

Quantum Science Concepts in Enhancing Sensing and Imaging Technologies: Applications for Biology—A Workshop

Committee

Taekjip Ha

Chair

Taekjip Ha is a Bloomberg Distinguished Professor of Biophysics and Biomedical Engineering at Johns Hopkins University and an investigator with the Howard Hughes Medical Institute. He develops and uses single molecule and single cell measurement tools to study life at high resolution. Dr. Ha received a bachelor in Physics from Seoul National University in 1990 and Physics Ph.D. from University of California at Berkeley in 1996. After postdoctoral training at Stanford, he was a Physics professor at University of Illinois at Urbana-Champaign until 2015. Dr. Ha serves on Editorial Boards for Science. He is a member of the National Academy of Sciences and a fellow of the American Academy of Arts and Sciences. He received the 2011 HoAm Prize in Science.

Clarice D. Aiello

Member

Clarice D. Aiello is a Brazilian quantum engineer, leader of the University of California, Los Angeles' (UCLA) Quantum Biology Tech Lab (QuBiT) and interested in how quantum physics informs biology at the nanoscale. She holds a Diplôme d'Ingénieur from the École Polytechnique (France), a Physics M.Phil. from the University of Cambridge (UK) and a Ph.D. from Massachusetts Institute of Technology (MIT) in Electrical Engineering. Prior to joining UCLA, Dr. Aiello held postdoctoral appointments in Bioengineering at Stanford and in Chemistry at Berkeley. Throughout her career, she received fellowships and/or awards from institutions such as the Moore Foundation, the Schlumberger Foundation, Fullbright, UNESCO and the French Ministry of Foreign Affairs. Dr. Aiello was also recognized by MIT's School of Engineering's Award for Extraordinary Teaching and Mentoring. She is actively engaged in fostering the quantum biology field as organizer of an international series of trainee-focused weekly talks about Quantum Biology and also as chair/keynote speaker in venues such as the NSF Nanoscale Science and Engineering Grantees Conference (2019); The Australian and New Zealand Conferences on Optics and Photonics (ANZCOP/SPIE) (2019); the IEEE MIT Undergraduate Research Technology Conference (2019); MindshareLA (2020); HRL Laboratories (2020) and the 2020 APS March Meeting.

Prem Kumar

Member

Prem Kumar is Professor of Information Technology in the McCormick School of Engineering and Applied Science at Northwestern University. He holds a Ph.D. in Physics from the State University of New York at Buffalo. Although Dr. Kumar's primary appointment is in the Department of Electrical and Computer Engineering, a courtesy appointment in the Department of Physics and Astronomy allows him to recruit students from both disciplines into his research group, a privilege that has proven extremely beneficial for his research interests that lie at the interface of basic quantum science and applied information technology. His primary research focus is on photonic devices and their applications utilizing the principles of nonlinear and quantum optics. Recent projects have included generation, distribution, and ultrafast processing of photonic entanglement for applications in quantum information networks; novel quantum light states for precision measurements, imaging, and sensing; and novel optical amplifiers and devices for networked classical optical communications. From February 2013 to January 2017, Dr. Kumar was on leave from Northwestern to be at DARPA, where he served as a Program Manager in the Defense Sciences Office. Prior to joining DARPA, Dr. Kumar served on the National Academies Committee that issued the 2012 landmark study, "Optics and Photonics: Essential Technologies for Our Nation," which spawned the National Photonics Initiative (NPI). Presently, Dr. Kumar serves on the NPI Steering Committee, lending his expertise to issues pertaining to the National Quantum Initiative. Dr. Kumar is a Fellow of the OSA, APS, IEEE, IoP (U.K.), AAAS, and SPIE. He has been a Distinguished Lecturer for the IEEE Photonics Society, Hermann A. Haus Lecturer at MIT, recipient of the Quantum Communication Award from Tamagawa University in Tokyo, Japan, and the Walder Research Excellence Award from the Provost's office at Northwestern University.

Philip Kurian

Member

Philip Kurian is a theoretical physicist, translational scientist, and founding director of the Quantum Biology Laboratory (QBL) at Howard University. Dr. Kurian is the recipient of awards from the U.S.-Italy Fulbright Commission, Oak Ridge and Argonne Leadership Computing Facilities, Whole Genome Science Foundation, National Physical Science Consortium, and the U.S. NIH. He serves as the principal investigator for a federal study examining how optical pumping of aqueous proteins far from equilibrium can produce collective restructuring of their internal mechanical degrees of freedom, and as co-PI for the conceptualization of an NSF "quantum leap" challenge institute to develop novel platforms for quantum sensing and information processing in complex biological environments. His QBL was the first group outside the UK to receive a grant from the Guy Foundation, which was established in 2018 to facilitate exploration into quantum biology and the role it could play in advancing medicine globally. Dr. Kurian's vision is to uncover how fundamentally quantum interactions can produce biological manifestations at the mesoscopic and clinical scales, including in neurodegeneration, cancer, immunodiversity, oxidative metabolism, and human consciousness. As a board member for the AAAS Science for Seminaries program, Dr. Kurian also advises seminary professors on how to integrate frontier science topics into theological conversations. He received his Ph.D. in Physics from Howard University.

Prineha Narang

Member

Prineha Narang is an Assistant Professor at the John A. Paulson School of Engineering and Applied Sciences at Harvard University. Prior to joining the faculty, she came to Harvard as a Ziff Fellow and worked as a Research Scholar in Condensed Matter Theory at the MIT Department of Physics. Dr. Narang received an M.S. and Ph.D. in Applied Physics from the California Institute of Technology (Caltech). Her work has been recognized by many awards and special designations, including an NSF CAREER Award in 2020, being named a Moore Inventor Fellow by the Gordon and Betty Moore Foundation, CIFAR Azrieli Global Scholar by the Canadian Institute for Advanced Research, a Top Innovator by MIT Tech Review (MIT TR35), and a Young Scientist by the World Economic Forum in 2018. In 2017, Dr. Narang was named by Forbes Magazine on their “30under30” list for her work in quantum engineering. NarangLab's research at Harvard focuses on how quantum systems behave, particularly away from equilibrium, and how we can harness these effects. By creating predictive theoretical and computational approaches to study dynamics, decoherence and correlations in matter, NarangLab's work would enable technologies that are inherently more powerful than their classical counterparts ranging from scalable quantum information processing to ultra-high efficiency optoelectronic and energy conversion systems.

Jennifer Pett-Ridge

Member

Jennifer Pett-Ridge is a senior staff scientist and group leader at LLNL who uses the tools of systems biology and biogeochemistry to link, identity, and function in environmental microbial communities. Recently awarded a DOE Early Career award to study responses of tropical soil microbes to climate change, she has also pioneered the use of NanoSIMS isotopic imaging in the fields of microbial biology and soil biogeochemistry. As lead scientist of the LLNL Genomic Science Program Biofuels Scientific Focus Area (SFA) from 2009–2018 and more recently the LLNL Soil Microbiome SFA, Dr. Pett-Ridge helps to coordinate multi-disciplinary teams that integrate biogeochemistry, stable isotope probing, NanoSIMS imaging, molecular microbial ecology, and computational modeling to understand biotic interactions and energy flow in microbial communities critical to the soil carbon cycle, nutrient cycling and sustainable biofuel production. She is the group lead for the Environmental Isotope Systems group in the Nuclear and Chemical Sciences division and manages a portfolio of over \$10 million in DOE, NSF, NASA and other funding. Dr. Pett-Ridge helps to mentor a group of staff scientists, postdocs, and graduate students working on terrestrial and marine carbon cycling, plant-soil interactions, and development of new isotope tracing methods (EI-FISH, Chip-SIP, STXM-SIMS), and collaborates frequently with scientists at academic institutions and other national labs. She has published over 85 peer-reviewed articles, including a patent ROI for the “ChipSIP” approach linking microbial identity and function using NanoSIMS analysis of microarrays. Dr. Pett-Ridge was awarded a Ph.D. in Soil Microbial Ecology from the University of California at Berkeley and both a M.S. in Forest Science and a B.A. in Biology and Studies in the Environment from Yale University.

Jason B. West

Member

Jason B. West is an Associate Professor in the Department of Ecology and Conservation Biology at Texas A&M University. He is a plant physiological ecologist who studies the ecological and evolutionary causes of trait variation across a range of organizational and spatiotemporal scales, as well as the ecosystem-scale impacts of that variation. He has worked in a number of ecological systems in North and South America and collaborates with colleagues around the world in many others. Dr. West is an internationally recognized expert in plant physiological ecology and spatial modeling of plant isotopes and seeks transdisciplinary solutions to difficult scientific questions. He obtained a Ph.D. from the University of Georgia and a B.S. from Utah State University and has held research positions at the University of Minnesota and the University of Utah, and was a visiting scientist at INRAE Nouvelle-Aquitaine Bordeaux.

Steven Moss

Staff Officer