



More Viewpoints, Better Science

2017 Conference Planning Committee

Jennifer Ross, Chair

Department of Physics,
University of Massachusetts Amherst

Karen Bjorkman

Department of Physics and Astronomy,
University of Toledo

Seth Cohen

Department of Chemistry and Biochemistry,
University of California, San Diego

Julio de Paula

Department of Chemistry,
Lewis & Clark College

Gina MacDonald

Department of Chemistry and Biochemistry,
James Madison University

Nicola Pohl

Department of Chemistry,
Indiana University Bloomington

Jennifer Prescher

Department of Chemistry,
University of California, Irvine

Zachary Schultz

Department of Chemistry and Biochemistry,
University of Notre Dame

Silvia Ronco

Senior Program Director,
Research Corporation for Science Advancement

From the Program Chairs	2
Conference Objectives and Survey	3
Agenda and Meeting Room Maps	4
Conference Keynote Speaker	8
FRED Award Winner	9
TREE Award Winners	10
Presentations by Cottrell and Cottrell-Fulbright Scholars	12
Presentations by Cottrell Scholars Collaborative Teams	13
Cottrell Scholars Collaborative Proposal Writing Rules	13
Profiles of 2017 Cottrell Scholars	14
Profiles of 2017 Cottrell-Fulbright Scholars	26
Networking Directory	27
Conference Participants	35

2017: More Viewpoints, Better Science

From the Program Chairs

Welcome to the 2017 Cottrell Scholar Conference!

Diversity and mentoring are key issues in STEM education today, and thus highly appropriate as the focus of our 23rd annual conference.

Keynote speaker Geri Richmond, Presidential Chair in Science and Professor of Chemistry at the University of Oregon, will address these issues in practical terms. Richmond, a National Medal of Science winner, is the founding and current director of COACH (<http://coach.uoregon.edu>), a grass-roots organization formed in 1998 that has helped in the career advancement of thousands of scientists and engineers in the U.S., Asia, Africa and Latin America.

We also have on hand a magnificent set of discussion facilitators with extensive experience mentoring underrepresented minorities as well as dealing with LGBT and women's issues. We're hoping the ideas generated from your interactions with these accomplished teacher-scholars—in Q&A sessions, during official breakout sessions, and in your numerous one-on-one conversations during the next two-and-a-half days—will lead to a new level of awareness of the need for diversity among researchers as well as new, more effective methods for mentoring the next generation of scientists.

Inclusiveness and diversity begin with you. So listen, speak up, and, above all, contemplate.

A great way to pursue new ideas and quality projects is to participate in the Cottrell Scholars Collaborative. A cross-disciplinary network begun in 2011, CSC's overarching goal is to improve undergraduate and graduate science education at colleges and universities across the country. CSC participation is also a good way to develop your academic leadership skills.

We hope you find this event informative and stimulating. Please contact us with advice on how to make both the CS program and the conference even better!

Jenny Ross

Associate Professor of Physics
University of Massachusetts Amherst

Silvia Ronco

Senior Program Director
Research Corporation for Science Advancement

Conference Objectives and Survey

To empower scholars to promote diversity and inclusion in academic settings, participants will:

- Discuss successful activities and approaches for engaging with students, colleagues, and administrators at different types of institutions.
- Learn how to work with colleagues and administrators to engender buy-in for educational change.
- Explore partnerships engaging diverse constituents.
- Become familiar with ongoing activities aimed at transforming STEM education at the national level.
- Identify tactics that enable collective action.
- Have the opportunity to form teams and become involved in educational projects of national impact.
- Engage in collaborative work that will continue throughout the year.

Conference Evaluation Survey

An online conference survey will be available on Friday, July 14, 2017. To access and complete the survey, please go to: <http://www.surveymonkey.com/r/2017CSconferencesurvey>

2017: More Viewpoints, Better Science

2017 Cottrell Scholar Conference Agenda

More Viewpoints, Better Science
Westin La Paloma

Wednesday, July 12, 2017

2:00 - 6:00 pm	Registration	Retail Foyer
3:00 - 4:00 pm	Opening Reception Drinks and Light Hors d'Oeuvres	Murphey Patio
4:00 - 5:00 pm	Welcome and Introductions Conference Overview and Goals Silvia Ronco, Jenny Ross Introduction of Scholars	Murphey
5:00 - 6:30 pm	2017 Cottrell Scholars Presentations	Murphey
7:00 - 9:00 pm	Dinner	Sonoran I
7:45 - 8:30 pm	FRED Presentation Carlos Meriles, Physics, City College of New York Cottrell Scholar Trophy Ceremony	

2017 Cottrell Scholar Conference Agenda

More Viewpoints, Better Science
Westin La Paloma

Thursday, July 13, 2017

7:00 am	Registration	Finger Rock Foyer
7:00 - 8:00 am	Breakfast	Murphey Patio
8:00 - 9:45 am	2017 Cottrell Scholar Presentations	Murphey
10:00 - 10:15 am	Morning Break	Finger Rock Foyer
10:15 am - 12:00 pm	Breakout Session I <i>Mentoring and Diversity</i>	Finger Rock I, II, III & Acacia
	Report Out	
12:00 - 1:00 pm	Lunch	Sonoran I
1:00 - 2:30 pm	Keynote Presentation "Elements for Success in Science and Innovation" Geri Richmond, Chemistry Department, U of Oregon	Murphey
	Discussion / Q&A	
2:30 - 3:00 pm	Afternoon Break	Finger Rock Foyer
3:00 - 4:30 pm	Breakout Session II <i>Mentoring and Diversity</i>	Finger Rock I, II, III & Acacia
	Report Out	Murphey
4:30 - 6:00 pm	Pool Time Swimming & Informal Discussion	
6:00 - 7:00 pm	Reception Honoring New Scholars Poster Session with Drinks & Light Hors d'Oeuvres	Sonoran
7:00 - 10:00 pm	Dinner	Sonoran
7:30 - 9:00 pm	2017 TREE Award Presentations Seth Cohen, Chemistry, U of California, San Diego David Ginger, Chemistry, U of Washington	Sonoran
9:00 - 10:00 pm	Poster Session with Dessert & Drinks	

2017: More Viewpoints, Better Science

2017 Cottrell Scholar Conference Agenda Continued

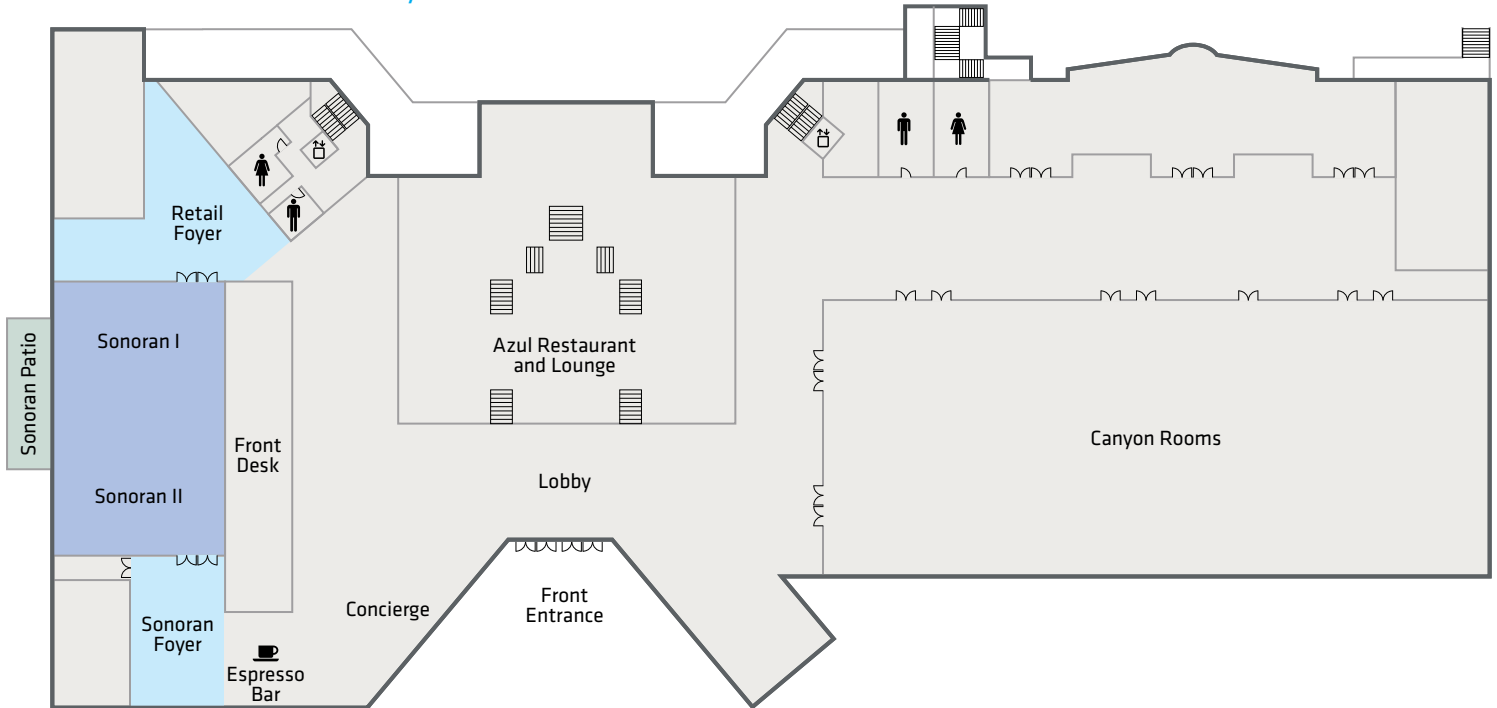
More Viewpoints, Better Science
Westin La Paloma

Friday, July 14, 2017

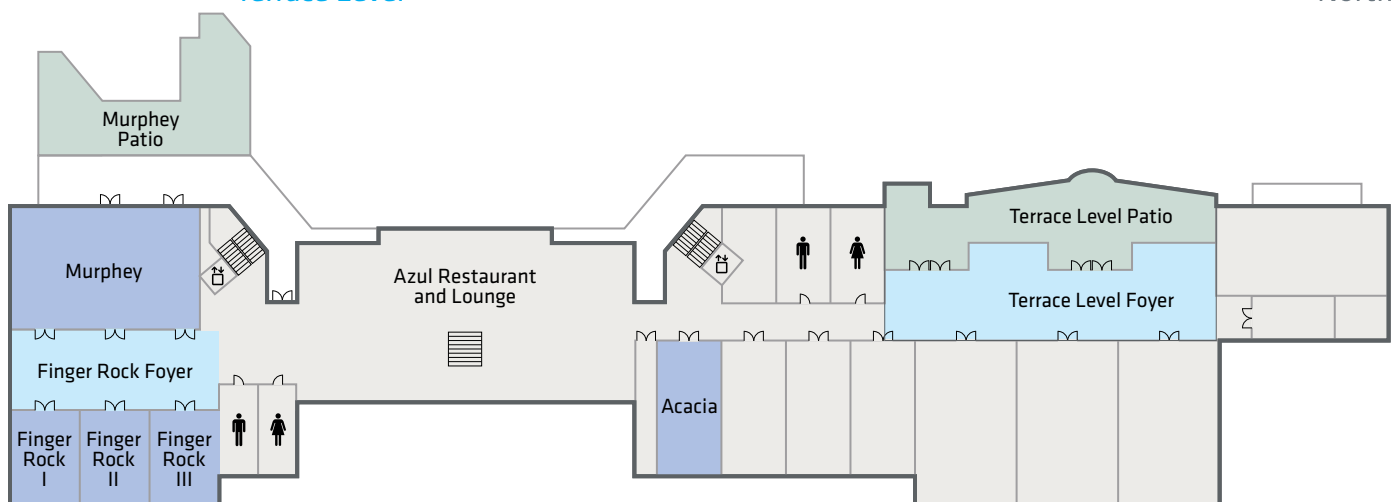
7:00 - 8:00 am	Breakfast	Murphey Patio
8:00 - 10:00 am	Cottrell Scholar Collaborative Presentations	Murphey
10:00 - 10:30 am	Morning Break	Finger Rock Foyer
10:30 am - 12:00 pm	Breakout Session III <i>Cottrell Scholars Working Together</i>	Finger Rock I, II, III & Acacia
	Report Out	Murphey
12:00 - 1:00 pm	Lunch with Poster Session	Sonoran I
1:00 - 1:45 pm	2016 TREE Award Presentation Vince Rotello, Chemistry, U of Massachusetts Amherst	Murphey
1:45 - 4:30 pm	Breakout Session IV Unstructured Time to Work on Collaborative Projects	Finger Rock I, II, III & Acacia
4:30 - 5:00 pm	Conference Survey	Murphey
5:00 - 6:00 pm	Pool Time Swimming & Informal Discussion	
6:00 - 7:00 pm	Reception Drinks & Light Hors d'Oeuvres	Terrace Level Patio
7:00 - 9:30 pm	Dinner All Guests are Invited to Join	Terrace Level Foyer

Westin La Paloma Resort and Spa

Lobby Level



Terrace Level



Keynote Speaker

Elements for Success in Science and Innovation

Geraldine Richmond

Presidential Chair in Science and Professor of Chemistry,
University of Oregon



Abstract: The multitude of challenges that we face around the globe with rapidly growing populations, depletion of resources and climate change require us to examine anew the most effective strategies for maximizing the positive impact of science and innovation on our world. The complexity of these issues demands an approach that challenges the traditional ways that science has been conducted. Changes that are necessary and how we can all work together to empower these changes will be the focus of this presentation.

Bio: Geraldine (Geri) Richmond is the Presidential Chair in Science and Professor of Chemistry at the University of Oregon where she has been since 1985. A native of Kansas, she received her B.S. in Chemistry from Kansas State University and her Ph.D. in Physical Chemistry from the University of California, Berkeley. Her educational efforts have focused largely on Introductory Chemistry and Science Literacy courses as well as being the Director of several University of Oregon undergraduate research programs. She is currently serving on the National Science Board (Obama appointee) and is a past president of the American Association for the Advancement of Science (AAAS). She has recently served and as U.S. State Department Science Envoy to the SE Asian Lower Mekong River countries (Kerry appointee). Richmond is the founding and current Director of COACH, helping in the career advancement of over 20,000 women scientists and engineers in the U.S. and in over 20 developing countries in Asia, Africa and Latin America. Richmond received the Medal of Science in 2015 and is the ACS Priestley Medal recipient for 2017.

2016 FRED Award Winner

Variable-Charge Point Defects in Diamond as a Platform for Ultra-Dense Storage and Quantum Information



Carlos A. Meriles

Physics Department, CUNY-City College of New York
 Cottrell Scholar 2007

The negatively-charged nitrogen-vacancy (NV-) center in diamond is the focus of widespread attention for applications ranging from nanoscale metrology to quantum computing. Of interest in these applications is the manipulation of the NV charge state, which can be attained by optical excitation. In this talk I will discuss recent experimental results on the dynamics of NV photo-ionization, charge diffusion, and trapping in nitrogen-rich diamond. Using multi-color confocal microscopy, we uncover the formation of mesoscale patterns of trapped charge, which we qualitatively reproduce via a model of the interplay between photo-excited carriers and atomic defects. I will devote special attention to the limit of low illumination intensities, where we uncover the formation of nanometer-sized textures of trapped charge, driven by carrier tunneling to and from the NVs. Finally, I will show how these processes can be exploited, for example, to optically store classical information in three dimensions, and how these ideas can be extended to the sub-diffraction limit by combining NV spin control and super-resolution microscopy.

Bio: Carlos Meriles is Professor of Physics at the City College of New York. He carries a Ph.D. in Physics cum laude and a B.S. in Physics from Universidad Nacional de Córdoba in Argentina. He joined the faculty at City College of New York in 2004 as an Assistant Professor and became a Professor of Physics in 2012. He became a Fellow of the American Physical Society in 2015, an Alexander von Humboldt Scholar in 2011, a Cottrell Scholar in 2007, and a Wegman Brothers Faculty Fellow in 2006. Also in 2006 he won the NSF CAREER Award. His research interests focus on the development of new spin-based platforms for nanometer-resolution MRI and various nanoscale sensing protocols, quantum control of individual spin clusters for quantum information processing, and the generation of electron or nuclear spin hyper-polarization. He received the inaugural FRED award in 2016.

2016 TREE Award Winner

Created in 2015, the TREE Award (Transformational Research and Excellence in Education) honors the outstanding research and education accomplishments of the community of Cottrell Scholars. Additionally, the award encourages the improvement of science education and raises the national profile of the Cottrell Scholar community.

Vincent Rotello

Department of Chemistry, University of Massachusetts Amherst
Cottrell Scholar 1996

Vincent Rotello is the Charles A. Goessmann Professor of Chemistry and a University Distinguished Professor at the University of Massachusetts at Amherst. He received his B.S. in Chemistry in 1985 from the Illinois Institute of Technology, and his Ph.D. in Chemistry in 1990 from Yale University. He was an NSF postdoctoral fellow at Massachusetts Institute of Technology from 1990-1993, and joined the faculty at the University of Massachusetts in 1993. He has been the recipient of the NSF CAREER and Cottrell Scholar awards, as well as the Camille Dreyfus Teacher-Scholar, the Sloan Fellowship, and the Langmuir Lectureship, and is a Fellow of the American Association for the Advancement of Science (AAAS) and of the Royal Society of Chemistry (U.K.). He was also recognized in 2014 and 2015 by Thomson Reuters as one of the “Most Influential Scientific Minds.” Rotello is currently the Editor-in-Chief of *Bioconjugate Chemistry*, and is on the Editorial Board of 14 other journals. His research program focuses on using synthetic organic chemistry to engineer the interface between hard and soft materials, and spans the areas of devices, polymers, and nanotechnology/bionanotechnology, with over 460 peer-reviewed papers published to date.



2017 TREE Award Winners

Seth Cohen

Department of Chemistry, University of California, San Diego
Cottrell Scholar 2004

Seth Cohen obtained a B.S. in Chemistry and a B.A. in Political Science from Stanford University before earning his Ph.D. from the University of California, Berkeley. From there, he performed postdoctoral research at the Massachusetts Institute of Technology, then went on to the University of California, San Diego, where he became a Professor of Chemistry in 2011. He served as Chair of the Department of Chemistry and Biochemistry from 2012 to 2015. Cohen was named a Cottrell Scholar in 2004 and is especially noted for his development of the Science Policy Internship Program stemming from his AAAS-sponsored sabbatical at the White House Office of Science and Technology Policy. The Research Group of Seth M. Cohen performs a variety of investigative studies in the general areas of inorganic, bioinorganic, medicinal, materials, and supramolecular chemistry.



David Ginger

Department of Chemistry, University of Washington
Cottrell Scholar 2006

David Ginger is a Professor of Chemistry and Physics at the University of Washington. He is also a Washington Research Foundation Distinguished Scholar, Associate Director of the UW Clean Energy Institute, and Associate Editor of Chemical Reviews. He obtained his Ph.D. in Physics in 2001 at the University of Cambridge. He became a Cottrell Scholar in 2006 and was awarded the Microscopy Society of America Burton Medal in 2012, the Camille Dreyfus Teacher-Scholar Award and the UW Department of Chemistry Outstanding Teaching Award in 2007. He has many publications, including *Quantum Dot/Plasmonic Nanoparticle Metachromophores with Quantum Yields That Vary with Excitation Wavelength* and *Imaging Local Trap Formation in Conjugated Polymer Solar Cells: A Comparison of Time-Resolved Electrostatic Force Microscopy and Scanning Kelvin Probe Imaging*. His research interests include nanoscale morphology in conjugated polymer blends, optoelectronic properties of colloidal quantum dots, and near-field nanophotonics.



Presentations by Cottrell and Cottrell-Fulbright Scholars

2016 Cottrell Scholars

Nandini Ananth	Chemistry, Cornell University
Eva-Maria Collins	Physics, University of California, San Diego

2017 Cottrell Scholars

Shane Ardo	Chemistry, University of California, Irvine
Robert Berger	Chemistry, Western Washington University
Laura Chomiuk	Physics, Michigan State University
Charles Doret	Physics, Williams College
Edward Flagg	Physics, West Virginia University
Nathaniel Gabor	Physics, University of California, Riverside
Eilat Glikman	Physics, Middlebury College
Kamil Godula	Chemistry, University of California, San Diego
Amanda Hargrove	Chemistry, Duke University
Minsu Kim	Physics, Emory University
Michelle Kovarik	Chemistry, Trinity College
Daniel Lambrecht	Chemistry, University of Pittsburgh
Mariangela Lisanti	Physics, Princeton University
Tyler Luchko	Physics, California State University, Northridge
Kathryn Mouzakis	Chemistry, Fort Lewis College
James Neilson	Chemistry, Colorado State University
Monika Schleier-Smith	Physics, Stanford University
Natalia Shustova	Chemistry, University of South Carolina, Columbia
Yogesh Surendranath	Chemistry, Massachusetts Institution of Technology
Timothy Wenczewicz	Chemistry, Washington University in St. Louis
Adam Willard	Chemistry, Massachusetts Institution of Technology
Amanda Wolfe	Chemistry, University of North Carolina at Asheville
Yan Xia	Chemistry, Stanford University

2017 Cottrell-Fulbright Scholar

Ute Hellmich	Pharmacy and Biochemistry, University of Mainz
---------------------	--

Presentations by Cottrell Scholars Collaborative Teams

Academic Leadership Training

Rigoberto Hernandez, Chemistry, Johns Hopkins University

Promoting Adoption of Research and Inquiry-Based Lab Curricula

Jennifer Heemstra, Chemistry, University of Utah

Bridges to Germany: Junior Faculty Professional Development Workshop

Carla Frohlich, Physics, North Carolina State University

Olalla Vazquez, Chemistry, University of Marburg

Teacher Scholar Ambassadors for PUI-R1 Partnerships

Zachary Schultz, Chemistry, University of Notre Dame

Diversity Survey and Policy

Adam Leibovich, Physics, University of Pittsburgh

The Quantum Flip

Andriy Nevidomskyy, Physics, Rice University

Cottrell Scholars Collaborative Proposal Writing Rules

Successful proposals should have the potential to positively impact undergraduate and/or graduate science education in the classroom, at the departmental level or at the national level.

- Up to four \$25,000 awards will be given to teams of Cottrell Scholars working collaboratively.
- Two-year awards made to a team formed at this conference.
- Members of the team are active or past Cottrell Scholars.
- Award could be for a new project that will expand the impact of existing funded collaborative projects. New collaborative projects are also welcome.
- Proposal should briefly explain an innovative approach for projects with potentially broad impact.
- Two-page proposal must be submitted electronically to Silvia Ronco (sronco@rescorp.org) and Richard Wiener (rwiener@rescorp.org) by midnight (PDT) on July 28, 2017.
- Awards will be announced within a month of submission.

2017 Cottrell Scholars

Shane Ardo

Department of Chemistry and Chemical Engineering and Materials Science,
University of California, Irvine

Photoacid-Sensitized Polymers as Light-Driven Ion Pumps for Photodialysis of Salt Water and Mapping Functional Neuron Connectivity

My group is pioneering the development of dye-functionalized ion-exchange materials to directly convert sunlight into *ionic power*. This mechanism is game-changing because it skips the electronic-to-ionic energy conversion steps that occur in traditional electro dialysis, which waste > 85% of the input energy. Our innovation, and recent demonstration, consisted of rationally designed ion-exchange polymers, whose electrostatics mimic that of pn-junction electronic semiconductors, with covalently-bound photoacid dye functionalities. Our research plan is to design, computationally model, synthesize, and characterize new photoacidic dyes, anchor them to ionically functionalized materials surfaces, and study their fundamental photochemistry and photophysics using time-resolved spectroscopies and microscopies, photoelectrochemistry, and materials science characterization techniques.

My educational plan is straightforward: to completely re-design graduate-level courses in electrochemistry by introducing a substantial laboratory component, restructuring lectures, and providing video-recorded lectures. Specifically, I plan to teach basic electrochemical concepts, with lectures rooted in specific phenomena and targeting well-defined concepts from applied mathematics, physics, chemical engineering, materials science, and chemistry. The video-recorded lectures will constitute homework assignments and will supply critical application centric information relevant to the laboratory assignments. I expect that execution of a laboratory-based electrochemistry course will facilitate incorporation of laboratory components into other graduate-level courses at UC Irvine, and other institutions worldwide.



Robert F. Berger

Department of Chemistry, Western Washington University

Novel Approaches to the Computational Understanding and Prediction of Perovskite Dopant Environments and Distortive Modes

Compounds adopting the ABX₃ perovskite structure are notable for their structural, compositional, and functional flexibility. A wide range of polar distortive modes and rotations of the B-X octahedra can be tuned via elemental substitution and changes in temperature for applications ranging from photovoltaics to ferroelectrics to superconductors. While metrics (known as tolerance factors) based on the geometric packing of spherical ions can be used to roughly estimate the stability of hypothetical bulk perovskites, these traditional metrics have significant weaknesses. They fail to address both the stability of technologically important doped and substituted perovskites (i.e., those with stoichiometries other than ABX₃), and the delicate energetic balance of competing structural distortions. Our Research Proposal blends geometric intuition and modern density functional theory calculations to develop new approaches to understand the driving forces of energetic stability in perovskite derived materials.

Our Educational Proposal addresses the challenge that quantum mechanics, while integral to understanding chemical structure, bonding, and reactivity, is inherently less intuitive than other topics in the undergraduate chemistry curriculum. This work aims to create and assess interactive Mathematica-based online modules, combining mathematical equations and pictorial intuition in ways that are not typically seen in existing lessons, for use in an undergraduate quantum chemistry course.



2017 Cottrell Scholars Continued

Laura B. Chomiuk

Department of Physics and Astronomy, Michigan State University

The Physical Drivers of Diversity in Nova Explosions

Classical novae—thermonuclear explosions on white dwarfs—hold immense potential for understanding Type Ia supernova progenitors and as laboratories for shock physics and particle acceleration. I propose a systematic multi-wavelength observational program that measures both fundamental explosion parameters and links them to the physical mechanisms that drive nova diversity. The research objectives of this proposal are (1) to establish and analyze the first-ever complete sample of Galactic novae; (2) to increase the sample of novae with well-measured ejecta masses, white dwarf masses, and accretion rates by a factor of 10, testing theoretical predictions of accreting white dwarfs; and (3) to measure the contribution of shocks to the energy budget of 40 novae and determine the efficiency of relativistic particle acceleration.

I will take advantage of my position as the director of the MSU Campus Observatory in a two-prong educational program. First, I will refine an undergraduate course in observational astronomy to make it more experiential, student-driven, and inquiry-based. Labs will make extensive use of the Observatory and encourage open-ended exploration. I will rework the lectures to be better aligned with lab experiences and more focused on active learning. Second, I will provide research experiences to a large number of MSU undergraduates, focusing on those from under-represented groups. Students will obtain and analyze data at the Observatory weekly, and present and publish these data. This effort will engage ~20 students yearly, with a goal of exposing students to authentic astrophysics and increasing the probability that they will pursue science careers.



Charles Doret

Department of Physics, Williams College

Measuring Nanoscale Thermal Transport with Chains of Trapped Ions

Demand for an improved understanding of nanoscale heat transport has grown steadily as improvements in fabrication and materials processing have permitted realization of ever-smaller microelectronic devices and other mesoscopic structures. This regime, at the crossover between ballistic and diffusive heat transport, resists both theoretical and experimental study. Nanoscale systems are still too large for practical first principles atomic-scale calculations, while experiments in solid-state systems are plagued by interface effects that can distort measurements. The set of experiments outlined here will address fundamental questions about the quantum-to-classical transition for heat transport using dual-species chains of trapped calcium ions. Using diode lasers to implement laser-cooled thermal baths and read-out ion temperatures we will determine equilibrium temperature distributions in these chains. We will also explore approaches for optimizing sympathetic cooling of dual-species ion chains and perform a measurement of the ${}^2\text{S}_{1/2} \rightarrow {}^2\text{D}_{5/2}$ electric quadrupole transition isotope shift.

Our educational plan proposes the restructuring of a first-year course in modern physics to incorporate guided small-group problem-solving sessions. These sessions, which will replace a portion of the class time traditionally spent in lecture, will ensure all students have opportunities for regular few-on-one interactions with their instructors. We will also add a guided introduction to computational software during laboratory periods. In so doing we hope to directly address differences in quantitative preparation among incoming students—a key factor contributing to lower rates of persistence and success in quantitative disciplines by underrepresented groups—and to improve outcomes for all students in the course.



2017 Cottrell Scholars Continued

Edward B. Flagg

Department of Physics and Astronomy, West Virginia University

Combined Coherent Manipulation and Single-Shot Measurement of an Electron Spin

Quantum information processing promises to make computationally intractable problems efficiently solvable, but the physical implementation of the quantum bits of a quantum computer faces many challenges. One candidate quantum bit is the spin degree of freedom of a single electron trapped in a quantum dot.

Unfortunately, with the current state of the field, the experimental conditions for initialization and manipulation of a spin in a quantum dot are incompatible with a single-shot measurement of the spin. I propose to address this challenge by using an innovative optical technique to engineer the simultaneous combination of coherent manipulation and measurement of a single electron spin in a quantum dot, moving an important step closer to practical quantum computing.

My educational plan addresses the limited adoption of teaching techniques based on the results of physics education research. Despite the proven positive effects of such techniques on student outcomes, less than half of higher-education physics faculty use them in class. One of the barriers to adoption is the usability of the techniques, which are often developed and presented piecemeal, rather than being integrated into a package that contains all the materials necessary to run a course. To improve this situation, I will develop, evaluate, disseminate, and support three full-course packages for upper-division physics that integrate active learning techniques from physics education research. A complete and readily available course package would allow instructors—especially new faculty and those teaching a course for the first time—to easily incorporate such techniques when they teach.



Nathaniel M. Gabor

Department of Physics and Astronomy, University of California, Riverside

Hot Electron Optoelectronics of Atomic Layer Heterostructures

The objective of this proposal is to exploit a new class of quantum optoelectronics based on heterostructures that integrate atomic layer semiconductor materials composed of transition metal dichalcogenides (TMDs). Two-dimensional (2D) materials—such as graphene, hexagonal boron nitride, and TMDs—can be mechanically assembled to form heterostructures whose properties are not simply the sum of the constituent materials. The new physics that emerges in these synthetic materials is still largely unresolved, owing to the burden of exhaustive comprehensive characterization and the need for new physical descriptions. The unique electronic transport regimes in 2D materials sets them apart from conventional electronic systems, and hold promise for new quantum optoelectronics based on out-of-equilibrium, yet steady state hot-electron photoresponse. We aim to investigate the fundamental and technical aspects of these layered 2D systems based on their extraordinary electronic properties. Specific projects include: (1) investigation of fundamental physical properties of quantum electronic and optoelectronic transport in TMD heterostructures, (2) demonstration of the direct transfer of charge and energy between proximal atomically thin layers, and the exploration of the hot electron contribution to in-plane and out-of-plane energy flow, and (3) investigation and optoelectronic imaging of electronic energy flow utilizing novel ultrafast photoresponse microscopy techniques.

The key outcome of the PI's support through the Cottrell Scholar Award program will be deep understanding of the hot electron transport regime and the proposed interlayer impact excitation process in optoelectronic devices, as well as synergistic integration of advanced research and education.



2017 Cottrell Scholars Continued

Eilat Glikman

Department of Physics, Middlebury College

Understanding the Role of Quasar Feedback in Galaxy Evolution across Luminosities and Redshift

Observational evidence suggests that quasar activity plays an important role in regulating how galaxies and their nuclear supermassive black holes grow, despite their orders-of-magnitude difference in scale. I propose to use a sample of highly luminous dust-reddened quasars that have been shown to reside in merging galaxies, and that represent a short-lived phase in the lifetime of a quasar, to study the physical mechanisms by which their energy output (feedback) impacts their host galaxies. I will study these sources using imaging and spectroscopic data that span the electromagnetic spectrum, from space and ground-based facilities. Since most AGN are significantly less luminous than the red quasars in my sample, the impact of lower luminosity systems on their hosts is particularly important to understand. Therefore, I will also expand the sample of red quasars toward lower luminosities, by mining data-rich fields, to understand how feedback effects depend on quasar power.

My education plan concerns making astronomy and physics more inclusive to students of color, with the ultimate goal of having more voices and minds contributing to the problems we work to solve. I will work with the STEM Posse program at Middlebury to teach astronomy and physics courses during a two-week summer-intensive science orientation for each incoming class. I will develop modules that make use of our upgraded campus observatory to invite these incoming freshmen to become physics majors and pursue careers in astronomy and physics. I will closely interact with and advise these students as they progress through our major.



Kamil Godula

Department of Chemistry and Biochemistry, University of California, San Diego

Harnessing the Mechanobiology of the Glycocalyx to Influence Stem Cell Specification

The glycocalyx is a major component of the cell-matrix interface, providing cells with a protective barrier, while also mediating cellular recognition and signaling. While the contributions of individual glycan structures are beginning to come into focus, the collective biophysical properties of the glycocalyx as an ensemble of nanoscale macromolecules is much less appreciated. Here, we propose to combine approaches from chemistry, materials science and biophysics to tailor the architecture of the glycocalyx on living cells and to investigate how its biomechanical properties contribute to cellular differentiation during myogenesis.

The research part of this proposal is complemented by an educational plan to broaden the exposure of undergraduate students to glycans and to increase their general familiarity with and understanding of glycan-related topics. In the first aim, we will establish a new introductory glycoscience course at the Glycobiology Research and Training Center tailored to be accessible to undergraduate students from across all science and engineering programs on campus. While the creation of a specialized glycoscience course is clearly needed, a bigger challenge is to expose students to glycan-related content early in their education. The second aim of this proposal will produce teaching materials highlighting glycoscience concepts designed for inclusion into basic science course lectures. These activities will be integrated into the glycoscience education curriculum at the GRTC and disseminated to our sister UC campuses.



2017 Cottrell Scholars Continued

Amanda E. Hargrove

Department of Chemistry, Duke University

Harnessing Small Molecule Receptors to Identify Patterns in RNA Structure and Implement a Course-Based Interdisciplinary Research Experience

The research proposed here will combine the diverse chemical space of small molecules with the power of differential sensing to develop first-in-class methods that rapidly elucidate critical principles of RNA recognition. Molecular-scale pattern-based sensing relies on differential interactions between receptors and analytes without the need for highly specific receptor: analyte pairing. Based on our preliminary work, we propose that molecular scaffolds known to interact with RNA motifs can be used as cross-reactive receptors to develop pattern recognition protocols for RNA structural features. Systematically increasing the complexity of small molecule receptors and RNA structures will yield novel insights into the importance of sequence, two-dimensional structure, environment and/or topology in RNA molecular recognition. The developed technologies will broadly enable RNA discoveries at the interface of chemistry and biology.

The education proposal will incorporate these methods into a research-based laboratory module that addresses my department's need for more consistent undergraduate research experiences, increased instruction on noncovalent interactions, and laboratory experiences in biochemistry and chemical biology. Students will first visually evaluate small molecule: RNA interactions through virtual reality headsets. Based on this analysis and literature, they will design hypothesis-driven experiments addressable by testing the binding of commercially available small molecules to a range of RNA sequences using a simple indicator displacement assay. These experiments will directly contribute to research that examines patterns in small molecule recognition of RNA structure, and the students will be able to immediately assess their contribution to this ongoing interdisciplinary project, which is expected to result in educational and research journal publications.



Minsu Kim

Department of Physics, Emory University

Quantitatively Characterizing the Effects of Slow Physiological Changes on Phenotypic Switching in Bacteria

As a mechanism to cope with hostile environments, bacteria spontaneously switch between markedly different phenotypes. This phenotypic switching plays a critical role in survival of bacteria under starvation, antibiotic treatment, attacks by host immune systems, etc. Studies have shown that the rate of phenotypic switching is a particularly critical factor for bacterial survival. Here, I will investigate what determines the switching rate. My central idea is that slow physiological changes associated with switching serve as a low-pass filter, leading to low switching rates. The proposed research will establish novel effects of the global state of cells, triggering a shift in studies of cellular-level dynamics from the traditional focus on molecular-level interactions. The outcome is expected to be highly important for medicine and biotechnology, e.g., guiding development of strategies to manipulate the rates of phenotypic switching for preventive and therapeutic purposes.

Tight collaborative research makes it difficult to distinguish physics and biology anymore. An unprecedented number of physicists are working on biological problems, and biological research is beginning to command center stage in physics. Thus, the next generation of physicists must be well-versed in both physics and biology. Here, I propose to modernize the content and pedagogy of undergraduate physics courses. I will develop class materials balancing understanding of physical principles and their application to biological problems, and incorporate them into inquiry-based instruction. Recognizing exciting developments at the intersection of physical and biological research, this plan will lay an essential foundation for fostering a pipeline of future interdisciplinary scientists.



2017 Cottrell Scholars Continued

Kirill Korolev

Department of Physics, Boston University

Chiral Pattern Formation and the Benefits of Chirality

Chiral growth is common in the microbial world, cancer, and during embryogenesis, but the origin and purpose of chirality remain unclear. In particular, we lack physical models that describe chiral pattern formation and its effects on the population dynamics of agents with microscopic chirality. I propose to investigate whether chiral cells have a distinct selective advantage, i.e. the chirality, at the population level, is a result of natural selection rather than an accidental byproduct of evolution.

To address this question, we developed a minimal reaction-diffusion model of chiral growth, which quantitatively recapitulates recent experimental results. Next, we will study competition between strains with different chiralities. Preliminary results show either exclusion of the less chiral strain or stable coexistence between strains with opposite chirality. The proposed work will create a theory of these puzzling phenomena and place them within the framework of statistical physics. Specifically, we will develop a new method to study selection induced pattern formation, understand the origin and role of chirality, and determine how physical principles can be used to control the structure and function of populations.

The educational component proposes the development of new courses to train students in modeling, nonequilibrium physics, and biophysics. The courses will address an important gap in our curriculum and will be the first attempt at BU Physics to create an upper-division undergraduate course completely focused on peer instruction, active-learning, and student-centered pedagogy. This course will also teach communication and research skills and provide many opportunities for self-driven scientific explorations.



Michelle L. Kovarik

Department of Chemistry, Trinity College

Biological Noisiness of Reactive Oxygen Species in *Dictyostelium discoideum*

Despite genetic and environmental uniformity, the inherent stochasticity of chemical reactions within cells produces biological noise. Recent research suggests that this inherent variation between individual cells may sometimes be adaptive since phenotypic variability within cell populations ensures a wide range of responses to environmental stresses. Single-cell analysis methods are maturing rapidly, presenting an opportunity to explore the relationship between cellular heterogeneity and stress response in detail. We propose to characterize the factors affecting noise levels in oxidative stress in the social amoeba *Dictyostelium discoideum*. A combination of microfluidic chemical cytometry and fluorogenic reporters will facilitate high-throughput analyses of statistically relevant numbers of cells. We will compare noise levels resulting from equivalent levels of oxidative stress from both endogenously produced ROS (from glucose metabolism) and exogenously supplied ROS (from peroxide standards) while controlling for cell cycle and dye loading in wild type cells and mutants. The results will contribute to a richer understanding of biological noise and its role in stress response.

An educational component designed to train students to engage actively with the primary literature in analytical chemistry will complement and support the proposed laboratory research. While several methods for teaching the primary literature have been published, few provide opportunities for repeated practice throughout the curriculum. The goal of the proposed educational plan will be to develop a set of comprehensive materials for teaching the primary literature in the analytical chemistry curriculum. These literature activities are part of my goal of incorporating engaged student learning throughout the classroom and laboratory.



2017 Cottrell Scholars Continued

Daniel Lambrecht

Department of Chemistry, University of Pittsburgh

Bridging Quantum Chemistry and Chemical Intuition to Characterize, Understand and Design New Chemical Sensor Materials

This project aims to establish quantitative structure-property relationships to guide the rational functionalization of chemically converted graphene to enable chemical sensing of volatile organic compounds. Such sensors could be used, e.g., as wearable “chemical noses” for real-time monitoring (and prevention) of health and safety threats, such as exposure to toxic or carcinogenic compounds, environmental contaminants, and explosives. This work is novel in that we will establish quantitative structure-property (in this case, sensing) relationships by identifying the molecular mechanisms and driving forces for analyte adsorption and resulting sensor responses in terms of intermolecular interactions defined from quantum chemistry. We expect that this approach will transform thinking by establishing a new quantitative basis for sensing mechanisms in terms of contributions such as electrostatics, charge transfer, and dispersion, and will furthermore facilitate molecular control over sensor responses to specific contaminants.

The educational plan aims to create inquiry-guided learning experiences in introductory chemistry classes to improve learning outcomes. This learning intervention is critically needed to address late graduation rates of up to 36% (Univ. Pittsburgh, 2009-13). One of students’ greatest challenges is navigating different chemical representations (macroscopic-microscopic-symbolic, “Johnstone’s Triangle”). The proposed work is transformative in that it will use smartphone technology to empower students to utilize different representations for solving chemistry problems, for free, and literally at their fingertips. Based on the Pitt Quantum Repository (<http://pqr.pitt.edu>), a web-based platform for molecular visualization on smartphones co-created by the PI, this project will create process oriented guided learning inquiry activities for practicing canonical chemistry concepts.



Mariangela Lisanti

Department of Physics, Princeton University

Confronting the Dark Matter Paradigm: New Approaches for Direct and Indirect Detection

Dark matter comprises the vast majority of the Universe’s matter density, and yet its basic properties remain a mystery. The Weakly Interacting Massive Particle (WIMP) has been the primary theoretical paradigm for dark matter, and is currently being put to the test by an extensive experimental program. This research proposal has two primary goals: to both confront and to expand beyond the WIMP paradigm. First, the PI will improve sensitivity to signals of dark matter annihilation using several new analysis methods that distinguish emission of diffuse gamma rays from astrophysical sources. Data from the *Fermi* Large Area Telescope will be used to study the Inner Galaxy and high-latitude sky. Second, the PI will develop new experimental approaches to extend the search for non-WIMP dark matter, specifically focusing on novel materials that can serve as effective targets for dark matter down to keV masses. The two primary research directions covered by this proposal take advantage of current and upcoming data from diverse experiments to shed light on dark matter and elucidate its particle and astrophysical properties.

For the educational proposal, the PI will create a new freshman seminar that develops mathematical, computing, and communication skills necessary for scientific research. All students accepted into the seminar will be guaranteed funding to work with a physics faculty mentor on an independent summer research project. The course will be specifically designed to attract women and underrepresented minorities to the major at an early stage, and to establish a peer and faculty support network for prospective physics majors.



2017 Cottrell Scholars Continued

Tyler Luchko

Department of Physics, California State University, Northridge

Modeling Complex Solvents at Molecular Interfaces: Extracting Information and Improving Accuracy

Molecular recognition drives biological function, enables bacterial infection, and provides pathways to create new treatments for disease, but modeling this emergent behavior depends critically on the complex interactions with the solvent environment. Here we propose extending 3D reference interaction site model (3D-RISM) theory of molecular solvation to capture physical details of acidic and basic solvent environments and deliver detailed information of solvent organization. 3D-RISM already uses statistical mechanics to rapidly compute the ensemble behavior of water molecules and co-solvents, like ions, around individual biomolecules while retaining molecular detail. By extending 3D-RISM to treat proteins in extreme pH environments and provide 3D thermodynamic maps of solvent thermodynamics we will gain new insights to molecular recognition and provide valuable information for medicinal chemists. This will have direct applications to the bacterial protein HdeA, which negatively affects the health of millions of people every year.

A wide range of approaches to complex systems exist and, starting in Fall 2017, as part of the new CSUN Joint Ph.D. Program in Complex Systems, graduate students will be trained to improve physical realism of complex health systems in chemistry and biophysics. The educational objectives proposed here will address major obstacles in attrition (commonly 50%) by improving academic preparation, time-to-completion, motivation and supervision at the individual, classroom and programmatic levels. Together, these two initiatives will advance our understanding of complex physical systems now and in the future.



Kathryn D. Mouzakis

Department of Chemistry and Biochemistry, Fort Lewis College

Structural Basis of -1 Programmed Ribosomal Frameshifting in Human T-cell Lymphotropic Virus Type I

Programmed ribosomal frameshifting (PRF) is a common viral mechanism used to regulate the levels of viral enzymatic and structural proteins. How RNA structures induce a one nucleotide (-1) PRF is a fundamental question of relevance to human health, due to its prevalence in retroviruses that infect and cause human diseases. Here, we propose to determine the basis of structure-stimulated 1 PRF in the human T-cell lymphotropic virus type I (HTLV-I) retrovirus. HTLV-I's two frameshift sites are located at the *gag-pro* and *pro-pol* open reading frame junctions. We aim to determine the length and structure of the HTLV-I *pro-pol* frameshift site, and to investigate the relationship between the *gag-pro* structure's thermodynamic stability and -1 PRF efficiency. These studies will provide fundamental insight into role of the HTLV-I *pro-pol* frameshift site structures in -1 PRF.

At Fort Lewis College (FLC), the number of chemistry and biochemistry majors greatly exceeds the number of FLC chemistry undergraduate research experiences (UREs) available each year. As a result, many students, greater than 50% of whom are considered underrepresented, are unable to participate in a FLC URE before they graduate. Here, we propose to increase availability of UREs by integrating HTLV-I themed course-based UREs (CUREs) into the biochemistry curriculum. Specifically, we aim to modify the current research-based advanced biochemistry laboratory course (CHEM 411) so it functions as a sustainable CURE, and to establish a four-week transitional lab in the preceding laboratory course (CHEM 312). This educational plan will have a substantial impact on undergraduate education at FLC.



2017 Cottrell Scholars Continued

James R. Neilson

Department of Chemistry, Colorado State University

Materials Design Principles for Effective Light-Induced Charge Separation in Revolutionary Photovoltaics

Understanding how light induces charge separation in materials remains a challenging problem in fundamental science with a large potential for impact in sustainable energy collection. Perovskite halide semiconductors have challenged our conventional expectations and models for how inorganic semiconductors separate and transport charges. The proposed research seeks the material design principles behind why these materials are so effective for turning light into separated charges. This research plan will employ the targeted synthesis of specific compounds in order to test the hypothesis that lone-pair compatible electronic states (e.g. $5s^2$ electron configurations) are responsible for efficient charge separation through experimental characterization of the photoconductivity.

At Colorado State University (CSU), there is a need to engage more early career students in science, technology, education, and mathematics (STEM), as needed for the future Colorado STEM workforce. This need is currently not being met. This can be partially attributed to the loss of declared science students to applied sciences and non-STEM fields, which is pronounced for under-represented minorities. With advances in materials chemistry, it is now feasible to bring transformative fundamental sciences to early stage (nominally 1st year) students. The proposed project is to create a new freshman seminar in the form of a solar energy collection competition using devices made and studied by the participating students. The audience of students will be selected from the “sustainability floor” of the CSU College of Natural Sciences Learning Community. The proposed activities combine many high-impact educational practices, including: 1st year seminar, learning community, collaborative projects, and undergraduate research.



Monika Schleier-Smith

Department of Physics, Stanford University

Seeking Quantum Limits with Cold Atoms and Light: from Sensing and Control to Scrambling

Quantum mechanical entanglement is in principle an astoundingly powerful resource for applications ranging from precision measurement to computation. Motivated by the quest to harness the full potential of quantum mechanics, I propose a set of experiments investigating fundamental limits in the dynamics of quantum systems.

The first area of investigation is quantum metrology: how can we design a sensor that reaches a given measurement precision as fast as possible with finite resources? A related question is that of quantum control: how can we most efficiently steer the evolution of a many-particle quantum system into a desired state—such as one that is useful for sensing or computation? States of particular interest are those where entanglement is spread over many degrees of freedom, raising the question: how fast can a single qubit of information become delocalized across many particles (“scrambled”)? Intriguingly, the very same question has been asked in the effort to understand the information paradox in black holes, and we will explore how insights derived in that context can be applied to quantum many-body systems realizable in the laboratory.

Building technologies that operate at fundamental quantum limits will require the ingenuity not only of my generation but also of the next. My education plan aims to inspire the next generation to pursue careers in physics by developing a freshman-level course on exciting topics in quantum information science. Introducing creative young minds to these topics will provide a foundation for tackling difficult problems in quantum engineering in the decades to come.



2017 Cottrell Scholars Continued

Natalia B. Shustova

Department of Chemistry and Biochemistry, University of South Carolina, Columbia

Photophysics of Hybrid Hierarchical Structures with Emphasis on Directional Energy Transfer

The research objective of this proposal is to establish fundamental principles of directional energy transfer in well-defined hierarchical hybrid materials. The development of crystalline materials with a predesigned pathway for energy transfer (ET) will benefit a number of applications ranging from optoelectronic devices to photocatalysts, significantly enhance energy utilization efficiency, and thereby drastically modify the existing energy and material landscape. The advantages of utilizing the proposed materials for ET studies are (i) modularity, which allows tuning of material photophysical properties; (ii) crystallinity, which allows systematic studies of energy transfer mechanisms; and (iii) porosity, in combination with structural modularity, allows study of different ET pathways involving organic/inorganic blocks and guests. The self-assembly approach proposed for material synthesis will also allow replication of the hierarchical organization of hundreds of chromophores observed in the natural photosystem.

With the support of the Cottrell Scholar Program, we will also aim to establish the Women-in-Science (Wi-Sci) Educational Program, which integrates a summer educational program for African-American females from historically black universities and colleges along with many other educational innovations.



Yogesh Surendranath

Department of Chemistry, Massachusetts Institute of Technology

Bridging Heterogeneous and Molecular Electrocatalysis: Inner-Sphere Electron Transfer at Graphite-Conjugated Molecular Active Sites

The interconversion of electrical and chemical energy requires the coupling of electron transfer with the rearrangement of chemical bonds. This can be achieved via innersphere electron transfer at the surface exposed active sites of a heterogeneous electrocatalyst or via outer-sphere electron transfer to a molecular electrocatalyst. Herein, we aim to bridge the traditional disparate fields of heterogeneous and molecular electrocatalysis by examining the innersphere electron transfer reactivity of a new class of molecular materials, graphite-conjugated catalysts (GCCs), developed recently in our laboratory. These materials combine the salient features of both molecular and heterogeneous catalysts—like molecular electrocatalysts, the surface active sites of GCCs are structurally well-defined and synthetically tunable; like heterogeneous electrocatalysts, the surface active sites of GCCs are electronically coupled to the delocalized states of the conductive graphitic electrode. By systematically exploring the mechanisms of electron transfer and substrate activation at GCC active sites, we propose to develop a molecular-level description of heterogeneous electrocatalysis for the first time.

My educational plan aims to transform chemistry education at MIT by implementing a debate-based framework for interactive learning, professional communication, and critical discourse. The plan draws from my own personal experience as a competitive high school policy debater and integrates complementary approaches including the introduction of debate-based instruction in the classroom, annual workshops targeted at constructing compelling scientific arguments, and the establishment of student-driven debates of contemporary research articles. Together, these educational initiatives will provide students with the rhetorical skills necessary to be effective thought leaders and communicators in chemistry.



2017 Cottrell Scholars Continued

Timothy A. Wencewicz

Department of Chemistry, Washington University in St. Louis

Chemoenzymatic Synthesis of Strained Beta-Lactones

Beta-lactones are important pharmacophores used clinically as serine hydrolase inhibitors for the treatment of obesity, diabetes, and cancer. I recently discovered the first beta-lactone synthetase in a *Pseudomonas fluorescens* producer of the beta-lactone antibiotic obafluorin. An embedded thioesterase domain catalyzes beta-lactone ring formation during antibiotic cleavage from a non-ribosomal peptide synthetase assembly line. I will characterize the molecular mechanism of enzyme catalyzed beta-lactone ring formation. I will develop a chemoenzymatic platform for the production of peptides capped at the C-terminus with a beta-lactone warhead to complement existing synthetic methods for producing challenging beta-lactone synthetic targets. I will use knowledge of obafluorin biosynthesis to guide the discovery of new beta-lactone synthetases and establish a general set of rules for beta-lactone biosynthesis in nature. Natural products present a unique opportunity to study organic chemistry in a biological system.

I will develop a bioorganic chemistry course cross-listed with advanced organic chemistry to converge the organic chemistry curriculum at Washington University in St. Louis (WUSTL) with an emphasis on the chemistry of life processes. I wrote a custom textbook for this course. I will transfer lesson plans from my upper level course to sophomore organic chemistry to create a second track of organic chemistry with a biological emphasis. The WUSTL Department of Chemistry and College of Arts & Sciences has initiated a plan to broaden the chemistry curriculum in a convergent manner that merges the physical and life sciences to better prepare our diverse student population for careers in STEM disciplines.



Adam P. Willard

Department of Chemistry, Massachusetts Institute of Technology

Simulating the Effects of Nanoscale Disorder on Charge and Energy Transport in Molecular Semiconductors

This proposal presents a research plan that is aimed at investigating the charge and energy transport properties of disordered molecular semiconductors. Our approach is to develop a theoretical method for simulating exciton dynamics in the presence of nanoscale molecular disorder. We apply our theoretical method to study how exciton properties are shaped by nanoscale molecular morphology and how the presence of molecular disorder can drive exciton dissociation into free charge carriers.

This proposal also includes an educational plan that is designed to enhance learning outcomes for core concepts in molecular physics. Our approach utilizes the development of two new simulation modules. The first module provides a virtual framework to design and carry out experiments on nanoscale systems. The second module applies data-derived audio output to standard molecular visualization techniques. These modules will be incorporated into the physical chemistry curriculum at MIT.



2017 Cottrell Scholars Continued

Amanda L. Wolfe

Department of Chemistry, University of North Carolina at Asheville

Improving Antibacterial Drug Discovery through Mixed Microbial Culture and Synthetic Organic Chemistry

The rapid onset of bacterial resistance has diminished the effectiveness of nearly all clinical antibiotics, bringing infectious disease, especially hospital infections caused by “ESKAPE” pathogens, to the forefront as a catastrophic threat to global health. To combat these infections, new methods for discovering structurally unique antibacterial agents with novel mechanisms of action are desperately needed. We propose to develop a multifaceted approach for rapidly accessing novel and efficacious antibiotics by first isolating and characterizing new antibacterial secondary metabolites from mixed microbial culture of soil bacteria, and then modifying these metabolites to improve antibiotic activity against both resistant and non-resistant pathogens using semisynthesis and total synthesis. Through this work we hope to produce a library of compounds with broad-spectrum activity against globally relevant Gram-positive and -negative bacterial infections.

In addition to developing novel antibiotics, we also propose to improve student learning, retention rates, and the transition into independent undergraduate research projects for chemistry majors at UNC Asheville through the development of a junior level Drug Discovery Interdisciplinary Project Laboratory (IPL), which combines synthetic organic chemistry, computational modeling, and biochemistry to design, produce, and evaluate novel compounds with medicinally relevant biological activity, as part of a suite of IPLs relating different disciplines. Although interdisciplinary laboratory courses have been shown to have a positive effect on student learning, increased faculty workload has led them to be abandoned at many institutions. Through assessment of our program, we will develop best practices for implementing IPLs that can be easily translated to other institutions.



Yan Xia

Department of Chemistry, Stanford University

Conjugated Ladder Molecules and Polymers Containing Antiaromaticity Enabled by Efficient Catalytic Annulation

The proposed research aims to develop an efficient, modular, and streamlined strategy to synthesize a diverse family of π -systems (polycyclic aromatic hydrocarbons, oligomers, and polymers) containing antiaromatic cyclobutadienoids. The synthesis is based on efficient palladium-catalyzed C-H activation annulation of aryl bromides and oxanorbornenes followed by aromatization. This general strategy converts easily accessible aryl bromides and oxanorbornenes to a large variety of novel carbon-rich materials with antiaromatic characters, which are of fundamental interest to study the influence of antiaromaticity on reactivity, bonding structures, electronic properties, and crystal packing, as well as potential applications in organic electronics.

The educational proposal echoes the spirit of the scientific proposal to promote a curiosity- and self-driven, research-like atmosphere for students to excel in organic chemistry and more importantly to be equipped with skills to solve complex problems beyond organic chemistry in their future careers. In the educational plan, I will focus on 1) constructing organic concepts inventory in an interactive format and under a research-mimicking context; 2) encouraging peer-led team learning to stimulate talking and collaboration between students; 3) actively involving TAs (graduate students) in active learning—training TAs to implement effective pedagogical strategies and cultivate future science educators who promote active learning.



2017 Cottrell-Fulbright Scholars

Steffen Schumann

Department of Physics, University of Göttingen

Precision Simulations for the LHC

The proposed research in the field of elementary particle physics aims to establish a new level of precision in theoretical predictions for the LHC experiments. This is achieved by consistently including electroweak quantum corrections in an automated manner in the simulation of individual scattering events. The impact of the newly included electroweak corrections on benchmark processes and observables will be investigated in dedicated studies.

A teaching proposal comprising the implementation of numerical methods in the education of physics high-school-teacher students at Bachelor level and in the training of future particle physicists is presented. Practical experience in solving physical problems numerically and the application of concepts of scientific computing get communicated and trained in hands-on tutorials.



Ute Hellmich

Department of Pharmacy and Biochemistry, University of Mainz

From Local Alterations to Global Changes: ABC Transporters to Study Molecular Determinants of Protein Function and Dynamics

Molecular motion is a necessity for life: molecules are constantly changing their conformations, enzymes modify compounds and transporters deliver substrates. Nothing in biochemistry stands still, and therefore, I want to understand these motions, and how they underlie protein function, in molecular detail. At the same time, students need to see beyond their textbook version of protein function, where, provocatively put, at least at the introductory levels molecular machines are often only depicted as colored balls that change into triangles when a ligand induces a conformational change or as static cartoon representations.

Therefore, I propose a joint research and teaching proposal focused on an essential protein family, the ATP binding cassette (ABC) transporters. They translocate anything from nutrients to drugs and mutations lead to severe diseases. In the research proposal, I want to elucidate basic concepts of allostery and dynamics as prerequisites for function in a multi-domain protein through an interdisciplinary approach. Using ABC transporters also as a guiding theme in the teaching proposal, students will be introduced to biochemical methodology to learn how to use and combine methods creatively to solve scientific questions that they identify themselves. The proposed class therefore, enhances the current curriculum significantly by fostering student creativity and direct application of learned content through an independent research proposal. We will include real data from the lab in this class and discuss problems and pitfalls to give students an appreciation for the difficulties, but also the joys, of doing science.



Networking Directory

Mario Affatigato CS 1996

Department of Physics, Coe College

Glass structure and properties, and anything glass. Emphasis on novel and exotic glasses. Interested in physics and materials science education, and in the use of history to introduce science to non-majors.

Nandini Ananth CS 2016

Department of Chemistry, Cornell University

We develop theoretical methods for the simulation of charge and energy transfer processes in the condensed phase and apply them to the characterization and design of materials for renewable energy technologies. Designing tools to provide a strong foundation in mathematics for the physical sciences at the undergraduate level.

John Antos CS 2016

Department of Chemistry,
Western Washington University

My research interests include protein chemistry, bioconjugation, and sortase-mediated protein engineering strategies. My education interests are focused on incorporating research experiences into the undergraduate laboratory curriculum.

Shane Ardo CS 2017

Department of Chemistry, Chemical Engineering & Materials Science, University of California, Irvine

My research interests are driven by the pursuit of understanding and controlling energy-conversion mechanisms in electrochemical devices. My educational interests include training graduate-student researchers and high-school teachers, and development of active learning pedagogy.

Cyndi Atherton

Program Director of Science, Heising-Simons Foundation

Timothy Atherton CS 2015

Department of Physics and Astronomy, Tufts University
Soft matter theory; shape; packing; jamming; emulsions; colloids; liquid crystals. Integrating computation into the graduate and undergraduate curriculum. Issues of LGBT inclusion in STEM.

Gary Baker CS 2015

Department of Chemistry, University of Missouri-Columbia
Cross-disciplinary, problem-solving research involving sustainable nanoscience, optical spectroscopy, and task-specific solvent-engineering approaches, particularly efforts related to ionic liquid and deep eutectic solvents. Educational interests entail a forward-looking response to the "pipeline problem" in STEM education, proposing a holistic solution to bridging this gap by encouraging the entry and retention of greater numbers of underrepresented students in science.

Sarbajit Banerjee CS 2010

Department of Chemistry, Texas A&M University

All things unstable and frustrated...the secret lives of transition metal oxides, especially their transformations. Looking outwards from the central science-diversifying chemistry.

Lauren Benz CS 2011

Department of Chemistry and Biochemistry,
University of San Diego

The Benz lab studies the surface chemistry of metal organic frameworks and oxides. My teaching interests include general, inorganic, and physical chemistry lecture and lab.

Robert Berger CS 2017

Department of Chemistry,
Western Washington University

I study relationships between crystal and electronic structure in solids. This often involves DFT calculations of perovskite materials. I aim to blend conceptual and equation-based lessons in undergraduate quantum chemistry, by designing interactive online homework modules.

Dave Besson CS 1996

Department of Physics, University of Kansas

Astroparticle physics and radioglaciology in Antarctica. Student-driven homework and exam formulation.

Penny Beuning CS 2009

Department of Chemistry and Chemical Biology,
Northeastern University

Molecular mechanisms of DNA damage responses, DNA replication, protein engineering, applications to forensics, antibiotic resistance, cancer. Education interests in CUREs, undergraduate early research, classroom active learning, graduate student and faculty professional development.

Mishkat Bhattacharya CS 2012

Department of Physics and Astronomy,
Rochester Institute of Technology

We are interested in the interaction of light with matter, with reference to atoms, molecules, and nanomechanics from a fundamental quantum mechanical perspective as well as applications to sensing, imaging, and information processing. We are interested in pedagogical techniques applied at all levels of the physics curriculum in the classroom, dissemination in pedagogical journals, and development of laboratory, as well as textual materials.

Networking Directory Continued

Karen Bjorkman CS 1999

Dean, College of Natural Sciences and Mathematics,
University of Toledo

Astronomy—observational diagnostics of the physical characteristics of circumstellar disks, including spectropolarimetry. Astronomy/physics for non-science majors; engaging public in science through outreach; science literacy; observational astronomy techniques.

Tamara Bogdanovic CS 2016

Department of Physics, Georgia Institute of Technology

I am a theoretical astrophysicist whose research interests include the ins and outs of some of the most massive black holes in the universe. I am interested in research-based, effective teaching techniques and the role of formative and summative assessment of teaching effectiveness.

Stephen Bradforth CS 1999

Department of Chemistry,
University of Southern California

Ultrafast spectroscopy applied to solar energy conversion, electrons in liquids and radiation damage in biomolecules. New approaches to instruction and learning in introductory undergraduate science; establishing more effective evaluation of faculty teaching.

Laura Brown

Department of Chemistry, Indiana University

My research group is comprised of undergraduate researchers, and we work on the synthesis of biologically important small molecules. I teach organic chemistry (all levels) and I am interested in incorporating research experiences into laboratory courses.

Jeffery Byers CS 2015

Department of Chemistry, Boston College

My research focuses on organometallic catalysis and its application to solve problems in energy, pharmaceutical, and materials science. My educational interests include incorporating discrepant events in lectures and demonstrations and promoting active learning practices.

Bert Chandler CS 2001

Department of Chemistry, Trinity University

My research interests are in metal nanoparticle synthesis and understanding reaction mechanisms over heterogeneous catalysts. I'm currently interested in developing active-learning methods and in developing courses for underprepared entering college students.

Laura Chomiuk CS 2017

Department of Physics and Astronomy,
Michigan State University

I study transient astronomical phenomena, like novae, by holistically piecing together observations from across the electromagnetic spectrum (radio to gamma-ray wavelengths). I want to help young people in my community reach their full potential and decrease their anxiety for what comes after school, by offering practical hands-on experience and career mentoring.

Seth Cohen CS 2004

Department of Chemistry and Biochemistry,
University of California, San Diego

Metal-organic frameworks, medicinal bioinorganic chemistry, and science policy. Science policy, inorganic and bioinorganic chemistry, large laboratory classes, and public engagement.

Eva-Maria Collins CS 2016

Department of Physics and CDB,
University of California, San Diego

Pattern formation in development and regeneration; tissue biomechanics; developmental neurotoxicology. "Learning through doing"; research-based laboratory courses for freshmen; personalized mentoring for women in STEM.

Linda Columbus CS 2010

Department of Chemistry, University of Virginia

Molecular understanding of membrane protein structure, dynamics, and function. Inclusive curriculum for introductory chemistry and biochemistry.

Jahan Dawlaty CS 2016

Department of Chemistry,
University of Southern California

Physical aspects of redox reactions: proton transfer in the excited state, coupling of electron and proton transfer, dynamics at electrochemical interfaces. New ideas in teaching thermodynamics making it more relevant to modern challenges. Mechanical models to teach chemical dynamics. Math with numerical emphasis.

Julio de Paula CS 1994

Department of Chemistry, Lewis & Clark College

Porphyrin-based nanomaterials; photocatalytic water remediation; chemical archaeometry. General, physical, analytical chemistry; writing textbooks.

Michael Dennin CS 2000

Department of Physics and Astronomy,
University of California, Irvine

Mechanical properties of complex fluids, such as foams and large scale granular matter such as ice melange. Institutional change around evidence-based teaching and learning.

Ashley Donovan

Department of Education, American Chemical Society
Professional development opportunities for chemistry faculty at two- and four-year higher education institutions.

Charles Doret CS 2017

Department of Physics, Williams College
Applications of simple atomic systems; quantum simulation and precision measurements with trapped ions. Conveying quantitative and problem-solving skills to both physicists and non-physicists alike.

Lourdes Echegoyen

Campus Office of Undergraduate Research Initiative, University of Texas at El Paso
Impact of undergraduate research participation on minority students' retention, degree completion, and pursuit of advance degrees. Course-based undergraduate research experiences.

Aaron Esser-Kahn CS 2015

Department of Chemistry, University of California, Irvine
Use chemical tools to dissect immune responses. Gamifying learning while helping to improve personal interactions in the classroom.

Andrew Feig CS 2002

Department of Chemistry, Wayne State University
*I study bacterial toxins from *C. difficile*, bacterial gene regulation. Faculty uptake of evidence-based teaching methods, faculty attitudes toward teaching, institutional change and data-driven decision making in higher education.*

Edward Flagg CS 2017

Department of Physics and Astronomy, West Virginia University
My research is solid-state quantum optics for quantum information: coherent photons, control of electron spins, and spin-photon interfaces. I'm interested in applying phys education research to upper-level undergrad courses: flipped classroom, peer instruction, problem solving.

Carla Frohlich CS 2014

Department of Physics, North Carolina State University
I blow up stars to study which ones fail to explode, which ones explode (and how), and what elements are made in these explosions. Computational skills for undergraduate students; communication skills (written and oral) for graduate and undergraduate students.

Kai-Mei Fu CS 2015

Department of Physics, University of Washington
Optical study and control of defects in condensed matter. Scalable educational tools for large classes.

Nathaniel Gabor CS 2017

Department of Physics and Astronomy, University of California, Riverside
Exploring quantum mechanics in the lab to unravel the bizarre and unintuitive behavior that emerges in nanoscale systems. Integrating big ideas in physics utilizing big data analytics.

Sharon Gerbode CS 2016

Department of Physics, Harvey Mudd College
We study how disorder moves in crystals of colloidal particles. My main teaching goal is to demystify physics and broaden participation in STEM.

Jordan Gerton CS 2007

Department of Physics and Astronomy, University of Utah
Nanoscale light/matter interactions, development of novel nanoscale optical microscopy, and optical properties of nanostructured materials. Improving student success in science courses, broadening access to high-quality programs, improving quality and equity of K-12 instruction.

John Gilbertson CS 2009

Department of Chemistry, Western Washington University
My research interests are in the movement of protons and electrons for small molecule activation. Undergraduate education.

David Ginger CS 2006

Department of Chemistry, University of Washington
Ginger Lab "Probes What You Can't See" by using microscopy to understand how nanostructure controls materials properties from solar energy to bioelectronics. Ginger Lab supports undergraduate education and public awareness of science by tapping interest in clean energy to discuss STEM.

Eilat Glikman CS 2017

Department of Physics, Middlebury
I study dust reddened quasars—heavily obscured, rapidly growing supermassive black holes that link quasar activity to galaxy mergers. Contributing astronomy lessons and mentoring to STEM Posse students at Middlebury will broaden the pool of talent in astronomy and physics.

Networking Directory Continued

Kamil Godula CS 2017

Department of Chemistry and Biochemistry,
University of California, San Diego

Using chemistry to gain an understanding of how carbohydrates, or glycans, encode and transmit biological information at the boundary between cells and their environment. Enhancing fluency in glycoscience topics across general undergraduate student population by talking about sugars often, early and broadly.

Catherine Grimes CS 2015

Department of Chemistry and Biochemistry,
University of Delaware

I am interested in learning how the human body differentiates between good and bad bacteria. I will use problem-based learning to engage students in a range of subjects from spectroscopy to biochemistry.

Carlos Gutierrez CS 2007

Department of Chemistry and Biochemistry,
California State University, Los Angeles

Synthesis of the siderophore enterobactin and analogs; selective acylation of polyamines for the synthesis of selective MRI agents and drug delivery agents. Undergrad chemistry is taught as exposition of dogma. Yet, it should reveal how chemists think about and do their work. Content should be result, not the starting point.

Kathryn Haas CS 2016

Department of Chemistry and Physics,
Saint Mary's College

Bioinorganic Chemistry, specifically in human copper homeostasis and in using spectroscopic studies of model peptides as tools for understanding metal-protein interactions. Technology-enhanced teaching, development of classroom undergraduate research experiences, and interdisciplinary lower-division courses that spark student interest in STEM.

Bo Hammer

Sr. Director for Member Society Business Development,
American Institute of Physics

Amanda Hargrove CS 2017

Department of Chemistry, Duke University

The Hargrove Lab explores RNA-biased small molecules and privileged RNA topologies for selective small molecule: RNA recognition. Hargrove plans a research-based lab where students ID patterns in RNA recognition via VR, binding assays and principal component analysis.

Jennifer Heemstra CS 2015

Department of Chemistry, University of Utah

We harness the molecular recognition and self-assembly properties of biomolecules for sensing, imaging, and therapeutics. I utilize and promote CUREs and other EBPs, but am especially passionate about coaching students on Mindset and embracing failure.

Ute Hellmich CS 2017

Department of Pharmacy and Biochemistry,
University of Mainz

Membrane protein dynamics: how small molecules move big machines. If all you have is a hammer, everything looks like a nail. Let's hand our students chisels and brushes to uncover the details of science and to paint their own canvas.

Rigoberto Hernandez CS 1999

Department of Chemistry, Johns Hopkins University

Theoretical and Computational Chemistry: Multiscale nonequilibrium dynamics of molecules, nanoparticles, assemblies, and devices. Active learning, broad-based mentoring, cyber-enabled pedagogy, and inclusive excellence.

Michael Hildreth CS 2003

Department of Physics, University of Notre Dame

I work at the Large Hadron Collider searching for signatures of new physics. I also am interested in policy questions surrounding knowledge preservation and public access to research data. I am working on graduate student training and professional development, especially in computing and data science. I am also passionate about excellence in teaching introductory physics.

Brent Iverson

RCSA Board Member,
Dean of Undergraduate Studies,
University of Texas, Austin

Malika Jeffries-EI

Department of Chemistry, Boston University

My research focuses in development of organic semiconductors—materials that combine the processing properties of polymers with the electronic properties of semiconductors. My educational interests include organic chemistry and materials science. I am also interested in addressing pipeline issues and increasing diversity in STEM.

Pamela Kanellis

Director, Research and Global Academy,
Canadian Institute for Advanced Research (CIFAR)

Canadian-based global research institute that brings together interdisciplinary researchers to solve big questions. Nurturing the next generation of researchers.

Minsu Kim CS 2017

Department of Physics, Emory University

Quantitatively understanding bacterial interactions at single-cell resolution. Enhancing students' critical thinking and class participation.

Dmytro Kosenkov CS 2016

Department of Chemistry and Physics
Monmouth University

Modeling excitation energy transfer in light-harvesting proteins and mechanisms of fluorescence quenching under protein/DNA-ligand binding. Course-based undergraduate research experiences (CUREs), integration of research projects into physical chemistry curricula.

Michelle Kovarik CS 2017

Department of Chemistry, Trinity College

I am a bioanalytical chemist using microelectrophoretic separations for enzyme assays and single cell analysis. I develop curricular materials for active learning in analytical chemistry with an emphasis on student engagement with primary literature.

Daniel Lambrecht CS 2017

Department of Chemistry, University of Pittsburgh

Establishing structure-property relations for chemical sensors using quantum chemistry to improve monitoring of threats to health and safety. Helping students master canonical chemistry concepts by navigating between chemical representations (macroscopic, microscopic, and symbolic).

Aaron Leconte CS 2016

Department of Chemistry, Keck Science Center,
Claremont McKenna, Pitzer, and Scripps Colleges

Biochemical characterization and engineering of unnatural protein function (specifically, Taq DNA polymerase and Firefly luciferase). Incorporating authentic research experiences into the curriculum; inclusivity in STEM.

Adam Leibovich CS 2006

Department of Physics and Astronomy,
University of Pittsburgh

Primarily theoretical particle physics with some gravitational waves mixed in. System-wide, lasting changes to undergraduate courses in physics.

Hai Lin CS 2006

Department of Chemistry, University of Colorado, Denver

Adaptive multiscale modeling across the quantum/classical boundary: Solvation, transport, and reaction in complex environments. Compounds, equations, and mechanisms (students will likely forget after 10 years) and passion for sciences (hopefully they will retain).

Mariangela Lisanti CS 2017

Department of Physics, Princeton University

I am a theoretical particle physicist studying signatures of dark matter. I am interested in efforts to increase diversity in STEM fields.

Casey Londergan CS 2008

Department of Chemistry, Haverford College

Conformational dynamics of proteins via IR and Raman spectroscopy. Active learning, flipped classroom, inquiry- and research-based laboratories.

Tyler Luchko CS 2017

Department of Physics and Astronomy,
California State University, Northridge

We study the role of water and co-solvents in molecular recognition within biological systems using 3D-RISM. I am working to improve graduation rates by modifying programs, updating teaching methods and using strong individual mentorship.

Gina MacDonald CS 1997

Department of Chemistry and Biochemistry,
James Madison University

I use spectroscopy to study how solution conditions alter protein and peptide solvation, stability and aggregation. I am interested in using the laboratory to bring research-like experiences to large numbers of students and using active-learning in the classroom.

Lisa Manning CS 2015

Department of Physics, Syracuse University

My groups predicts the mechanical behavior of disordered, non-equilibrium materials—from glasses to biological tissues. I am working to increase recruitment and retention of a diverse populations in STEM by improving gatekeeper course via TA pedagogy and technology.

Tyrel McQueen CS 2014

Department of Chemistry, Physics and Astronomy,
Materials Science and Engineering, John Hopkins University

Synthesis, discovery, and analysis of new quantum materials, with a vision of their current and future utility. Experimentation is essential to the formation of chemical and physical intuition, connecting abstract concepts and ideas to physical reality.

Brent Melot CS 2016

Department of Chemistry, University of Southern California

We investigate the influence that lattice stiffness has on the intercalation of Li- and Na-ions into polyanionic compounds. We are developing a middle-school outreach program to Native American students in the Los Angeles area to encourage more STEM participation.

Networking Directory Continued

Carlos Meriles CS 2007

Department of Physics, City College of New York

Major areas of work are the discovery and understanding of point defects in wide bandgap semiconductors and the application of these defects to nanoscale sensing and quantum information processing. Interested in teaching methodologies for instruction laboratories. Also interested in movies as a vehicle for attracting students into science.

Emily Miller

Associate Vice President, Education Policy,
Association of American Universities

Examining the cultural and institutional challenges to improving undergraduate and graduate education. Improving undergraduate education at research universities #AAUSTEM.

Kathryn Mouzakis CS 2017

Department of Chemistry and Biochemistry,
Fort Lewis College

Understanding how viral RNA structures manipulate host-translational machinery to ensure successful viral replication. Increase the preparedness of FLC STEM graduates for their careers by increasing the number of local UREs available to students.

Karl Mueller CS 1996

Physics and Computational Science,
Pacific Northwest Laboratory

Multimodal analysis of chemical systems with applications to battery science and the nucleation/self-assembly of hierarchical materials. Coupling the educational opportunities in academia and national laboratories through mentoring and meaningful engagement.

Catherine Murphy CS 1996

RCSA Board Member,
Department of Chemistry,
University of Illinois at Urbana-Champaign

Gold nanoparticle synthesis and bio interactions. Putting materials into chem curriculum.

James Neilson CS 2017

Department of Chemistry, Colorado State University
Materials by design: kinetic control of solid state chemistry and structure property relationships in functional materials. Recognizing the importance of fundamental science in real-world problems through active learning, early engagement, and local impact.

Andriy Nevidomskyy CS 2014

Department of Physics and Astronomy, Rice University

Theoretical physicist studying emergent electronic behaviors in magnets, superconductors and novel materials. Interactive teaching and learning, especially in upper-level physics curriculum.

James Nowick

Department of Chemistry, University of California, Irvine

My laboratory studies the molecular basis of Alzheimer's and other amyloid diseases through peptide model systems. I enjoy teaching in the classroom and research laboratory; mentorship of students in research, videos of my classes on YouTube; K-12 outreach.

Teri Odom CS 2017

Department of Chemistry and Materials Science and
Engineering, Northwestern University

Nanoscale alchemy; multi-scale fabrication of hard and soft materials; manipulation of light and water at the nanoscale. Creating nanoscale experts; integrating multi-media tools in freshman chemistry.

Nicola Pohl CS 2003

Department of Chemistry,
Indiana University Bloomington

Developing machine-assisted methods and uncovering chemical rules to make and analyze carbohydrates to apply to vaccine design/immunology. Incorporating cutting-edge research and all five senses into the undergraduate organic/analytical/biochemistry lab and lecture classes.

Jennifer Prescher CS 2014

Department of Chemistry,
University of California, Irvine

I spy on cellular communication. I design cross-disciplinary research exercises for undergraduate lab courses.

Michael Ramsey-Musolf

Department of Physics,
University of Massachusetts, Amherst

Research in theoretical physics to (1) explain why the universe contains more matter than anti-matter (2) determine what additional forces are present in nature beyond those known to exist (3) elucidate the nature of neutrinos and the Higgs boson. Supporting an educational climate in science that welcomes and supports students and junior researchers from diverse backgrounds.

Patricia Rankin

Department of Physics, University of Colorado

Rarity—from unusual particle decays probing nature through under-represented groups in physics and impacts on research effectiveness. Broadening participation and broadening skills—how to work in teams to address complex problems.

Cindy Regal CS 2014

Department of Physics, University of Colorado
*Quantum optics and information with atoms and solids.
Undergraduate education—courses and research.*

Geraldine Richmond

Department of Chemistry, University of Oregon
*Understanding the molecular properties of liquid surfaces
that have relevance to environmental remediation,
biomolecular assembly and atmospheric chemistry.
Science literacy for nonscientists; career development
courses for emerging and career scientists and engineers
in the US and developing countries.*

Kate Ross

Department of Physics, Colorado State University
*I study novel solid state materials where quantum
entanglement determines their properties. My research
group grows crystals of the materials and studies them
using inelastic neutron scattering. I am interested in
developing a more active learning environment for my
physics courses, to augment the traditional lecture style.*

Jennifer Ross CS 2010

Department of Physics,
University of Massachusetts Amherst
*Learning new physics from biological, active, and soft
systems. Trying to make every class hands-on, active,
and engaging.*

Vincent Rotello CS 1996

Department of Chemistry,
University of Massachusetts Amherst
*Synergistic co-engineering of biological and
nanomaterials systems. Integrated graduate education.*

Monika Schleier-Smith CS 2017

Department of Physics, Stanford University
*Quantum engineering and quantum simulation with
laser-cooled atoms. Active learning and early exposure
to 21st-century physics.*

Zachary Schultz CS 2013

Department of Chemistry and Biochemistry,
University of Notre Dame
*Spectroscopy and Imaging of biochemical and interfacial
systems. Increasing and motivating student self-
engagement in the learning process.*

Mats Selen CS 1996

Department of Physics,
University of Illinois at Urbana-Champaign
*Physics Education Research and Technology Development.
Assessing the learning outcomes of introductory labs and
studying the needs of life science students.*

Natalia Shustova CS 2017

Department of Chemistry and Biochemistry,
University of South Carolina, Columbia
*The focus of the Shustova group is materials with
a predesigned pathway for energy transfer for their
application in optoelectronic devices. Dr. Natalia Shustova
aims to establish the Women-in-Science
(Wi-Sci) Educational Program, which focuses on gender
gap elimination.*

Sara Skrabalak CS 2012

Department of Chemistry,
Indiana University Bloomington
*Shaping the synthesis of nanoscale materials. Integrating
nanoscale research with education to enhance student's
interdisciplinary training.*

Sebastian Slama CFS 2016

Physics Department, Eberhard Karls Universität Tübingen
*Develops quantum technology with ultracold atoms in
quantum optics. Is engaged with the physics education of
natural scientists at the faculty of science.*

Tobin Smith

Vice President of Policy,
Association of American Universities
*Science and technology policy; higher education policy;
regulation, compliance and research costs; technology
transfer; scientific openness and security; U.S. Congress
and American government. Undergraduate STEM
education improvement and reform; institutional change;
informal science education; science communications; and
public engagement in STEM.*

Eileen Spain CS 1995

Department of Chemistry, Occidental College
*I study a variety of interfaces, surfaces, and films.
Currently, I seek to understand the interfacial chemistry of
bacterial predation and nanomaterial synthesis. I seek to
change student-faculty interactions to enhance inclusion
and engagement in the sciences for students of varied
backgrounds and lived experiences.*

Levi Stanley CS 2016

Department of Chemistry, Iowa State University
*My group seeks to develop new synthetic methods to
prepare bioactive molecules and useful materials via
transition-metal catalysis. My educational interests focus
on leveraging learning communities and course-based
research experiences as platforms for student success.*

Networking Directory Continued

Yogesh Surendranath CS 2017

Department of Chemistry,
Massachusetts Institute of Technology
We use electricity to rearrange chemical bonds, by controlling surface reactions at the molecular level. Can we apply the basic principles of rhetoric to improve STEM education?

Eric Toberer CS 2015

Department of Physics, Colorado School of Mines
We study crystalline materials for energy conversion, with a focus on the light, charge, and heat nexus. Integrating research into the classroom and development of flipped classrooms; learning efficiency.

Adam Urbach CS 2005

Department of Chemistry, Trinity University
Supramolecular chemistry in aqueous solution, including sequence-specific biomolecular recognition, multivalency, and protein interactions. Replacing rote laboratory experiments with scientific process-oriented activities, including experimental design and precise technique.

Olalla Vázquez CFS 2016

Department of Chemistry, Philipps-Universität Marburg
We are interested in studying epigenetic mechanisms at the atomic level. I am interested in meaningful active learning in chemistry.

James Vyvyan CS 1998

Department of Chemistry,
Western Washington University
Organic synthesis, both target oriented and method development. Organic chemistry and spectroscopy; active-learning techniques.

Timothy Wenczewicz CS 2017

Department of Chemistry,
Washington University in St. Louis
My research focus is organic chemistry in biological systems with an emphasis on the molecular mechanisms of antibiotic action, biosynthesis, and resistance. My educational focus bridges the physical and life sciences with organic chemistry to better prepare students for careers in STEM and medicine.

Jodi Wesemann

Department of Education, American Chemical Society
Translating educational and social science research into practice. Systemic change in STEM higher education.

Matthew Whited CS 2011

Department of Chemistry, Carleton College
Inorganic and organometallic chemistry; photochemistry; sustainable catalysts; new reactions for organic synthesis and energy storage. Course-based research experiences; undergraduate research and adaptive expertise; crystallography in the undergraduate curriculum.

Adam Willard CS 2017

Department of Chemistry,
Massachusetts Institute of Technology
My research utilizes theory and computation to explore the effects of nanoscale disorder on charge and energy transport in molecular semiconductors. My educational interests are to enhance molecular visualizations by adding data-derived audio output.

Amanda Wolfe CS 2017

Department of Chemistry,
University of North Carolina at Asheville
My research focuses on the discovery, development, and SAR evaluation of novel antibiotics produced by bacteria in either single or multi-culture. I hope to improve independent undergraduate research experiences and retention through the development of a research-based interdisciplinary teaching laboratory.

Yan Xia CS 2017

Department of Chemistry, Stanford University
Building and breaking molecular ladders to develop functional organic materials. Creating research-mimicking and peer-led learning environment for organic chemistry with everyone (instructor, every student, and TA) involved.

Xiaodong Xu CS 2014

Department of Physics, University of Washington
Spin and Pseudospin Physics in 2D materials and devices; 2D magnetism; electronic phase transition; quantum optics; topological physics; superconductivity. New experimental module for advanced undergraduate labs.

Conference Participants

Mario Affatigato
maffatig@coe.edu

Nandini Ananth
ananth@cornell.edu

John Antos
john.antos@wwu.edu

Shane Ardo
ardo@uci.net

Cyndi Atherton
cyndi@heisingsimons.org

Timothy Atherton
timothy.atherton@tufts.edu

Gary Baker
bakergar@missouri.edu

Sarbajit Banerjee
banerjee@chem.tamu.edu

Lauren Benz
laurenbenz@sandiego.edu

Robert Berger
Robert.Berger@wwu.edu

Dave Besson
zedlam@ku.edu

Penny Beuning
penny@neu.edu

Mishkat Bhattacharya
mv6154@gmail.com

Karen Bjorkman
karen.bjorkman@utoledo.edu

Tamara Bogdanovic
tamarab@gatech.edu

Stephen Bradforth
stephen.bradforth@usc.edu

Laura Brown
brownlcb@indiana.edu

Jeffery Byers
jeffery.byers@bc.edu

Bert Chandler
bert.chandler@trinity.edu

Laura Chomiuk
chomiuk@pa.msu.edu

Seth Cohen
scohen@ucsd.edu

Eva-Maria Collins
emscollins@physics.ucsd.edu

Linda Columbus
columbus@virginia.edu

Jahan Dawlaty
dawlaty@usc.edu

Julio De Paula
jdepaula@lclark.edu

Michael Dennin
mdennin@uci.edu

Ashley Donovan
A_Donovan@acs.org

Charles Doret
scd2@williams.edu

Lourdes Echegoyen
lourdes@utep.edu

Aaron Esser-Kahn
aesserka@uci.edu

Andrew Feig
afeig@chem.wayne.edu

Edward Flagg
edward.flagg@mail.wvu.edu

Carla Frohlich
cfrohli@ncsu.edu

Kai-Mei Fu
kaimeifu@uw.edu

Nathaniel Gabor
nathaniel.gabor@ucr.edu

Sharon Gerbode
gerbode@hmc.edu

Jordan Gerton
jgerton@physics.utah.edu

John Gilbertson
john.gilbertson@wwu.edu

David Ginger
dginger@uw.edu

Eilat Glikman
eglikman@middlebury.edu

Kamil Godula
kgodula@ucsd.edu

Catherine Grimes
cgrimes@udel.edu

Carlos Gutierrez
cgutier@exchange.calstatela.edu

Kathryn Haas
khaas@saintmarys.edu

Bo Hammer
hammer@aip.org

Amanda Hargrove
amanda.hargrove@duke.edu

Jennifer Heemstra
heemstra@chem.utah.edu

Ute Hellmich
u.hellmich@uni-mainz.de

Rigoberto Hernandez
r.hernandez@jhu.edu

Michael Hildreth
hildreth.2@nd.edu

Brent Iverson
iversonb@austin.utexas.edu

Malika Jeffries-Eli
malikaj@bu.edu

Pamela Kanellis
pamela.kanellis@cifar.ca

Minsu Kim
minsu.kim@emory.edu

Dmytro Kosenkov
dkosenkov@monmouth.edu

Michelle Kovarik
michelle.kovarik@trincoll.edu

Daniel Lambrecht
lambrecht@pitt.edu

Aaron Leconte
aleconte@kecksci.claremont.edu

Adam Leibovich
akl2@pitt.edu

Hai Lin
hai.lin@ucdenver.edu

Mariangela Lisanti
mlisanti@princeton.edu

Casey Londergan
clonderg@haverford.edu

Tyler Luchko
tluchko@csun.edu

Gina MacDonald
macdongx@jmu.edu

Lisa Manning
mmanning@syr.edu

Tyrel McQueen
mcqueen@jhu.edu

Research Corporation Participants

Dan Linzer

Incoming President
dihl@northwestern.edu

Brent Iverson

RCSA Board Member,
Dean of School of Undergraduate Studies,
University of Texas, Austin
iversonb@austin.utexas.edu

Catherine Murphy

RCSA Board Member,
Department of Chemistry,
University of Illinois at Urbana-Champaign
murphycj@illinois.edu

Danny Gasch

Interim President, Chief Financial Officer
dgasch@rescorp.org

Silvia Ronco

Senior Program Director
sronco@rescorp.org

Richard Wiener

Senior Program Director
rwiener@rescorp.org

Dan Huff

Communications Director
dhuff@rescorp.org

Kathy Eckert

Senior Program Assistant
keckert@rescorp.org

Debra Keiser

Program Assistant, Post-Award Coordinator
dkeiser@rescorp.org

Kylie Johnson

Program Assistant, Event Coordinator
kjohnson@rescorp.org



4703 East Camp Lowell Dr.
Suite 201
Tucson, Arizona 85712
Phone 520.571.1111
www.rescorp.org

RESEARCH CORPORATION 
for SCIENCE ADVANCEMENT