

Societal Benefits from Condensed Matter and Materials Research

Committee

George W. Crabtree

Chair

George Crabtree is a Senior Scientist and Distinguished Fellow in the Materials Science Division at Argonne National Laboratory and a Distinguished Professor of Physics, Electrical, and Mechanical Engineering at University of Illinois at Chicago. From 2001 to 2008 Dr. Crabtree was also the Director of Argonne's Materials Science Division. He received his Ph.D. in Condensed Matter Physics from the University of Illinois at Chicago, specializing in the electronic properties of metals. His research interests include materials science, superconductivity and magnetism, and energy science. He has won several research awards, including the Kamerlingh Onnes Prize for his work on high-temperature superconductivity. He is a fellow of the American Physical Society and has also served as Chairman of the Division of Condensed Matter Physics with the American Physical Society. He has won the University of Chicago Award for Distinguished Performance at Argonne twice, and the U.S. Department of Energy's Award for Outstanding Scientific Accomplishment in Solid State Physics four times. He has an R&D 100 Award for his pioneering development of Magnetic Flux Imaging Systems, and is a charter member of ISI's compilation of Highly Cited Researchers in Physics.

Andrea J. Liu

Vice Chair

Dr. Andrea Liu is a professor of physics at the University of Pennsylvania. Prior to her arrival at Penn in 2004, she was on faculty at UCLA in the Department of Chemistry and Biochemistry. She earned her Ph.D. from Cornell University in 1989. Her research interests are in the field of condensed matter theory studying problems in soft matter physics. Dr. Liu's current fields of interest include jamming in glass-forming liquids, foams and granular materials under varying conditions such as pressure or density. Her studies also include biophysical self-assembly in actin structures such as the cytoskeleton of cells in motion, as well as other systems. Among her many professional activities, Dr. Liu recently served on the NRC Committee on Condensed-Matter Materials Physics (CMMP) 2010.

Eva Y. Andrei

Member

Dr. Andrei is a professor in the Physics and Astronomy Department at Rutgers University. She received her PhD in physics from Rutgers University. Her research is centered on the dynamics and thermodynamics of low dimensional systems. Currently she is working on the electronic properties of graphene – a one-atom thick membrane of crystalline carbon with extraordinary electronic properties stemming from charge carriers that behave like ultra-relativistic particles. Her other research interests include: dynamics of vortices in superconductors; correlated phenomena of two-dimensional electron layers realized on liquid helium and at semiconductor interfaces; ferroelectric polymers. She employs a range of nano-fabrication and characterization techniques including scanning tunneling microscopy and spectroscopy, scanning electron microscopy, atomic force microscopy, radio-frequency spectroscopy and magneto-transport. Dr. Andrei is a fellow of the American Physical Society (APS) and the American Association for the Advancement of Science (AAAS) and has served on the executive committee of the APS. She was awarded the French CEA Medal of physics for her work on the Magnetically Induced Wigner Crystal and the "Rutgers Board of trustees award for excellence in research" for her work on graphene.

Paul Canfield

Member

Paul Canfield is a senior scientist at Ames Laboratory and distinguished professor at the Department of Physics and Astronomy at Iowa State University. After getting his Ph.D. from the University of California at Los Angeles, he served as a postdoc at Los Alamos National Laboratory. From there, he began work at Ames Laboratory, where he started the Novel Materials and Ground State group in 1992. His current work focuses on compounds with novel electronic and magnetic features. Experimentally based, his efforts include designing, discovering, growing and characterizing these novel materials. Included among his current efforts are investigations of iron-arsenic-based superconductors, one of the latest approaches to developing high temperature superconductors. As senior scientist at Ames Laboratories, Dr. Canfield would also bring to the committee an understanding of the needs of national laboratories.

Juan J. de Pablo

Member

Dr. de Pablo is the Howard Curler Distinguished Professor in the Chemical and Biological Engineering Department at the University of Wisconsin at Madison. He received his BS in chemical engineering from the National University of Mexico and his PhD in chemical engineering from the University of California, Berkeley. He is also associated with the Rheology Research Center and the NSF-funded MRSEC Center that focuses on the formation, characterization, and exploitation of materials at the nanoscale. Dr. de Pablo fills a gap on the committee in the area of soft-matter physics and nanomaterials. His research focuses on attempting to understand the thermophysical properties of fluids and solids at a molecular level. He uses molecular simulations to examine molecular motion; recent areas of study include the effect of adding nanoparticles to polymer fluids and glasses on these materials' transport and mechanical properties, and the mechanisms by which DNA are placed in small spaces such as viral capsids and subsequently ejected.

Allen M. Goldman

Member

Allen M. Goldman is a Regents Professor of physics at the University of Minnesota. He received his A.B. in chemistry and physics from Harvard University and Ph.D. in physics from Stanford University. Dr. Goldman's research interests are in properties of superconductors and selected magnetic materials in the configuration of thin films. Dr. Goldman is a fellow of the American Physical Society and the American Association for the Advancement of science and a member of the National Academy of Sciences.

Andrew Millis

Member

Andrew Millis is a professor in physics department of Columbia University. His research interests include theoretical condensed matter physics, especially the relationship of theories of strongly correlated electrons in solids and of quantum transitions to the behavior of novel materials including high temperature superconductors, 'colossal' magnetoresistance manganites, quasi one dimensional conductors, heavy fermion systems, and nearly magnetic systems. He is also doing research in optical conductivity as a probe of correlated electron physics; physics governing magnetic transition temperatures in 'half metals'; superconductivity near quantum critical points; electron-phonon coupling in correlated electron systems; effect of disorder on correlated electron and quantum critical materials; phase fluctuations and the theory of the 'pseudogap' in high temperature superconductors; interplay between local electronic physics and strain fields; relation of Luttinger Liquid physics to experiments on quantum wires; nonequilibrium behavior of correlated systems; theory of magnetic semiconductors.

Monica Olvera de la Cruz

Member

Dr. Monica Olvera de la Cruz is a professor of materials science and engineering at Northwestern University. She earned her Ph.D. from Cambridge University in 1985. Her research interests are in the thermodynamics, statistics and dynamics of macromolecules in complex environments. She studies co-assemblies of cationic and anionic biological and synthetic molecules and their stability in different ionic media by using a combination of liquid theory and solid state physics techniques. She served as director of the Integrated Graduate Program to Prepare Educators of Materials Technologists and now serves as director of the Research Experience for Undergraduate/Minority Research Initiative at Northwestern University. She currently serves on the Mathematical and Physical Sciences Directorate Advisory Committee of the NSF.

Stuart S. Parkin

Member

Dr. Stuart Parkin is an IBM Fellow (IBM's highest technical honor), Manager of the Magnetoelectronics group at the IBM Almaden Research Center, San Jose, CA and a Consulting professor in the Dept. of Applied Physics at Stanford University. He is also director of the IBM-Stanford Spintronic Science and Applications Center. Dr. Parkin's research interests include oxide thin films and heterostructures, high-temperature superconductors, and, magnetic thin film structures and spintronic materials and devices for advanced sensor, memory, and logic applications. Parkin's discoveries in magnetoresistive thin film structures enable a 1000 fold increased in the storage capacity of magnetic disk drives in little more than a decade. Most recently, Parkin is working on a novel storage class memory device, "Racetrack Memory", which could replace both hard disk drives and many forms of conventional solid state memory. Parkin is an elected Member of the National Academy of Sciences, the National Academy of Engineering, a Fellow of the American Academy of Arts and Sciences and a Fellow of the Royal Society (London). Parkin is also a Fellow of the American Physical Society, the Materials Research Society, the Institute of Physics (London), the IEEE, and the AAAS. Parkin is the recipient of numerous awards and honors including, the American Physical Society International Prize for New Materials (1994), the Europhysics Prize for Outstanding Achievement in Solid State Physics (1997), and the 1999-2000 American Institute of Physics (AIP) Prize for Industrial Application of Physics. Parkin has received Honorary Doctorates from the RWTH Aachen, Germany and the Eindhoven University of Science and Technology, The Netherlands, and has been appointed a Distinguished Visiting Professor at seven universities in Europe, Singapore, Taiwan and Korea. Most recently Parkin received the 2008 IEEE Daniel E. Noble Award for his work on MRAM, the 2008 IEEE Distinguished Lecturer Award, the 2009 IUPAP Magnetism Prize and Neel Medal for outstanding contributions to the science of magnetism, the 2008 Guttenberg Research Award, the 2009 Dresden Barkhausen Award, and the 2012 David Adler Lectureship Award from the American Physical Society. Parkin has authored ~400 papers and has ~88 issued patents.

Daniel C. Ralph

Member

Daniel Ralph is a professor in the physics department at Cornell University. His work focuses on the fabrication of nanometer-scale devices and the measurement of their electronic and magnetic properties (usually) at low temperatures. His research interests include high-speed dynamics in magnetic devices, transport through metal-nanoparticle, single-molecule, and carbon-nanotube quantum dots, magnetic and superconducting devices quantum properties of defects and impurities. Dr. Ralph is also the director of the Cornell NanoScale Science and Technology Facility, and has been awarded Sloan and Packard Fellowships, the William L. McMillan Award, the Research Corporation Research Innovation Award and the ONR Young Investigators Award.

Cyrus R. Safinya

Member

Dr. Safinya is a Professor of Materials, Physics, and Molecular, Cellular, and Developmental Biology at the University of California at Santa Barbara. He received a B.S. in Physics and Mathematics from Bates College and received his PhD in Physics from the Massachusetts Institute of Technology. His experimental research focuses on understanding mechanisms of assembly for a variety of biological systems such as lipids, lipid-nucleic acids and protein-based assemblies derived from neurons. The ultimate goal is to relate structure to function. His group uses a broad range of structure characterization techniques including synchrotron X-ray scattering, optical microscopy techniques, including fluorescence microscopy, and electron microscopy. Dr. Safinya is a Fellow of The American Physical Society (APS) and of The American Association for the Advancement of Science (AAAS).

Jerry A. Simmons

Member

Jerry Simmons is senior manager of the Semiconductor Materials and Device Science Department at Sandia National Laboratories. His department conducts research into a number of areas with direct ties to the Solid State Sciences Committee, such as quantum transport in low dimensional systems, optical properties of nanostructures, and solid state lighting. In the past, Dr. Simmons has been senior manager of Sandia's Energy Sciences Department, and the Solid State Program Manager and Acting Co-Director for the Center for Integrated Nanotechnologies at Sandia. He also has served as the principal contact between Sandia and the Office of Basic Energy Sciences of the Department of Energy. Dr. Simmons has previous NRC experience as a member of the NRC's Committee on Nanophotonics Accessibility and Applicability from 2006-2008.

Mark Stiles

Member

Dr. Mark Stiles is a Fellow at the National Institute of Standards and Technology. He received his M.S. in Physics from Yale University, and his Ph.D. from Cornell University. His primary research interests include magnetic multilayers, thin films, nanostructures, and electronic structure calculations. He is an Adjunct Professor with the Department of Physics and Astronomy at Johns Hopkins University. He is currently on the Vice Chair of the Topical Group on Magnetism of the American Physical Society and a past Executive Committee Member of the APS Division of Condensed Matter Physics. He has been awarded Nanotech Briefs Innovator Award (2006); Department of Commerce Silver Medal (2005); Arthur S. Flemming Award (2003); and Sigma Xi, Young Scientist Award for Excellence (1996).

Katsuyo Thornton

Member

Katsuyo Thornton is an associate professor in the Materials Science and Engineering Department at the University of Michigan. She received her BS from Iowa State University and her MS and PhD from University of Chicago. Her work bridges the important gap between basic materials research and industrial application by using large-scale simulations to investigate the evolution of micro- and nano-sized structures in materials during process and operations. Recent topics of research include coarsening in elastically stressed solids, evolution of topologically complex systems in three dimensions, simulations of electrochemical systems, and self-assembly of quantum dots and other nanoscale phenomena during heteroepitaxy of semiconductors. Because most of her work involves mathematical modeling that requires significant computational resources, she brings to the committee an understanding of the advantages to materials research offered by computational design, including the capabilities of multi-user facilities such as NSF's TeraGrid. Dr. Thornton has also been involved in working on the long-term needs of the materials research community, having recently surveyed and reported on the trends and needs in computation materials science and education, "Computational Materials Science and Engineering Education: A Survey of Trends and Needs," *Journal of Minerals, Metals, and Materials Society* 61:12 (2009), and published guidelines for accessing the TeraGrid, the National Science Foundation's effort to build and deploy the world's largest distributed infrastructure for open science research, [Applying for computational time on NSF's TeraGrid-the world's largest cyberinfrastructure supporting open research," *Journal of Minerals, Metals, and Materials Society* 62:17 (2011).

Dale J. Van Harlingen

Member

Dale Van Harlingen is a Professor of Physics at the Materials Research Laboratory and the NSF Science and Technology Center for Superconductivity at the University of Illinois. He received his Ph.D. in physics in 1977 from Ohio State University. After a year as a NATO postdoctoral fellow in the Cavendish Laboratory at the University of Cambridge, England, he held a postdoctoral research position at the University of California at Berkeley for three years. His research interests include non-equilibrium superconductivity; superconductor device physics; superconductor materials, including classic, high temperature, and heavy fermion superconductors; microfabrication and nanofabrication techniques; mesoscopic physics; scanning tunneling microscopy and scanning SQUID microscopy; and phase coherence and vortex dynamics in superconductor systems. Dr. Van Harlingen is a fellow of the American Physical Society, a member of the National Academy of Sciences, and a member of the American Academy of Arts and Sciences. He received the prestigious Oliver E. Buckley Prize in Condensed Matter Physics from the American Physical Society in 1998.

David A. Weitz

Member

David Weitz is the Mallinckrodt Professor of Physics and of Applied Physics at Harvard University. After receiving a PhD from Harvard, he worked for about 18 years as a research scientist and Exxon Research and Engineering. He was then a professor of Physics for nearly 4 years at the University of Pennsylvania, and then assumed his current position at Harvard University. He runs a group that investigates the physics of soft matter, and has interests ranging from the materials science of soft materials, to biophysics, and to the practical applications of soft materials. He is Director of Harvard's NSF-supported Materials Research Science and Engineering Center. He also helped establish and is also co-director of the BASF Advanced Research Initiative at Harvard. Weitz also co-directs Harvard's Kavli Institute for Bionano Science and Technology. Weitz is a member of the National Academy of Sciences and the American Academy of Arts and Sciences. He also serves on several scientific advisory boards, for both government institutes and companies. In addition, he is active with several startup companies that have come from his research group.