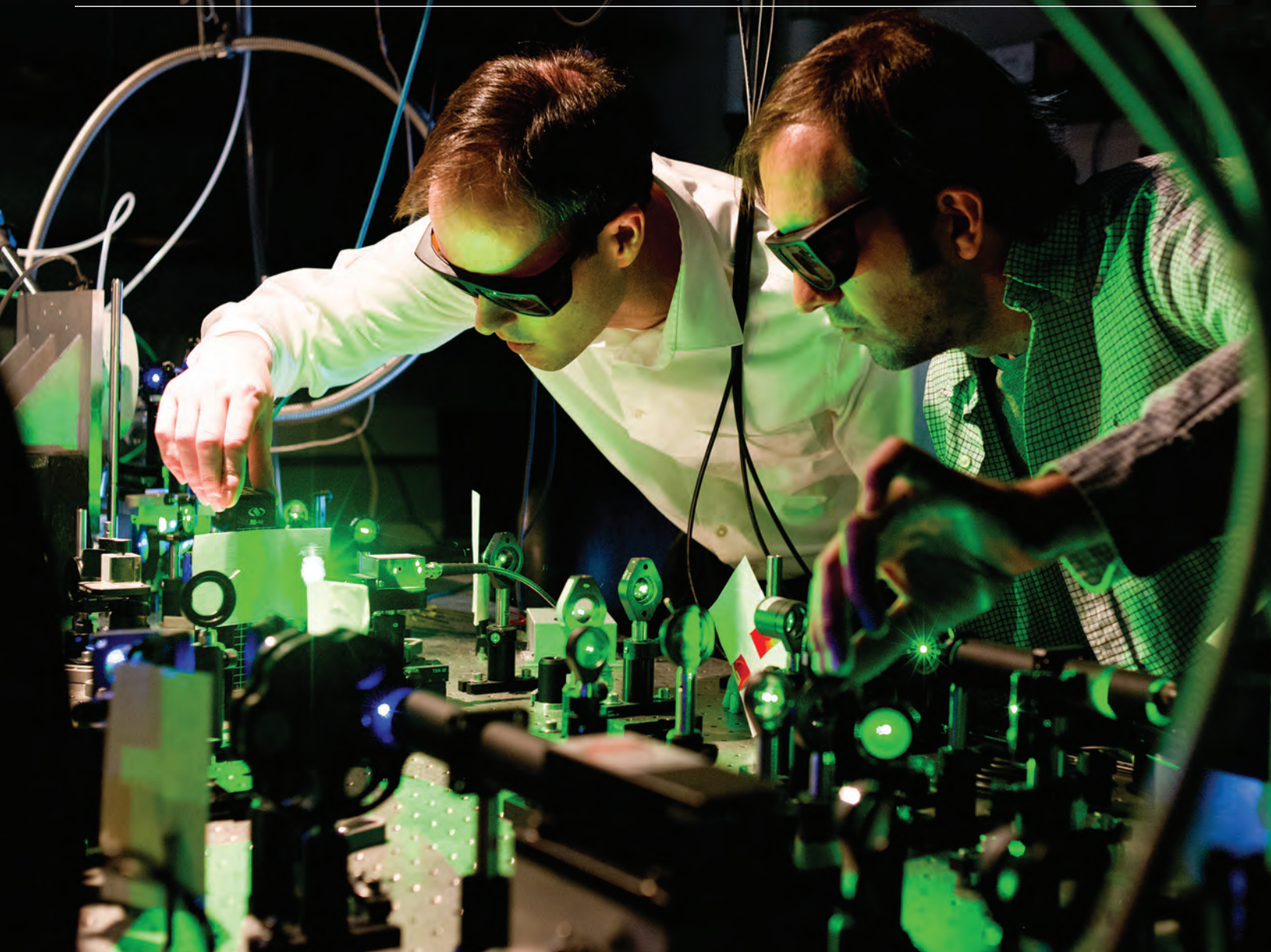
CornellEngineering
Applied and Engineering Physics

AEP

Alumni Newsletter
2020-2022



DEAR FRIENDS OF AEP,

Laura Mortelliti

In 2020, after six transformative years, Professor Lois Pollack stepped down as director of the School of Applied and Engineering Physics at Cornell. In fact, she will soon step into the role of the college's Associate Dean for Research and Graduate Studies. I have been honored to succeed her as director of AEP. I'm delighted to share that I first came to AEP as a Ph.D. student in 1991 and did my research in Professor Watt Webb's lab in the basement of Clark Hall. After spending five years at Bell Labs, working on optical imaging and then fiber optic telecom, I returned to AEP as an assistant professor in 2002. My work over the years at Cornell has focused on fiber optics and biomedical imaging—particularly on developing tools for imaging the brain. I've always had a strong resonance with the mantra of AEP: applying the fundamental knowledge of physics to solve real-world problems. Over the last five years, I had the good fortune to start Cornell Neurotech, a collaborative program between Cornell Engineering and A&S supported by a multi-million dollar gift from Stephen Mong (BS'92, MEng'93, MBA'02), and I continue to serve as its founding co-director.

I feel fortunate to be able to contribute to the philosophy of an AEP education, the intellectual breadth of AEP research, and the school's unique ability to continuously develop and implement big, leading ideas for the future. Please feel free to email me at aep_director@cornell.edu.

With warm wishes,

Chris Xu
Professor and Director

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AEP STAFF SPOTLIGHT: Bonni Jo Davis

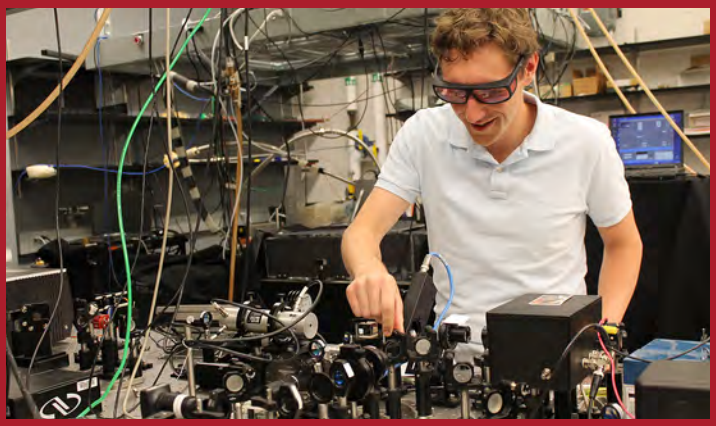
Diane Tessaglia-Hymes

On June 1, 2022, Bonni Jo Davis, AEP's valued and committed Finance Lead for the last 38 years, will retire from Cornell University. She has graciously agreed to continue supporting AEP for a few more weeks until her replacement arrives. We can't thank her enough for her invaluable service throughout the years and for supporting this transitionary period a little longer than planned. We are beyond grateful for all she has done for AEP, and very sad to see her go. We wish her all the best as she pursues the next chapter of her life.

INSIDE THIS ISSUE

ABOUT THE COVER

Professor Gregory Fuchs (right) works on a confocal microscope with Nick Jungwirth.



Jason Bartell works on the optics of the Fuchs lab magnetic microscope.

AEP Associate Professor Gregory Fuchs and his lab have been using point defects in diamonds, known as nitrogen-vacancy (NV) centers, to create quantum technologies ranging from magnetic field sensors to nodes of a quantum internet. Fuchs and other researchers are using the spin of NV centers as a sensor, with the capacity to detect small changes in magnetic fields on the atomic scale. The quantum sensors are capable of a wide range of applications, such as mapping electrical impulses in the brain. They are also integrating NV centers with micro-electromechanical systems (MEMS) fabricated from diamond. By applying vibrations to the NV center, Fuchs and his team can control both spin and optical responses of NV centers. Fuchs is working with Cornell's Center for Technology Licensing to patent the discovery. Looking ahead, this could have important applications in navigation technology.

In the cover image, Professor Fuchs (left) aligns optics for magneto-thermal microscope with Isaiah Gray.

Photos and cover photo by Robyn Wishna/Cornell University Photo

NEW STAFF

Laura Monteleiti

Photo courtesy of Suzanna Dodge

Robyn Wishna/Cornell University Photo

Chris Tessaglia-Hymes

Mary Cornell
Administrative Assistant

Mary joined AEP in October of 2019 after 13 years in two similar positions at Cornell, most recently Biological and Environmental Engineering. She assists AEP faculty and students in the front office, and we are pleased to have her expertise in the department.

Suzanna Dodge
Financial Lead

Suzanna, a long-time resident of Horseheads and current Sponsored Awards Manager at CLASSE (Cornell Laboratory for Accelerator-based Sciences and Education), has accepted the position of Lead Finance for AEP and will begin work on June 7, 2022.

Rebecca Tucker
Director of Administration

Rebecca brings to AEP more than 20 years experience as an administrator and skilled relationship builder. At Cornell, she has led finance, human resources, and facility operations. Rebecca was also part of the Onboarding & Orientation Strategy Team that received the One Cornell Employee Excellence Award in 2019.

Diane Tessaglia-Hymes
Communications Coordinator

Diane worked for many years in the Cornell Lab of Ornithology as the senior graphic designer/design director. She has a M.S. in Wildlife Biology and brings her love of science and art to her position at AEP to promote communication about the school through social media, the newsletter, and video.

KEEPING IT IN THE AEP FAMILY

By Christopher Dawson

Cornell University College of Engineering photographs, #16-2-2378. Division of Rare and Manuscript Collections, Cornell University Library

John Silcox (at left) and Phil Batson (at right) at the high voltage power supply for the Hitachi electron microscope, modified by Phil Batson.

A CENTURY OF INNOVATION

John Silcox and Watt Webb were young men in 1961 when each moved to Ithaca to start tenure track positions in Cornell's School of Applied and Engineering Physics (AEP). At the time, the school was only 15 years old and Clark Hall did not yet exist, though the school already had a formidable reputation as one of the leading engineering physics programs in the country. They did not know each other and followed different paths to Cornell. Silcox had earned an undergraduate degree from England's Bristol University in 1957 and a doctorate from Cambridge University in 1961, both in physics. Webb earned his undergraduate degree in Business and Engineering Administration and his Doctor of Science (Sc.D.) degree in Metallurgy from MIT. Webb then worked at Union Carbide for five years, coordinating fundamental research, while Silcox moved into a research fellowship at Cambridge University for electron microscopy studies of magnetic materials.

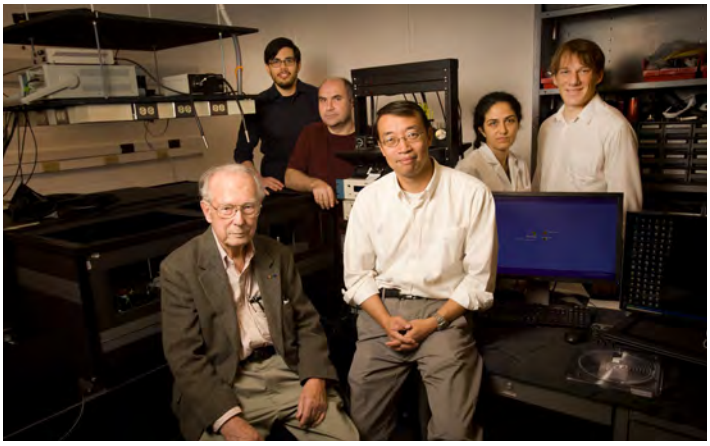
When they joined AEP almost 60 years ago, it is fair to say neither one knew just how successful they would be and how long into the future their impact would resonate. Between them, they total a century of teaching and research at Cornell. Silcox is now the David E. Burr Professor of Engineering Emeritus and Webb held the title of Samuel B. Eckert Professor of Engineering Emeritus until has death recently in New York City at the age of 93.

While they never worked on research together in their cumulative 100 years at Cornell, both men were responsible for huge advances in the broad field of microscopy; Silcox in electron microscopy and Webb as one of the inventors of fluorescence correlation spectroscopy and multiphoton microscopy.

Silcox was a pioneer in the development of the scanning transmission electron microscope (STEM). He combined atomic-size electron beams with electron spectroscopy to get a close look at electronic-structural features on the atomic scale. A primary goal of his research was to develop techniques at the atomic and sub-atomic length scale that could then be used to address materials science questions. He was wildly successful in reaching this goal, and his multiple breakthroughs were honored in 1996 by the Microscopy Society of America with the Distinguished Scientist Award in the Physical Sciences.

Webb was also wildly successful in his research, creating imaging techniques that have allowed scientists to observe structures and mechanisms deep within living tissue without harming the tissue. (Oh, and before that he and a Cornell undergraduate researcher designed the first intrinsically stable superconducting magnet. These magnets became the basis for nuclear magnetic resonance imaging (NMRI)). Working with a grad student—Winfried Denk '89—Webb developed multiphoton microscopy and used it to obtain high-resolution 3D images of biological structures, allowing researchers to see things they had never seen before.

Through their contributions to microscopy, both men made it possible for us to know more about the physical world. If this was all they had accomplished, their careers would be worth celebrating. But that is far from the total of what they gave to Cornell and the world.



Jason Koski (UREL)

Watt Webb and Chris Xu (left to right, front row), professors of Applied & Engineering Physics, in the multiphoton endoscope lab with students.

THE NEXT GENERATION

When David Muller first came to the Cornell campus it was 1991 and he was looking for a Ph.D. program. He had traveled halfway around the globe from Australia and made his way across the U.S. visiting universities. When he came to the Silcox Lab at Cornell he found a group in the midst of a raucous celebration over some experimental results produced by a cold field emission microscope. Muller did not know that the machine had taken roughly five years to get up and running and that he happened to be visiting the very day it finally worked.

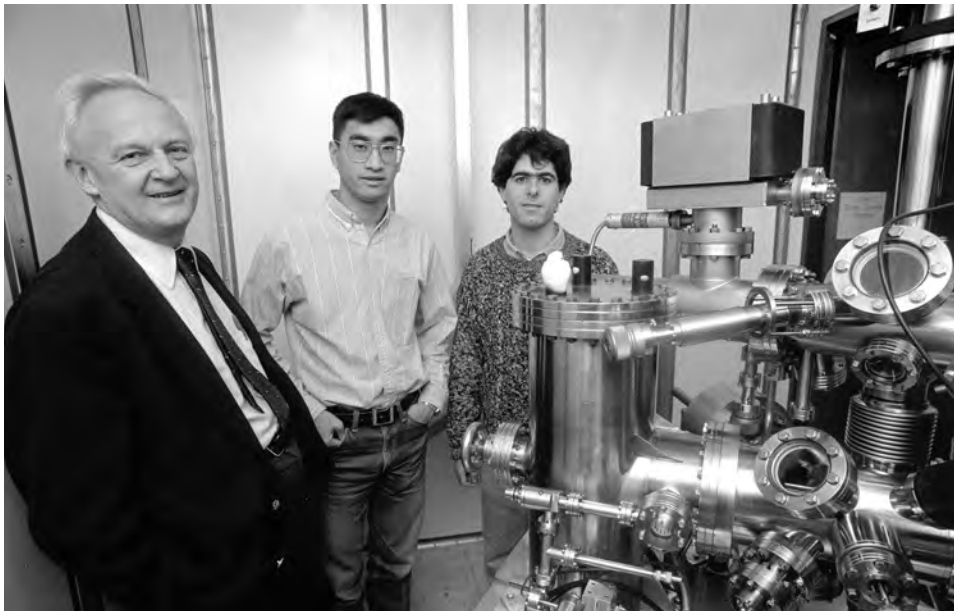
"My impression of the Silcox group from that visit was that everyone was really excited," says Muller. "They were incredibly happy about their data—of course, I didn't know that it had taken four or five years to get to that point. I just thought they were a very positive group."

Fittingly enough, Chris Xu also arrived at Cornell from the other side of the world within a few months of David Muller. These days Xu jokes that he got to Cornell, and to the lab of Watt Webb, about two years too late. "Multiphoton microscopy was invented in 1990," says Xu, "and I didn't join the Webb group until February 1992. The technology was brand new and we needed to work out the infrastructure—to understand where this technology could be most useful and what kinds of instruments should be used to optimize the technology."

Muller and Xu each spent the next five years at Cornell, earning their Ph.D.s in the Silcox and Webb Labs, respectively. The details of their day-to-day work were markedly different, since the technologies and procedures they were mastering were very different. But there was one defining feature of their graduate school experiences Muller and Xu shared: freedom to follow their curiosity.

"The beauty of working with Watt," says Xu, "is that he would give you a project to do and that was pretty much it. You work on your project and you get it going, and then you do whatever you want. This was clear from my thesis. The first chapter was the mandate from Watt where I measured the things he wanted me to measure. The rest is started by me and my fellow students and post-docs—we cooked up some ideas and we pursued them. I had lots of freedom and I took it and ran with it."

Similarly, Muller identified what he wanted to explore as a Ph.D. student and Silcox supported his decision entirely. "Before I arrived at Cornell for my visit I was interested in diffraction and synchrotrons and neutron scattering and I always thought of an electron microscope as a less-capable synchrotron," says Muller with a chuckle. "But when I saw what the group had managed to do on that one day I was there, I realized the electron microscope had incredible potential and there were things you could do with it that you could not do by any other method. That immediately grabbed my attention and I decided 'okay—this is what I want to be doing!'"



Office of Visual Services (UREL)

John Silcox, Zhiheng Yu, and David Muller as a grad student in 1994 (left to right) in the lab.

Upon graduation in 1996 Xu and Muller both went to Bell Labs, where each promptly started an entirely new (to them) line of research. Chris Xu put multiphoton microscopy temporarily on the shelf and started working on improving fiber optics for telecommunications, and set the world record for ultra-long haul fiber optic transmission in 2002. David Muller set aside the electron microscopy work on metal alloys

Continued

he had been doing at Cornell and created a microscopy technique that helped lead to the development of the world's smallest and fastest transistor.

By the summer of 2003, Xu and Muller were both back in Ithaca and on the faculty of the School of Applied and Engineering Physics. Muller says that his time at Bell Labs confirmed something about the way things are done at Cornell. "The style of how people do science at Cornell is an intrinsically collaborative style. It is not an accident that Bell Labs—which many think was the greatest industrial lab the world has ever seen—had this same collaborative model. The team science which we did at Bell is something that has been adopted wholeheartedly at Cornell."

Today, Xu is the IBM Professor of Engineering and Director of the School of Applied and Engineering Physics. Muller is the Samuel B. Eckert Professor of Engineering. Since returning to Cornell as faculty members, both Xu and Muller have had incredibly successful research careers. Xu has 24 patents and has moved beyond Webb and Denk's two-photon microscopy into three-photon microscopy, which has allowed for even deeper imaging into living, functioning biological tissues and structures. Xu is also working to create medical endoscopes for non-invasive real-time diagnostics of tissues without relying on any sort of staining or coloring agent.

Muller has pushed past the former limits of electron microscopy, developing new techniques to image beyond the traditional diffraction limit, and holds the Guinness world record for the highest resolution image. His group has applied these new approaches to explore "the chemistry, electronic structure and bonding inside objects as diverse as transistors, turbine blades, two-dimensional superconductors, fuel cells and batteries," and unravel the connections between quantum-mechanical changes on the atomic scale and the macroscopic behavior of materials. According to Web of Science, his work is ranked in the top 1% by citations in Physics.

In addition to their research success, Muller and Xu have also advised and mentored numerous grad students who have joined the field and grown the family.

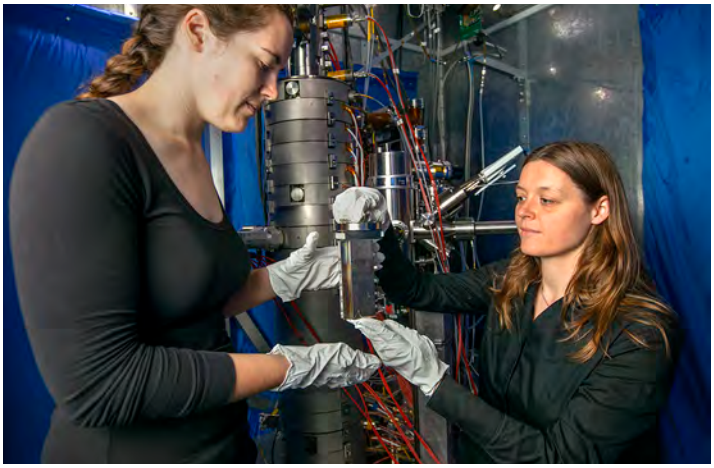
THE FUTURE

In his lab today Chris Xu has four post-doctoral researchers, seven Ph.D. students, and one undergraduate researcher. These students are the future of the field of three-photon microscopy. One of Xu's recent grad students, Tianyu Wang, has recently followed in Xu's footsteps and continued extending the thread Watt Webb started all those years ago at Cornell. Wang, who is now a post-doc at Cornell, recently gave an invited talk at the Optical Society of America (OSA) and published a review paper tracing the development of three-photon microscopy.

"His review article is like my thesis when I was a grad student. What I did for two- photon microscopy he has done for three-photon microscopy. Though somehow he has managed to publish papers with much higher impact than my papers had," Xu says with a laugh..

One of David Muller's past grad students, Lena Kourkoutis, has gone one step beyond even Tianyu Wang. Kourkoutis earned her doctorate in Muller's lab at Cornell in 2009. Next, she studied cryo-electron microscopy in the Molecular Structural Biology Group at the Max Planck Institute of Biochemistry in Martinsried, Germany as a Humboldt Research Fellow. And then she came back to Cornell and joined AEP as an assistant professor in 2013. The academic grandchild of John Silcox is now a tenured professor in the very same department where Silcox spent more than 50 years and did groundbreaking electron microscopy research. Kourkoutis and her lab group are now developing low-temperature, high-resolution electron microscopy techniques that promise to move the field forward in much the same way Professors Silcox and Muller have for non-cryogenic microscopes.

This should not come as a surprise. If you were to look back through the more-than 250 academic papers Kourkoutis has published, you would find one from her Ph.D. studies in 2008 that was recently cited in the 2020 Kavli Prize for Nanoscience. It is called "Atomic-Scale Chemical Imaging of Composition and Bonding by Aberration-Corrected Microscopy" and it appeared in the journal *Science*. Along with prize-winner Ondrej Krivanek, two of her co-authors on the paper were John Silcox and David Muller. Cornell-trained microscopists have gone on to their own successful careers at other peer institutions, with Professor Julia Mundy (Harvard) and Professor Pinshane Huang (UIUC), joining Kourkoutis as prestigious Packard Fellows, amongst their other awards.



Jason Koski (UREL)

Lena Kourkoutis (right) prepares to load electron transparent samples into a dedicated scanning transmission electron microscope for atomic-scale imaging and spectroscopy.

From its founding in the aftermath of World War II to today, Cornell's School of Applied and Engineering Physics has been at the forefront of discovery, excellence and innovation. And it has never been solely about the technology. It has always been the people of the program that are its strength and this is as true today as it was when John Silcox and Watt Webb took up their positions and started fiddling with the equipment way back in 1961. ♦

RECOGNITION TO...


Laura Morfelloti


Robert Barker (UREL)


Laura Morfelloti

Jeffrey Moses received the prestigious **NSF CAREER Award** in 2020. With this award, he's working to develop new nonlinear optical methods for light conversion. His research will explore crystal- and fiber-based devices to demonstrate light conversion methods that exhibit unprecedented efficiency and cover a broad range of frequencies. The Moses group focuses on capturing "ultrafast phenomena" in real time, as well as on developing the light-pulse and time-resolved spectroscopic technologies for doing so. This grant, totaling $500,000 over five years, is among the most competitive given by the National Science Foundation and designed to support promising junior faculty who exemplify the role of teacher-scholar through the combination of outstanding research and education. ♦

Joel Brock, AEP professor and director of the Cornell High Energy Synchrotron Source (CHESS), guided a new funding model for the center, in which multiple partners will steward facilities at CHESS. Announcing $54 million in funding over the next five years for a research and education subfacility at Wilson Laboratory, the National Science Foundation remains the largest contributing partner. While other synchrotron laboratories are typically located at national labs, Cornell remains the only U.S. university operating a large accelerator complex. This funding model will allow Cornell to continue training users in accerlator science and advanced X-ray technology. CHESS provides the ability to study materials at the macroscopic level, enabling research on a broad range of topics. ♦

Peter McMahon was one of only 20 assistant professors across the United States to be awarded a **Packard Fellowship for Science and Engineering** from the David & Lucile Packard Foundation in 2021. The award goes to innovative, early-career scientists and engineers, and is among the nation's largest nongovernmental fellowships, allowing maximum flexibility in how the $875,000 award funds can be used.

In 2020, McMahon was one of 13 junior professors chosen internationally to be named a **CIFAR Azrieli Global Scholar for 2020–2022**, and received CAN$100,000 in unrestricted research support for two years.

This year, McMahon was one of 23 early-career professors in physics and astronomy to be awarded a **2022 Sloan Research Award**, which recognizes today's most-promising scientific researchers. Also this year, he won an **Office of Naval Research Young Investigator Program Award** for his research proposal entitled "Superconducting Electronics Neural Networks for Wideband RF Signal Processing." The award includes a portion of nearly $17 million in funding to conduct innovative scientific research, shared among the 32 winners. The award can be used for stipends and scholarships, to acquire laboratory equipment, or on other expenses critical to the planned research. In his proposed project, McMahon's group will explore how to use analog superconducting circuits as neural networks for performing machine learning on radiofrequency signals. ♦

College of Engineering Awards for Excellence

College of Engineering Research Excellence Awards were won by **Joel Brock** and **Lena Kourkoutis** in 2021, and by **Greg Fuchs** and **Jie Shan** in 2020. This award is given to faculty in recognition of research contributions and leadership. Six awards were given to Cornell Engineering faculty in 2021, and nine awards were given in 2020. Research Excellence Awards were first established in 2015 to recognize the importance of leadership in innovative research. Past AEP faculty to receive the award include Professor David Muller (2018) and Professor Chris Xu (2017).

College of Engineering Excellence in Teaching Awards (the Dorothy and Fred Chau MS '74 Awards) were won by **Jeffrey Moses** in September, 2021, and by **Guillaume Lambert** in 2020.

Congratulations to all!

UPDATES

Lindsay Fraweck (UREL)

Professors Jie Shan (left) and Kin Fai Mak (right).

Jie Shan and Kin Fai Mak The Shan and Mak labs reported several scientific breakthroughs this year. The team stacked two semiconductor monolayers to create a two-dimensional triangular-lattice Hubbard model simulator. Their paper, "Simulation of Hubbard Model Physics in WSe2/WS2 Moiré Superlattices," was published March 18, 2020, in the journal *Nature*. They have used the analogue quantum simulator to make two significant discoveries: observing a Mott insulating state and mapping the system's magnetic phase diagram. Building on their March publication, Mak and Shan published another paper in *Nature* on November 11: "Correlated Insulating States at Fractional Fillings of Moiré Superlattices." The team created artificial electron crystals in the two-dimensional semiconductor heterostructures. The team devised a novel optical sensing technqiue to observe these states without perturbing the system. In June, the pair co-authored a paper in *Nature Materials*: "Imaging and Control of Critical Fluctuations in Two-Dimensional Magnets." This debuted a novel, real-time imaging technique that is fast and sensitive enough to observe elusive critical fluctuations in two-dimensional magnets. This technique allows researchers to control the fluctuations and switch magnetism via a "passive" mechanism that could lead to more energy-efficient magnetic storage devices. ♦

AEP photo

Professor Lena Kourkoutis (left) and Professor David Muller with the ThermoFisher Spectra 300 high-resolution TEM/STEM microscope.

ThermoFisher's Spectra 300 High resolution TEM and STEM Microscope was recently delivered to AEP and assembled for use. This microscope is the highest resolution, aberration corrected, scanning transmission electron microscope for all materials science applications.

"The Spectra is a really exciting step forward for pushing new kinds of experiments and analysis at the nanoscale. Beyond improvements to spatial and energy resolution, we'll also be expanding the kind of materials and physical questions we can study. For example, we can now reach atomic resolution at the very low accelerating voltages that are necessary for studying many 2D or other beam-sensitive materials," explains Berit Goodge, AEP Ph.D. student in the Kourkoutis group. "In other systems, we can take advantage of the extremely high brightness electron source to do dynamic in situ experiments by making the same measurements more than ten times faster than we could before. I think the Spectra is going to be a very far-reaching tool, with applications across various systems that are studied in AEP, from biological to energy to quantum materials."♦

NEW FACULTY

Robin Wisdom (UREL)

Photo courtesy Ankit Disa

Valla Fatemi earned his Ph.D. in Physics in 2018 from the Massachusetts Institute of Technology where he researched quantum transport in atomically layered quantum materials. He then moved to Yale University as a postdoctoral associate to apply circuit quantum electrodynamics probes to hybrid superconducting devices. In 2022, he joined AEP as an assistant professor and started a lab that brings together the physics of quantum materials and the techniques of superconducting microwave quantum circuits.

The Fatemi lab cross-pollinates ideas from quantum coherent devices in superconducting qubit architectures with quantum materials to develop new scientific insights and quantum information technologies. Three topics of interest that synthesize the above subject areas and materials platforms are:

Andreev states and qubits: Andreev states are discrete fermionic modes that exist at junctions between superconductors. Their supercurrent-carrying nature makes them naturally compatible with superconducting quantum technologies. Fatemi will apply these technologies to Andreev states to pursue both fundamental discoveries and the development of novel quantum coherent devices, including qubits.

Natural and engineered topological devices: Concepts from geometric topology have led to ideas in which the topology of a wave-function may result in protected states that robustly preserve quantum information. Fatemi's group is interested in developing new experiments to show that these kinds of quantum wavefunctions can be constructed (in natural or engineered systems) and to evaluate their performance in realistic environments.

Sensing quantum materials: Exotic quantum phases of electrons in materials are often fragile, only appearing at the lowest temperatures and in the cleanest samples. Consequently, experimental probes or sample processing methods are liable to perturb or damage the materials in ways that disrupt the correlated electronic phases. Fatemi's group will develop new experimental tools to detect and learn about the most delicate quantum phases of electronic matter. ♦

Ankit Disa, earned his B.S. in from Cornell University in 2010 and his Ph.D. from Yale University in 2016. His doctoral work focused on manipulating electronic and magnetic properties of complex oxides through the synthesis of atomically precise heterostructures. He then joined the Max Planck Institute for the Structure and Dynamics of Matter in Hamburg, Germany, as a postdoctoral scientist where he developed novel methods to control functional properties on ultrafast time scales using THz light. In 2017, he was awarded the Alexander von Humboldt Research Fellowship. In 2019, he became a fellow of the Max Planck-NYC Center for Non-equilibrium Quantum Phenomena based at Columbia University. He will return to Cornell in July 2022 to join the AEP faculty as an assistant professor.

Research in Disa's group centers around understanding and controlling the properties of quantum materials at the smallest length and time scales possible. A major focus of his lab will be exploring how one can tune quantum phases and induce new functionalities using light. Tailored optical excitation provides a route to dynamically steer quantum materials within a few picoseconds or less into states exhibiting phenomena that do not exist in equilibrium. Systems of interest include superconductors, magnets, ferroelectrics, and other electronically ordered solids. Key to this approach is the development of novel laser sources and nonlinear optical techniques to enable the study of structural and electronic excitations spanning the terahertz and infrared frequency range.

He is especially interested in investigating optically driven processes in artificially engineered heterostructures with atomic dimensions. By exploiting the ability to adjust picometer scale structure, composition, and dimensionality in such heterostructures, the goal is to gain a microscopic understanding of how light-induced non-equilibrium phases form, how to manipulate them, and how to functionalize them in next-generation computing and energy technologies. Ultimately, his goal is to establish a novel paradigm of non-equilibrium materials design, centering around the idea that one can create highly desirable dynamical states of matter by engineering light-matter interactions at the atomic scale.♦

RETIRED FACULTY

RICHARD LOVELACE

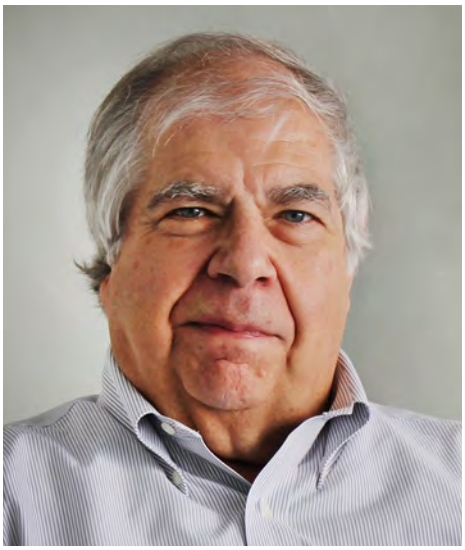
AEP Photo

Richard Lovelace came to Cornell as an assistant professor in the Department of Applied Physics in 1972, after holding research associate appointments at the U.S. Naval Research Laboratory and the Cornell Laboratory of Plasma Studies. From 1973 to 1974, he was a visiting scientist at the Princeton University Plasma Physics Laboratory. In 1975, he invented the Dynamo Model for the magnetic origin of astrophysical jets (July 10, 1975 in Urbino, Italy). In 1984, Lovelace was appointed to the position of Professor at Cornell. He was elected a Guggenheim Fellow in 1999 and a lifetime Overseas Fellow at Churchill College in 1994. He's also a Fellow of the American Physical Society and an Associate Editor of the journal, *Physics of Plasmas*.

Lovelace's research interests have included basic plasma physics, the theory of fluid and plasma flows, and the theory of astrophysical jets and accretion disks.

Most recently, Lovelace's theoretical and computer simulation research has been directed to different problems involving astrophysical flows and plasmas. There is a wealth of new observational data— including radio, infra red, optical, X-ray, and gamma ray measurements—on accretion disks and collimated, high-velocity jets. Magnetic fields have a crucial role in driving the outflows and in determining the evolution of the disks and the central stars. On a larger scale, active galactic nuclei are observed to be the sources of powerful, collimated, relativistic jets. ♦

ROBERT BUHRMAN: In Memoriam



AEP Photo

On April 13, 2021, Robert Burhman passed away peacefully at the age of 75. He is remembered by his friends and colleagues as always being guided by his love for physics, engineering and teaching; and for treating staff with complete respect. Andrew Bass, the Horace White Professor of Neurobiology and Behavior, and the senior associate dean for math and science in Arts and Sciences, said, "Traits that come to mind when I think about Bob's leadership include integrity, dedication, keen judgment and rigorous but compassionate mentorship of faculty, staff and students. Bob's understanding of the universe went far beyond its physical principles."

Robert Buhrman received his B.E.S. degree in 1967 from Johns Hopkins University in Engineering Physics, with departmental and general honors. He later arrived as a Cornell graduate student earning his Ph.D. in Applied Physics where his thesis research was on the superconducting properties of Al nanoparticles, and was hired on as a Cornell faculty member immediately upon graduation. He served as founder of the Cornell Nanofabrication Facility, director of the School of Applied and Engineering Physics, founding director of the NSF-funded Cornell Center for Nanoscale Systems, and senior vice provost for research at Cornell from 2007–2017. Professor Buhrman managed to take on these significant roles, all while maintaining an innovative research group, most recently focused on nanomagentic materials and spintronics devices; spin torque and spin transfer effects; giant spin Hall effect; and thin film materials.

Since the mid-1990s, the majority of Buhrman's research activities had been in spintronics and thin film nanomagnetism. He pioneered definitive demonstration of reversible spin transfer torque switching of thin film nanomagnets; the ability of spin transfer torque to excite nanoscale magnetic structures—including magnetic vortices—into persistent microwave precession; and the early demonstration that spin torque can be successfully utilized with magentic tunnel junctions, despite the fact that rather high tunnel current densities are required.

Throughout his professional career, Buhrman contributed regularly to the scientific literature in the fields of applied condensed matter physics with currently over 230 publications that have received more than 17,000 citations.

His death has left a deep void in the lives of many. ♦

2022 NSF GRADUATE RESEARCH FELLOWSHIP WINNERS

Three AEP students—seniors Chloe Washabaugh and Erin Fleck, and recent graduate Nick Diaco—each won a NSF Graduate Research Fellowship for 2022.

Photo courtesy of Erin Fleck

Erin Fleck studies experimental condensed matter and material physics to understand why materials behave the way they do. She has been in Professor Lena Kourkoutis's group since her freshman year doing electron microscopy. After graduation, she will pursue a Ph.D. in Applied Physics at Stanford University.

Photo courtesy of Chloe Washabaugh

Chloe Washabaugh's research focuses on quantum transduction. She has worked in Professor Greg Fuchs's group since her freshman year, translating quantum information stored in molecular qubits to its physical environment and vice versa. After graduation, she will pursue her Ph.D. at the Pritzker School of Molecular Engineering, University of Chicago. In addition to continuing with quantum transduction research, she hopes to establish herself as an advocate for the quantum information science community, by creating connections between physicists, the public, and policymakers.

Photo courtesy of Nick Diaco

Nick Diaco, a 2021 graduate of AEP, worked with Professor Christopher Ober to synthesize polymer nanocomposites with unique electrical and mechanical properties. Diaco is currently pursuing his Ph.D. in Mechanical Engineering at MIT, where he uses light to 3D-print polymer composites with applications in medicine and manufacturing. In the future, Nick plans to use his background in engineering physics and polymer science to develop new, more sustainable manufacturing technologies. ♦

WE WANT TO HEAR FROM YOU!

Please send an email to Cynthia at

AEP_info@cornell.edu

and tell us about your academic experience.

PH.D. STUDENTS SUPPORT STEM

Diane Tessalum-Homes

Danielle Markovich

Danielle Markovich and Berit Goodge, two Ph.D. students working with Lena Kourkoutis, are also making time to help young women become interested in science through the Cornell chapter of Expanding Your Horizons (EYH), a national one-day conference for 7th–9th grade students that began in 1988 as a way to stimulate girls' interest in math and science. Cornell's EYH Conference (www.eyh.cornell.edu) has been organized and run primarily by graduate student volunteers from many departments. Participants engage in hands-on activities, meet female scientist role models, and learn about opportunities in STEM careers. For the first time in three years, this event was held live and in person on April 9, 2022.

Markovich is a third-year Ph.D. student whose research is in transmission electron microscopy of energy materials, particularly the soft materials and energy materials associated with fuel cells and batteries. Originally from Israel, she received her B.S. from the University of Illinois, Urbana-Champaign. After completing her undergraduate degree, she looked into various Ph.D. programs throughout the country to do research in renewable energy, deciding on Cornell because of its high ratings and interdisciplinary nature. Currently she is working as part of CABES, the Center for Alkaline Based Energy Systems, where she has held a graduate research fellowship for the past two years.

Berit Goodge, who is in her final year as a Ph.D. student, has focused her research on understanding strongly correlated or "quantum" properties, such as superconductivity, multiferroicity, or other ordered phases through direct, quantitative measurements of the atomic lattice performed in the scanning transmission electron microscope (STEM). After graduating in Spring, 2022, Goodge will spend a research term with Professor Kwabena Bediako in the chemistry department at U.C. Berkeley as a University of California Presidential Postdoctoral Fellow. The following Fall, she'll travel to Germany where she will commence research as a Minerva Fast Track Group Leader in the Physics of Quantum Materials department at Max Planck Institute for Chemical Physics of Solids in Dresden, Germany.

Photo courtesy of Berit Goodge

Berit Goodge

Goodge has been the Cornell chair of the EYH program since 2019. Other AEP grad students who have participated in EYH include Jack Crowley, Eric Hebert, and Kathleen Smith. ♦

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Photo of Harvey Tian courtesy of Inso Bio

HARVEY TIAN
CO-FOUNDER & CEO, INSO BIO

Inso Biosciences (Inso Bio) is an early-stage, biotech start-up company at Cornell that is fronted by CEO Harvey Tian, who was a former Ph.D. student in Professor Harold Craighead's lab.

Inso Bio develops platform tools for biological sample preparation. Using their patented microfluidic technology, Inso Bio is transformimg the landscape of cellular sample processing, and exploring applications in long-read DNA sequencing, multi-omic analysis, and pathogen isolation. In addition to receiving funding from the National Science Foundation and the National Institutes of Health, Inso Bio also recently won the pitch competition for Cornell's Enterpreneurship Summit, "Eclectic Convergence."

The company's technology has been in development since 2010 when Tian joined the Craighead lab in 2010 as a Masters of Engineering student, and later the Ph.D. program in 2012. Since then, Tian has spent more than 10 years further developing this technology. In 2017, Adam Bisogni joined the lab as an academic collaborator. He brought on a deep background in molecular biology.

Together, Craighead, Tian, and Bisogni worked closely together for about three years developing microfluid technology before starting Inso Bio. In large part because of their strong team synergy, they have been able to maintain a high level of productivity despite the challenges and delays brought about by the 2020 pandemic.

Inso Bios vision is develop high-precision, streamlined, and automated solutions to sample preparation to reduce the errors, irreproducibility, and inconsistent yeilds often associated with processing samples by hand. The company's goal is to make genomics accessible for the applications of tomorrow. ♦

JULIA MUNDY
ACCLAIMED RESEARCHER

During the past few years, Cornell AEP alum, Julia Mundy, Ph.D. '14 has received several awards and accolades recognizing her work. In October, 2020, as a professor in the Department of Physics at Harvard University, she received a Packard Fellowship for Science and Engineering from the David & Lucile Packard Foundation. Mundy was one of 20 innovative, early-career scientists and engineers chosen, and will receive $875,000 over five years to pursue her research.

Mundy became an assistant professor of Physics and Applied Physics at Harvard University in 2018, and in 2021 she received a Department of Energy (DOE) Early Career Research Award for her work, "Epitaxial Stabilization of Novel Superconductors for Energy Generation, Storage and Distribution." The DOE award is designed to bolster the nation's scientific workforce by "providing support to exceptional researchers during the crucial early career years, when many scientists do their most formative work. Awardees were selected from a large pool of university- and national laboratory-based applicants. Selection was based on peer review by outside scientific experts."

In 2022, Mundy was one of 188 researchers who received a Sloan Research Fellowship Award. These two-year fellowships are awarded yearly to early-career researchers in recognition of distinguished performance and a unique potential to make substantial contributions to their field.

Mundy's research combines atomically precise thin-film synthesis with picoscale electron microscopy imaging to design, construct, and probe new quantum materials. Initial efforts are particularly focused on using thin film epitaxy to construct metastable materials, with an emphasis on materials with strong spin frustration/exotic magnetic properties and novel superconductors. ♦

Photo courtesy of Julia Mundy

Applied and Engineering

2021

Commencement Award Recipients

Nicholas S. Diaco
Hannah K. Doyle
Trevor R. Cuykendall Memorial Prize
Awarded to an Undergraduate Student for Outstanding Academic Achievement

Noah R. Flemens
Mandar M. Sohoni
Trevor R. Cuykendall Memorial Prize
Awarded to the Outstanding Teaching Assistant in Engineering Physics

Ellen Lee
Kevin J. Zhan
Paul L. Hartman Prize in Experimental Physics
Awarded to an Undergraduate Student for Excellence in Experimental Physics

Matthew Ko (Prof. David Muller, project supervisor)
Devin Dean (Prof. Jeff Moses, project supervisor)
Dorothy and Fred Chau Award
Awarded to an Undergraduate Student for Excellence in Research and for Excellence in Undergraduate Research Project Supervision

Thomas W. Watts
Henri S. Sack Memorial Award
Awarded to a Master of Engineering Student for Top Academic Performance

Thomas W. Watts
Neil N. Sexton
David Delano Clark Award
Awarded to a Master of Engineering Student for the Best Master of Engineering Project

Berit H. Goodge
Tianhong Wang
Yen-Lin Chen
William Nichols Findley Award
Awarded to a Graduate Student for Outstanding Research

Graduates

Bachelor of Science in Engineering Physics

Tanishq Aggarwal
Amogh Anakru*
Maxwell Gordon
Anderson Caleb
Kai Berman
Swathi Chandrika*
Alan Chen*
John C. Crossman*
Devin Dean*
Nicholas S. Diaco
Hannah K. Doyle
Connor M. Gerlach*
Katrina Howard
Joseph Anthony
I. Matthew Ko*
Kyle P. Krol
Ellen Lee*
Lun (Theory) Li
Shane Neil Lobo
Miroslava Marinova*
Christian Polydor
Rizo Rakhmanov
Michael J. Richardson
Francisco P. Rilloraza
Christopher R. Schwarze*
Jesse Smith
Connor L. Swenberg
Stavrini Tsangari
Philip F. Whitmarsh
Graham R. Wilcox
William Xu
Joshua S. Zak
Kevin J. Zhang

Master of Engineering in Engineering Physics

Ethan S. Bair
Turner E. Bryant
Ryan J. Hill
Ritheshkumar S. Neelamagam
Neil N. Sexton
Rongxing Tang
Thomas W. Watts

Master of Science in Applied Physics

Derrick R. Lin
Mihailo R. Rebec

Doctor of Philosophy in Applied Physics

Michael Chen Cao
Yen-Lin Chen
Paul D. Cueva
David A. Specht

**An asterisk after a student's name indicates an honors student.*

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2022 COMMENCEMENT
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Physics Commencement

2020

Commencement Award Recipients

Ian Madden

Jeremy S. L. Schuler
Trevor R. Cuykendall Memorial Prize
Awarded to an Undergraduate Student for Outstanding Academic Achievement

Jack Crowley

Shitong Zhao
Trevor R. Cuykendall Memorial Prize
Awarded to an Outstanding Teaching Assistant

Nam Mannucci
Trevor R. Cuykendall Memorial Prize
Awarded to an Undergraduate Student for Excellence in Experimental Physics

Connor Horn

Rosalyn M. Koscica
Dorothy and Fred Chau Award
Awarded to an Undergraduate Student for Excellence in Research

Tom A. Vandekerckhove
Henri S. Sack Memorial Award
Awarded to a Master of Engineering Student for Top Academic Performance

Tom A. Vandekerckhove
David Delano Clark Award
Awarded to a Master of Engineering Student for the Best Master of Engineering Project

Isaiah Gray

Alex Plumridge
William Nichols Findley Award
Awarded to a Graduate Student for Outstanding Research

Graduates

Bachelor of Science in Engineering Physics

Rana A. Ahmad
Ethan S. Bair
Qijia Chen
Samuel O. Feibel
Matthew Fu*
Alexander E. Garcia
Jack W. Glaser
Connor Horn*
Shailaja Humane
Gregory H. Kaiser
Rosalyn M. Koscica*
Kevin J. Kowalski*
Lior Kreindler
Benjamin E. Lucero
Ian Madden
Nam Mannucci*
Joao M. P. B. Mesquita
Ritheshkumar Neelamagam
Justin Joon Young Oh*
Jeremy S. L. Shuler*
Marshall T. Waggoner
Emily N. Waite

Master of Engineering in Engineering Physics

Ricardo De Levante Rodriguez
Tom A. Vandekerckhove

Doctor of Philosophy in Applied Physics

Samuel J. Bade
George J. Calvey
Xiaoyue Douglas Ding
Kyle J. Dorsey
Isaiah Gray
Chaitali Joshi
Andrea Katz
David W. Moreau
Albert Nin Gyu Park
Gauri N. Patwardhan
Rahul Sharma

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Sign at one of the entrances to Cornell by Lindsay France (UREL)

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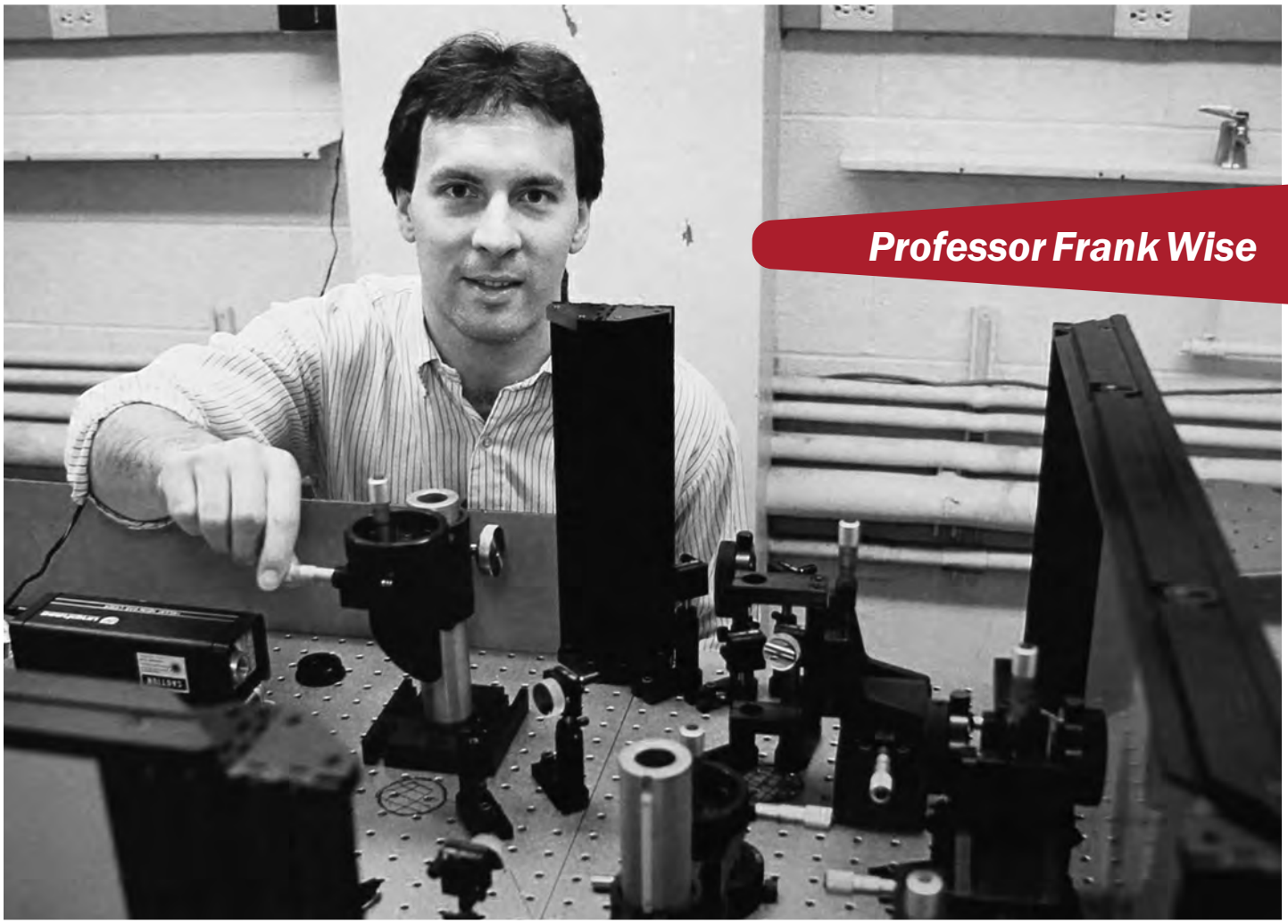

Professor Frank Wise

In the early 1990s, Professor Frank Wise used the very first components that would eventually become part of lasers his group builds to generate pulses of light with duration in the femtosecond range. The light assists with observing extremely fast processes in materials.