

# *the chemists club*

Spring 2022



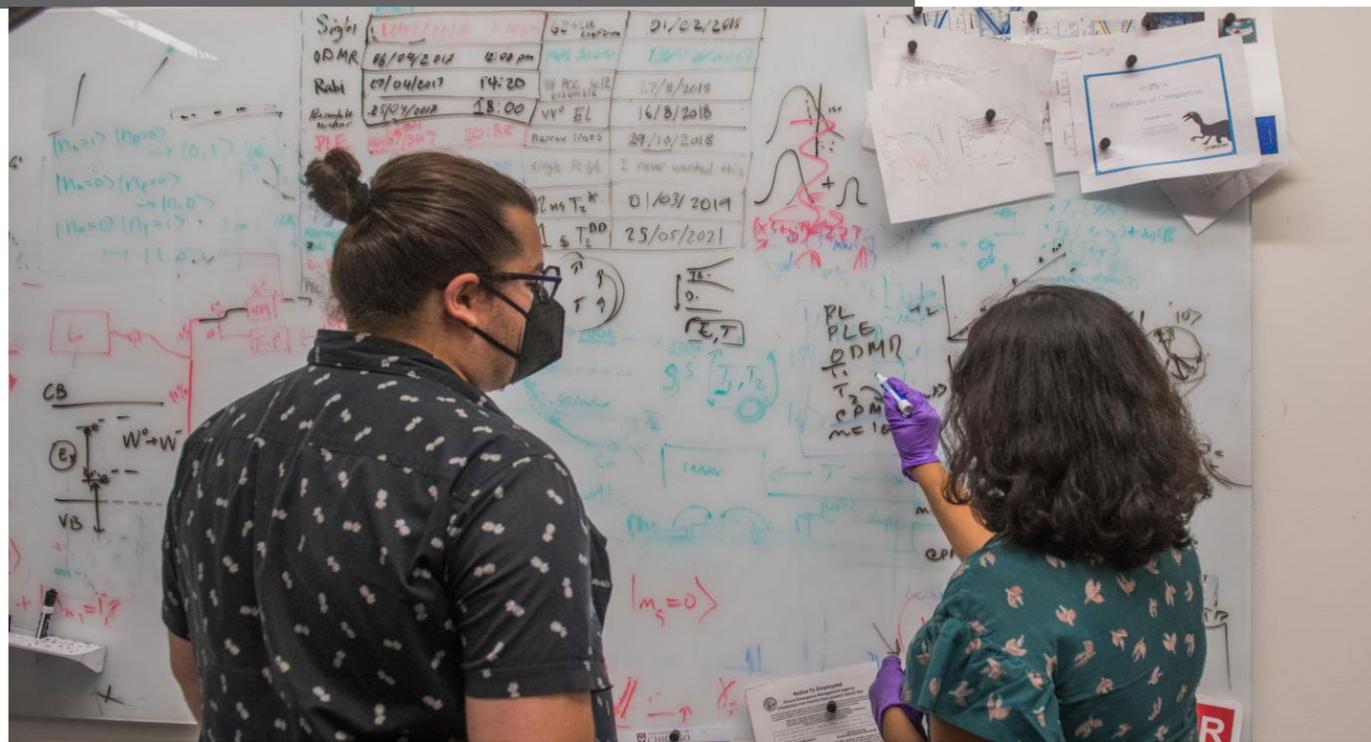
NSF announces \$25 million  
institute in Chicago for  
quantum biology research

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**UChicago, Chicago State, UIC, Harvard to investigate  
quantum imaging, create quantum workforce**

# NSF announces \$25 million institute in Chicago for quantum biology research

By Louise Lerner



(Cover) Graduate students Coco Li (foreground) and Lawson Lloyd (background) work in the Engel lab at the University of Chicago. Prof. Greg Engel will head a new National Science Foundation institute called the Quantum Leap Challenge Institute for Quantum Sensing for Biophysics and Bioengineering, designed to pioneer new ways to use quantum technology in biology, and to develop the quantum workforce through STEM education and outreach.

(Previous page) Graduate students Grant Smith, left, and Pratiti Deb, right, work at a whiteboard in the Aushalom lab at the University of Chicago Pritzker School of Molecular Engineering.

Quantum systems are extremely sensitive and react to the tiniest changes in their environment—a quality which has intrigued scientists who hope to harness this property for sensing. This sensitivity is why quantum computers are so difficult to make, but could also be an asset: “We seek to turn that challenge on its head, and use the extreme sensitivity for sensing,” Engel said.

“For example, when an immune cell comes in contact with a pathogen, we know that single molecule-level interactions influence how the cell deforms and adheres and kills whatever its target is; but it’s not well-understood, because sensing and measuring what those single molecules are doing in real time, in such a small space, is so hard,” said Allison Squires, Neubauer Family Assistant Professor of Molecular Engineering at UChicago and a member of the new institute. “If we can put a quantum sensor right there to directly read out what’s happening, that would be a game-changer.”

There are two scientific challenges the institute is designed to address. The first is to make these systems sensitive enough to pick up the changes scientists want to measure, and to ignore everything else. Because when it comes to biology, the noisiest environments are the most scientifically interesting. “You’d love to be able to peer inside a cell and watch the machinery at work,” Engel said, “but it’s one of the noisiest, most complex environments out there.”

The second challenge is to make sure scientists are measuring what they intend to measure, since the scales are so small. Thus the institute’s goal is to develop ways to integrate quantum sensing along with more traditional imaging, so that scientists can first understand where the probe is in the cell and then get readings from the quantum sensors.

This research will require intense collaboration across disciplines, including scientists and engineers from UChicago’s Departments of Chemistry and Physics, the Pritzker School of Molecular Engineering, and the Biological Sciences Division, as well as scientists at Chicago State, UIC and Harvard. UChicago’s affiliations with nearby Argonne and Fermilab offer access to expertise and unique resources, such as supercomputers and synchrotrons.

## Quantum collaborations

The collaboration is also intended to boost the involvement of Chicago students in quantum research ranging from K-12 to Ph.D.s, particularly those in underserved communities.

Planned activities at Chicago State University include the creation of a certificate program in quantum science and the continued development of curriculum that will train students in skills needed for the quantum workforce. CSU faculty and students will also perform outreach with Chicago Public Schools. This grant will offer funding support for students at UChicago, Chicago State and UIC. Faculty from all institutions also will collaborate on scientific exploration, bringing together ideas and resources.

“The field of quantum technology is at a crossroads, and this is a unique opportunity for our students to be in on the ground floor of a new and growing industry,” said Valerie Goss, associate professor of chemistry, in the department of chemistry, physics and engineering studies at Chicago State University. “This collaboration will open doors for both students and faculty across disciplines to build networks, develop fundamental research, and share resources and opportunities between our universities.”

A centerpiece of the program is pairing students with both academic and industry partners—an approach designed to prepare students for success in the workforce and also to speed the process from scientific discovery to implementation.

“For me the most exciting thing is the questions this technology can answer that we haven’t thought of yet,” said Peter Maurer, assistant professor of molecular engineering at UChicago and another member of the new institute. “We know of amazing potential applications, but I think probably the biggest ones are still to be discovered and that’s what excites me most: actually finding those applications and realizing them.”

In the Sept. 2 statement, NSF also announced funding for the NSF Quantum Leap Challenge Institute for Robust Quantum Simulation, led by the University of Maryland in College Park to develop quantum systems as well as the methods and tools for large-scale quantum simulators that will allow for quantum computation.

“Our Quantum Leap Challenge Institutes program is developing the foundation of quantum information sciences, as well as developing the future students, faculty, startups, and industry partners who are engaged in it,” said Sean L. Jones, NSF assistant director of mathematical and physical sciences. “These two new institutes are tapping into challenging fields that have the potential to develop the next generation of tools that will establish the United States at the forefront of quantum innovation.”

As part of a nationwide initiative to boost research in quantum science, the National Science Foundation will establish a \$25 million institute in Chicago to investigate quantum sensing for biology and train the quantum workforce. Headquartered at the University of Chicago and in partnership with Chicago State University, the University of Illinois at Chicago and Harvard University, the institute will be funded for five years.

The goals of the Quantum Leap Challenge Institute for Quantum Sensing for Biophysics and Bioengineering (QuBBE) are twofold: to pioneer new ways to use quantum technology in biology, and to develop the quantum workforce through STEM education and outreach.

“This institute is designed specifically to foster cross-disciplinary collaborations that are not incremental, but rather paradigm-shifting,” said Greg Engel, professor of chemistry at the University of Chicago and the new institute’s director. “It’s rapidly becoming clear that quan-

tum sensing could be transformative in the next phases of biology research, and Chicago is perfectly positioned as a home for that future, with a nexus of academic institutions, national laboratories, industries and a growing quantum workforce.”

The institute joins a growing hub of quantum research and industry in the Chicago area, including two U.S. Department of Energy quantum centers led by UChicago-affiliated Argonne National Laboratory and Fermilab, UChicago’s Pritzker School of Molecular Engineering, the Chicago Quantum Exchange, quantum startup accelerator Duality, and multiple tech incubators and startup companies.

## Using sensitivity for sensing

Quantum technology research seeks to exploit the behaviors of particles at the subatomic level, which are subject to different rules than what we see around us. Such particles can exist in two different places simultaneously, tunnel through walls or change states when measured.

# UChicago Takes the Helm of ACS Journals

By Sheila Evans



(from left to right) Chuan He, Laura Gagliardi, and Stuart Rowan

Three UChicago faculty are now at the helm of top ACS Journals as editors-in-chief. Along with Stuart Rowan as editor-in-chief for *ACS Macro Letters*, two other faculty members were appointed in 2021 as editors-in-chief for ACS Publications including Chuan He for *ACS Chemical Biology* and Laura Gagliardi for the *Journal of Chemical Theory and Computation*.

*ACS Chemical Biology*, established in 2006, provides an international forum for the rapid communication of research that broadly embraces the interface between chemistry and biology. “Since its inception, *ACS Chemical Biology* has established itself as the main platform for chemical biologists to communicate their research and share scientific discoveries,” says Prof. He. “I envision the journal expanding its scope to encompass emerging research areas which are likely to blossom in the coming decade. I also look forward to building relationships with young chemical biologists through new initiatives and believe that the journal can play an active role in encouraging all chemical biologists to explore new areas of research.”

*The Journal of Chemical Theory and Computation*, established in 2005, publishes papers reporting new theories, methodology, and/or important applications in quantum electronic structure, molecular dynamics, and statistical mechanics. Gagliardi served as Associate Editor of JCTC from 2016 to 2020 and published in the journal more than 35 times. “It is a great honor to serve the community in this role. JCTC is an outstanding journal that has helped to shape our field over

the years,” said Gagliardi. “It now has an opportunity to play a role in forming and promoting the next generation of theorists and computational chemical scientists, and as editor-in-chief, I will make such community-building a priority.”

*ACS Macro Letters* publishes research in all areas of contemporary soft matter science in which macromolecules play a key role, including nanotechnology, self-assembly, supramolecular chemistry, biomaterials, energy generation and storage, and renewable/sustainable materials. Rowan has served as the deputy editor of *ACS Macro Letters* since its inception in 2011 and was appointed editor-in-chief in 2018. “I am very excited to have two of my wonderful colleagues be chosen as the next Editor-in-Chief of these two great ACS journals,” said Rowan. “It says a lot about the strength and breadth of the Department of Chemistry here at the University of Chicago that we have three EICs of ACS journals in very different fields of chemistry.”

## Women in Chemistry: A student-led effort to create community among women and other gender minorities

Women in Chemistry (WiC) is a long-standing student-led group that helps foster relationships between women and other gender minorities in the University of Chicago’s Department of Chemistry for mutual encouragement, and to promote women in science by creating a supportive environment through engaging speakers and monthly social events.

“WiC is a student-led and focused organization, so we invite speakers based on the interests of the members,” says Olivia Laxton, a Chemistry Graduate student. These interests can include explor-

ing nontraditional career paths or traditional academic and industry chemists. Another outlet for connection is having separate “coffee chats” with a female or gender minority researcher hosted as part of a Department lecture series.

To develop community across the Department, WiC runs a mentoring program where members are matched up with incoming first-year students based on their research interests. “The mentorship is a very fun program,” says Maia Czaikowski, a Chemistry Graduate student. “It allows incoming students to connect with others outside of their lab group.”

WiC also plays an integral role in recruiting prospective students. There is a long-standing tradition of WiC hosting a brunch for prospective female and underrepresented students to connect to current students. “The WiC brunch is an important event at the end of recruitment because it gives prospective students the chance to ask questions and share thoughts that they wouldn’t normally ask in mixed settings,” says Czaikowski, “When I was invited to other schools as a prospective student, there were no gender-specific events, but I think it makes a difference.”

“There’s strong participation in recruitment by WiC members,” says Subhashree Pani, a Chemistry Graduate Student. “In science, you get used to being the only woman in a male-dominated field but when you’re surrounded by all women Chemists, for a moment you don’t feel like a minority.”

*The Women in Chemistry Brunch, a yearly tradition that wraps up recruitment for prospective graduate students.*





# Startup QDIR uses quantum dots for infrared detectors

By Emily Ayshford

Infrared imaging can enhance our senses by “seeing” through hazy weather, opaque plastic containers, and old paintings, and by identifying chemicals by their signature.

But infrared detectors are expensive and complicated to manufacture, and the process often produces low yields. New startup QDIR, based on technology developed in the lab of University of Chicago professor and Chicago Quantum Exchange member Philippe Guyot-Sionnest, is working to commercialize a new, low-cost way to create these detectors: with quantum dots.

QDIR’s approach is getting attention. The company is an active member of the 4th cohort of Argonne National Laboratory’s Chain Reaction Innovations (CRI) program, which embeds entrepreneurs at the lab in two-year stints to develop revolutionary technologies, and was awarded a National Science Foundation Phase I SBIR grant to support commercialization of its core technology.

“Over the past year, we’ve gotten an increasing amount of interest from companies in the industry,” said Guyot-Sionnest, who is a professor of chemistry at UChicago. “Infrared detection used to be such a secretive field, but now we have developed something in the lab that could be useful, and it will be great to see where this goes.”

The company’s technology is based on colloidal quantum dots: tiny semiconducting nanocrystals that range from 1 to 20 nanometers in dimension and suspended in a liquid. These quantum dots are made from mercury telluride and have the ability to absorb infrared light, and Matthew Ackerman, a recent PhD graduate from Guyot-Sionnest’s lab, has been working to develop photodiodes with these dots. Once in an array, these quantum dot diodes can be used to capture infrared images.

The company’s breakthrough lies in the manufacturing process.

While infrared detectors are often made from bulk crystals, QDIR’s detectors are made from solutions, which can be painted directly onto silicon integrated circuits – a cheaper and less complicated way to ultimately develop detectors. And while the bulk crystals create low yields, QDIR’s process has the potential to have very high throughput of product. It simplifies the manufacturing process, reduces cost, and creates higher yield.

Ackerman says they hope to validate the imaging capabilities of the technology with both short-wave infrared (good for revealing chemical features of a substance) and mid-wave infrared (good for thermal imaging of objects). They hope to achieve a higher sensitivity than current detectors, or the same sensitivity at higher operating temperatures. (Many current systems require that the detector be cooled cryogenically).

Short wave infrared light can be used to see through silicon wafers, inspect fruits, sort materials based on their specific absorption. Image courtesy Dr. Xin Tang.

Potential target markets for this technology are product engineers and equipment manufacturers that are developing machine vision, non-invasive quality testing systems, surveillance methods, and even autonomous transportation vehicles.

As part of the Argonne CRI program, Ackerman will use office and lab space at Argonne to work throughout the next year on validating the technology with potential customers and scaling production. The program also provides business mentorship to participants, and Ackerman hopes to continue to develop the business side of the company by seeking out customers and strategic relationships.

“At the end of CRI we hope QDIR can stand up on its own,” Ackerman said. “We could ultimately provide a better, inexpensive alternative to existing technology.”

**CHEMISTRY EVENTS** The most up-to-date information on Department of Chemistry lectures and events can be found online at [events.uchicago.edu/chem/index.php](https://events.uchicago.edu/chem/index.php).

**LET’S KEEP IN TOUCH** The Department of Chemistry is updating its records. Send your current e-mail address and other contact information to [chemistsclub@uchicago.edu](mailto:chemistsclub@uchicago.edu).

**CONNECT WITH US** on Facebook, LinkedIn, Twitter, and Instagram @UChiChemistry!

## THE DEPARTMENT OF CHEMISTRY

has started a campaign to fully endow two graduate student fellowships to honor the legacies of Professors Jack Halpern and Stephen Berry. Both were exceptional scientists and leaders in their fields, and both were longstanding members of our department. The fellowships were initiated by their families, and our goal is to raise funds so that each can fully support a graduate student.

**Double your Donation in 2022:** We are delighted to inform you that your charitable donation will be matched dollar-for-dollar (up to 25K per donor). Click the link below to contribute, and be sure to indicate the fellowship that you wish to support.

[DONATE](#)

# Congratulations DEGREES AWARDED

## PhDs

### Autumn Quarter 2021

Saara-Anne Azizi (MSTP Dickinson)  
Natalie Chan (Lewis)  
John Coukos (MSTP Moellering)  
McKenna Goetz (Anderson)  
Jaehyeok Jin (Voth)  
Chenghan Li (Voth)  
Michael Mellas (Tirrell)  
Preeti Poddar (Park)  
Won Hee Ryu (Voth)  
Cooper Taylor (Snyder)  
David Upp (Lewis)  
Bohdi Vani (Dinner)  
Laura Watkins (Voth)  
Han Yang (Galli)

### Winter Quarter 2022

Sarah Brown (Sibener)  
Xuanyu Feng (Lin)  
Jonathan Keim (Snyder)  
Alison McMillan (Sibener)  
Pei Qu (Snyder)  
Brooke Schuster (Tay; Moellering)

Heng Yi (Snyder)  
Sarah Zinn (Engel)

## MS in Chemistry

### Autumn Quarter 2021

Jasper T. Brown  
Ignacio Xionkon Chi Durán  
Chuhui Fu  
Indranil Ghosh  
Yu Ling Goh  
Blake Ryan Hance  
Sohee Kim  
Ziqing Lin  
Colin Francis Lynch  
Tyler Joseph Pleasant  
Arturo Sauza De La Vega  
Anna Olivia Schouten  
Qijie Shen  
Xingyu Shen  
Riley Sinnott  
Deborah Mary Thomas  
Cole Joseph Wagner

Haoyang You

Winter Quarter 2022  
Caitlin Cyrillia Bellora  
Mengrui Cao  
Miao Chen  
Sijia Chen  
Alex Edward Crolais  
Maia Czaikowski  
Julia Lucette Driscoll  
Jingxing Geng  
Spencer Chen Guo  
Mengshu He  
Shou-Ting Hsieh  
Ethan Hyland  
Olivia Laxton  
Sean Lee  
Seung Yeon Lee  
Beiye Li  
Jianqiao Liu  
Jianming Mao  
Lauren Elizabeth Mcnamara  
Daniel Pyle

Jirapon Sae-Jew  
Joseph Louis Spellberg  
Florence Maria Lucette Szczepaniak  
Samuel Warren  
Jisoo Woo  
Jiangbo Wu  
Yuan Wu  
Yutao Zhao  
Yuhao Zhong  
Zirui Zhou

## BA or BS in Chemistry

### Autumn Quarter 2021

Olivia Morales B.S

### Winter Quarter 2022

Justin Lee B.A

## Prof. Anna Wuttig Joins Department of Chemistry



Professor Anna Wuttig is joining the Department of Chemistry as a Neubauer Family Assistant Professor. The mission of the Wuttig group is to integrate renewable energy input into the synthesis of products across the chemical value chain by advancing the science underlying chemical reactivity at electrified interfaces.

Dr. Wuttig was born in Washington, D.C., and spent time in Germany, Japan, and the U.S. during her early years. She received her A.B. in Chemistry from Princeton University. There, she was introduced to scientific research in the laboratories of Profs. Haw Yang, Robert Cava, and Andrew Bocarsly, where she developed a great interest in the chemistry underlying electricity-driven processes. She received her Ph.D. from the Massachusetts Institute of Technology, where she investigated electrocatalytic CO<sub>2</sub> reduction with Prof. Yogesh Surendranath as an NSF Graduate Research Fellow. She then joined Prof. F. Dean Toste’s research group as an NIH Postdoctoral Fellow at UC Berkeley. There, she worked on understanding molecular electrocatalytic manifolds for selective radical processes.

## NOTABLE AWARDS

**Paul Alivisatos** accepts Priestley Medal

**Paul Alivisatos, Chuan He, Wenbin Lin, & Jiwoong Park** recognized as Highly Cited Researchers by Clarivate

**John Anderson** promoted to Associate Professor & **Bozhi Tian** promoted to Professor

**Laura Gagliardi** wins Royal Society of Chemistry Prize elected to Accademia Nazionale dei Lincei

**Ka Yee C. Lee** honored with Chang-Lin Tien Leadership in Education Award

**Sarah King** awarded Air Force Office of Scientific Research Award

**Mark Levin** awarded Sloan Fellowship receives Packard Fellowship in Science and Engineering

**Benoît Roux** elected fellow in the Royal Society of Canada (RSC)

**Norbert F. Scherer** named the 2022 C.E.K. Mees Medal Recipient by The Optical Society of America, now named Optica

**Andrei Tokmakoff** elected to National Academy of Sciences



THE UNIVERSITY OF  
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DEPARTMENT OF CHEMISTRY

# *the chemists club*

Spring 2022

*Dear friends,*

With a long, cold winter behind us, spring is bursting forth all over our beautiful campus. And with the promise of the new season comes renewed energy, fresh ideas, and sustained growth within the Department of Chemistry. I'd like to begin with some good news from the 2022 U.S. News ranking of chemistry programs: this year, UChicago has leapfrogged from 14 to 7 nationwide, and we aim to rise further. With relatively low COVID levels on our campus, the majority of our research activities and teaching have resumed in person. While not all difficulties are behind us, I'm looking forward to busy hallways, bustling laboratories, and more in-person with students, staff, and esteemed colleagues.

Our faculty is growing with recently appointed faculty, and we look forward to sharing their research and other contributions in upcoming issues of The Chemists Club. In this issue, you can learn more about Anna Wuttig, who joined us in 2021 as a Neubauer Family Assistant Professor. Anna completed her postdoc at UC Berkeley after earning her Ph.D. at MIT. Anna works to integrate renewable energy input into the synthesis of products across the chemical value chain by advancing the science underlying chemical reactivity at electrified interfaces. We are also delighted to welcome Jack W. Szostak to our faculty starting in September after many years at Harvard University. His biochemical inquiries into the origins of life will continue in our Department, where the construction of his new research space is underway.

Our faculty continues to take the lead in cross-campus research initiatives. Greg Engel will head a new National Science Foundation institute called the Quantum Leap Challenge Institute for Quantum Sensing for Biophysics and Bioengineering (QuBBE), which aims to discover new applications for quantum technology in biology and to develop the quantum workforce through STEM education and outreach.

Three UChicago faculty are now at the helm of top ACS Journals as editors-in-chief. Along with Stuart Rowan as editor-in-chief for ACS Macro Letters, two other faculty members were appointed in 2021 as editors-in-chief for ACS Publications: Chuan He for ACS Chemical Biology and Laura Gagliardi for the Journal of Chemical Theory and Computation.

To honor the legacies of Professor Steven Berry and Professor Jack Halpern, we have established graduate student fellowships in their names and are raising funds to fully endow them. We invite you to support the memory of these exceptional scientists by making a contribution to the fellowship funds. Our goal is to raise sufficient funds in time to award the first of these fellowships next year, so we will match your donations \$ for \$ (up to \$25K per donor).

We are planning to host an event around UChicago Alumni Weekend (May 19–22) to reconnect our chemistry community. We hope you will be able to join us.

Viresh Rawal  
Professor and Chair