on past gifts to the Department, this gift will also fund two endowed chairs to help the department recruit and retain top researchers. One chair will be named for Boand's parents and the other named for Alvin Kwiram, UW professor emeritus of chemistry and vice provost emeritus for research. Additionally, the gift will create an endowed departmental support fund to ensure the department has flexible and reliable resources to respond to opportunities as they arise.

Dalton and Boand's most recent investment in the Department of Chemistry serves to underscore and amplify their legacy of impact at the UW. Over the years, they have established two endowed professorships in chemistry and two endowed chairs. These endowments have provided meaningful research support to the six faculty members who have held them, and to the numerous undergraduate and graduate students working alongside those faculty.

"Larry Dalton has already made a phenomenal impact at the University of Washington, and to have a faculty member add to such a legacy by demonstrating this level of dedication to his field and to future generations of students and professors in the UW's chemistry department is truly remarkable," UW President Ana Mari Cauce said. "I am profoundly thankful for this commitment from Larry and Nicole, which will honor his work and support innovation at the UW for years to come."

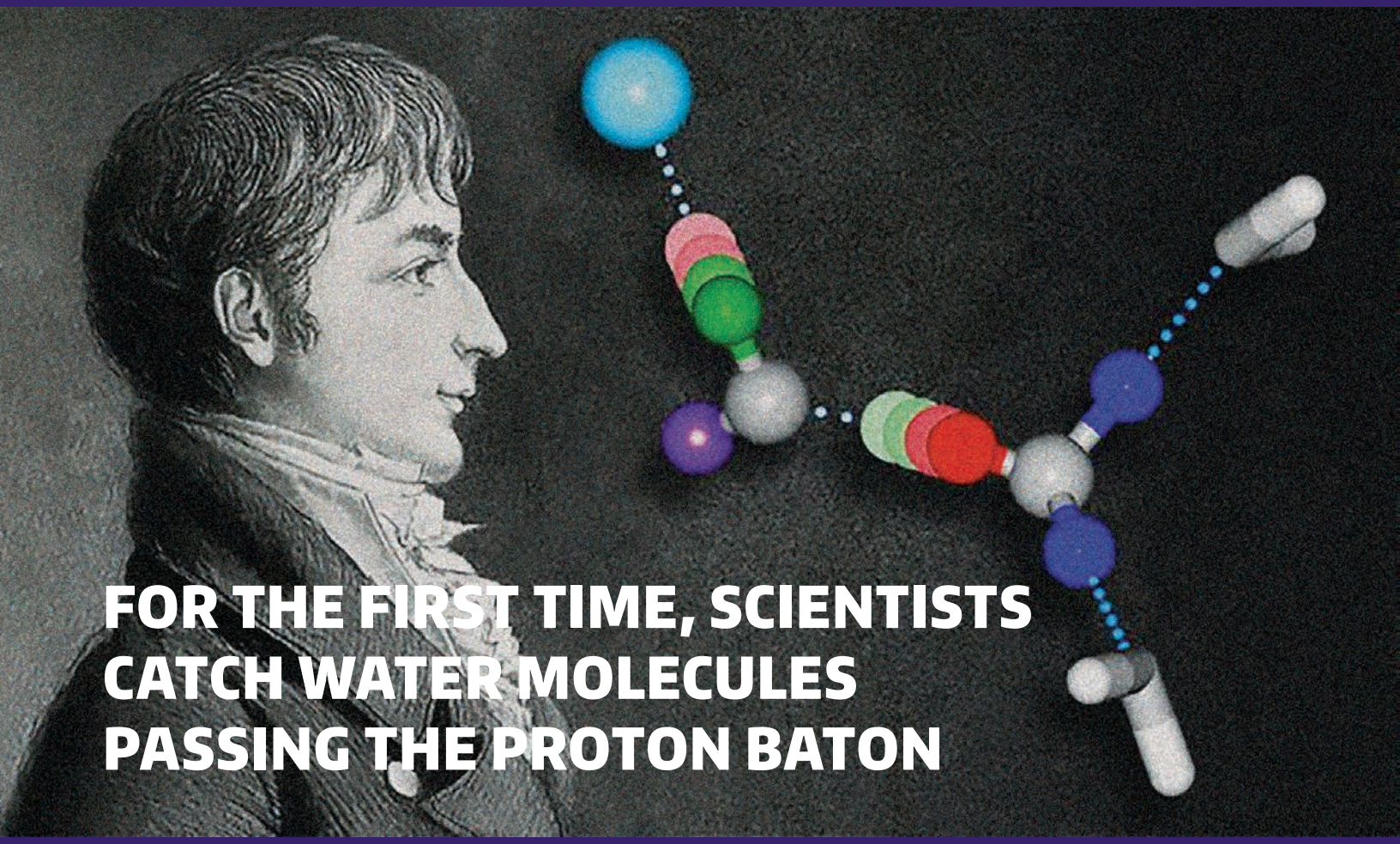
This gift follows Dalton's decades of research in photonics and nonlinear optics. He joined the UW Department of Chemistry in 1998. In 2000, Dalton and his collaborators published a foundational paper in *Science*, which laid the groundwork for innovations in opto-electronics, with major implications for telecommunications, sensor technology, and information technology. Dalton went on to found Lumera Corp.—now part of GigPeak—to develop and manufacture opto-electronic devices. His research was instrumental in securing a major grant from the National Science Foundation to launch the Center for Materials and Devices for Information Technology Research at the UW, which was foundational for what would become the UW Clean Energy Institute.

During his nearly 20 years in the Department of Chemistry, Dalton invested his time, energy, and resources to support students and burgeoning researchers. Both he and Boand have shown through their philanthropy a deep commitment to the next generation of science and scientists. The Dalton Postdoctoral Fellowship in Chemistry, along with the newly endowed chairs and other departmental support, is a culminating expression of that commitment.

"We make this current contribution in the hope and belief that it will promote recruitment and retention of the best and brightest researchers and educators in STEM fields to the University of Washington," said Dalton. "Nicole and I appreciate the critical impact that STEM research has made and is making to the economy and well-being of Washington and the nation, and to the importance of quality education which assures continuation of this broader impact of STEM research."

For more information, contact James Urton with the UW Office of News & Information at jurton@uw.edu or 206-543-2580. To arrange an interview with Dalton or Boand, contact Candice Douglass at candiced@uw.edu, 206-616-3506 or 425-214-2704 (after hours).

UW Professor Emeritus of Chemistry Larry Dalton.
Photo by Colette Cosner



FOR THE FIRST TIME, SCIENTISTS CATCH WATER MOLECULES PASSING THE PROTON BATON

JAMES URTON
News and Information, UW Today
December 1, 2016

Water conducts electricity, but the process by which this familiar fluid passes along positive charges has puzzled scientists for decades.

But in a paper published in the Dec. 2 issue of the journal *Science*, an international team of researchers has finally caught water in the act—showing how water molecules pass along excess charges and, in the process, conduct electricity.

"This fundamental process in chemistry and biology has eluded a firm explanation," said co-author Anne McCoy, a professor of chemistry at the University of Washington. "And now we have the missing piece that gives us the bigger picture: how protons essentially 'move' through water."

The team was led by Mark Johnson, senior author and a professor at Yale University. For over a decade, Johnson, McCoy, and two co-authors—Professor Kenneth Jordan at the University of Pittsburgh and Knut Asmis, a professor at Leipzig University—have collaborated to understand how molecules in complex arrangements pass along charged particles.

For water, this is an old question. Chemists call the process by which water conducts electricity the Grotthuss mechanism. When excess protons—the positively charged subatomic particles within atoms—are introduced into water, they pass quickly through the fluid, riding a transient, ever-shifting network of loose bonds between water molecules. By the Grotthuss mechanism, a water molecule can pick up an excess charge and pass it along to a neighbor almost instantaneously.

The exchange is fundamental to understanding the behavior of water in biological and industrial settings. But it is also so fast and the vibrations between water molecules so great that the hand-off cannot be captured using traditional spectroscopy—a technique that scatters light against a molecule to learn about its structure.

"With spectroscopy, you hit objects with a beam of photons, see how those photons are scattered and use that scattering information to determine information about the object's structure and arrangement of atoms," said McCoy. "And this is where Mark Johnson's lab at Yale has really been a leader—in adapting spectroscopy to better capture this transfer of protons among water molecules."

Johnson's group, along with collaborators in Asmis's group in Germany, figured out how to freeze the proton relay to slow the process, giving the researchers time to visualize the Grotthuss mechanism using spectroscopy. When these "spectroscopic snapshots" proved still too blurry due to vibrations in chemical bonds, they switched to studying this mechanism in "heavy water." In heavy water, regular hydrogen atoms are replaced by a heavier isotope called deuterium. By the quirky rules of quantum mechanics that underlie the behavior of subatomic particles, bonds in heavy water shake less than traditional H_2O.

Researchers have taken spectroscopic snapshots of the passage of extra protons from one water molecule to another during conductivity, a concept first described by chemist Theodor Grotthuss. *Image from Yale University/ Grotthuss image courtesy of Wikipedia*

But this snapshot required massive amounts of theoretical and computational decoding to reveal just how water molecules momentarily altered their structure to both receive and pass along an extra proton. McCoy's and Jordan's groups helped develop computational approaches to analyze the spectroscopy data.

Anne McCoy

"In spectroscopy, your goal is to determine the structure of molecules based on how they scatter light," said McCoy. "In our approach, we also asked how the behavior of bonds will affect spectroscopy. That really completed our circle of inquiry and allowed us to visualize this transfer of protons."

In their paper, they describe the Grotthuss mechanism attaching various tag molecules to complexes made up of four molecules of heavy water. According to McCoy, they would like to see how the proton relay changes among larger groups of water molecules and to expand these spectroscopy techniques to include other small molecules with complex structures.

Lead author on the paper is Conrad Wolke at Yale University. Other co-authors are Joseph Fournier of the University of Chicago; Laura Dzugan of The Ohio State University; Matias Fagiani and Harald Knorke of Leipzig University; and Tuguldur Odbadrakh of the University of Pittsburgh. McCoy, who moved to UW from The Ohio State University in 2015, currently maintains labs at both institutions and Dzugan is a member of her research group. The research was funded by the U.S. Department of Energy, the National Science Foundation, and the German Research Foundation.

For more information, contact McCoy at 206-543-7464 or abmccoy@uw.edu.

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2017 CHEMISTRY AWARDS DINNER

The Department of Chemistry hosted the 26th annual Awards Dinner in March to acknowledge our award winning students and faculty and to thank our friends and alumni, who make many of our student awards possible through gifts to departmental fellowships.

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