

The Current Status and Future Direction of High Magnetic Field Science in the United States, Phase II

Committee

Peter B. Littlewood

Chair

Peter B. Littlewood is a Professor of Physics at the University of Chicago, who was previously director of Argonne National Laboratory, and before that a Professor of Physics at the University of Cambridge and head of the Cavendish Laboratory. He is the founding executive chair of the Faraday Institution, UK's independent centre for electrochemical energy storage science and technology, supporting research, training, and analysis. He began his career with almost 20 years at Bell Laboratories, ultimately serving for five years as head of Theoretical Physics Research. His research interests include superconductivity and superfluids, strongly correlated electronic materials, collective dynamics of glasses, density waves in solids, neuroscience, and applications of materials for energy and sustainability. He is a fellow of the Royal Society of London, the Institute of Physics, the American Physical Society, and TWAS (The World Academy of Sciences). He serves on advisory boards of research and education institutions and other scientific organizations worldwide. He holds a bachelor's degree in Natural Sciences (physics) and a doctorate in physics, both from the University of Cambridge.

Diego Arbelaez

Member

Diego Arbelaez is a staff scientist / engineer at Lawrence Berkeley National Laboratory (LBNL). He received his PhD in mechanical engineering from the University of California at Berkeley in 2008. He has been working at Lawrence Berkeley National Laboratory since the completion of his PhD. His work at LBNL focuses on the development of novel magnet technologies for high energy physics and basic energy science applications. His past and current work at LBNL has focused on the development of novel high-field superconducting dipole magnet technologies, superconducting magnets for ECR ion sources, and superconducting and permanent magnet undulators. Currently, he is the LBNL area leader for the Nb₃Sn magnet area within the US Magnet Development Program (US MDP) as well as the lead engineer for the design and fabrication of a 15 T, Nb₃Sn, large aperture dipole for a high field cable test facility that is being constructed at Fermilab. He also leads the team at LBNL that is responsible for delivering the upgraded undulators for the LCLS-II High Energy upgrade project at the SLAC National Accelerator Laboratory.

Satoshi Awaji

Member

Satoshi Awaji is a professor/director at High Field Laboratory for Superconducting Materials (HFLSM), Institute for Materials Research, Tohoku University. He is an experimental scientist on superconducting materials research and high field magnet development with the experiences in the physics of superconducting materials and in the technology of high field superconducting magnets. His specialty areas of expertise are critical currents of practical superconducting wires/tapes and cryogen-free superconducting magnets with high temperature superconductors and Nb₃Sn. He is mostly involved in the understanding the flux pinning mechanism of practical superconducting materials and in the developing the high field cryogen-free superconducting magnets, as well as managing the user program of the HFLSM. He was awarded of 10th (2006) and 21st (2017) Superconductivity Science and Technology Award. He is currently a board member of the Applied Superconductivity Educational Foundation and of the Cryogenics and Superconductivity Society Japan.

Amber Y. Balazs

Member

Amber YaelSylvia Balazs is an Associate Director of Analytical, Structural and Chromatography Sciences in Oncology R&D Chemistry at AstraZeneca's Boston R&D site. In 2016 she joined AstraZeneca as an NMR Specialist (Senior Scientist), following a Visiting Scientist opportunity with Prof. James Chou at Harvard Medical School, from Technion – Israel Institute of Technology, where she had been a PhD NMR Laboratory Head since 2001.

Her primary NMR responsibilities are small molecule conformational analysis for drug discovery and mentoring others.

Amber is on the Board of Directors and Scientific Organizing Committee for the Practical Applications of NMR in Industry Conference. She holds ACS and AAAS memberships. She has a steady record of internally recognized awards.

During her undergraduate Chemistry studies, she began academic lab work assaying acetylcholine receptors. Amber moved from CA to MA to do a direct PhD under the guidance of Prof. Lynmarie Thompson, investigating site-directed solid-state NMR distance measurements to test mechanisms of transmembrane signaling in bacterial chemotaxis receptors. In her postdoctoral studies with Prof. Shimon Vega at the Weizmann Institute, Amber's research included peptides studies with solids NMR. High-resolution NMR training from a solids background came from on-the-job experiences, formal course work, extensive reading, and an NIH workshop.

Anna Marie Leese de Escobar

Member

Anna Marie Leese de Escobar. Ms. Leese de Escobar retired from Federal Service as the Navy's Distinguished Scientist for Cryogenic Electronics, Senior Science and Technology Manager (SSTM) in 2022 and is currently serving as the Chief Science Officer at Laconic Infrastructure Partners, an ESG company. She has 34 years of experimental physics research in cryogenic electronics and superconductor materials fabrication and devices for electromagnetic systems leading to the founding of the Cryogenic Exploitation of Radio Frequency (CERF) Laboratory at Naval Information Warfare Center Pacific. She led multiple cross-disciplinary and cross-organizational efforts in development engineering resulting in 2+ technology transitions into Fleet inventory. She is a Fellow of the National Academy of Inventors, a Senior Member of the IEEE, a recipient of the Lauritsen-Bennett Award for Excellence in Science and serves on several professional Boards and Committees including the National Academy of Inventors, the Applied Superconductivity Education Foundation and the U.S. Committee for Superconductor Electronics. She received a Bachelor of Science in Physics at UCLA in 1988 and is a member of Sigma Pi Sigma.

Edwin Fohtung

Member

Edwin Fohtung is an Associate Professor of materials science and Engineering at Rensselaer Polytech Institute (RPI) in Troy NY. He received her Ph.D. (Dr. rer. nat., summa cum laude) in materials physics from the University of Freiburg, Germany in 2010. He received his B.Sc. (2005) and M.Sc. (2007) in Technical and Applied Physics from the St. Petersburg State Polytechnic University Russia and was a postdoctoral fellow with the physics department in the University of California at San Diego. Before joining RPI, he was the LANSCE (Los Alamos Neutron Science Center) Professor of physics at Los Alamos National Laboratory (LANL). Since then, he has published numerous research papers in leading scientific journals and has received several grants for his work on neutron science and x-ray physics at synchrotrons and free electron lasers. He has also been invited to give lectures and keynote speeches at conferences around the world. Professor Fohtung is the recipient of numerous awards including the Rosen Fellow at LANL, and the International Excellence fellowship award in Karlsruhe Institute of Technology. In addition to his work as a professor, Dr. Fohtung is a dedicated mentor to his students and postdocs and serves as panel member for numerous grant agencies and national facilities. He is a member of the American Physical Society, and the Materials Research Society.

Petra Fromme

Member

Petra Fromme is Regents Professor and Paul V Galvin Professor at the School of Molecular Sciences and holds the position of the director of the Biodesign Institute of Applied Structural Discovery at Arizona State University. Her research is focused on the Structure and Dynamics of Biomolecules, which are investigated by a combination of different techniques including X-ray crystallography, NMR, cryo-electron microscopy, X-ray spectroscopy, optical spectroscopy and electron paramagnetic resonance. She and her collaborators have pioneered the method of serial femtosecond crystallography with X-ray Free Electron Lasers, enabling time-resolved studies of biomolecules at room temperature in real time with femtosecond time resolution. She is also engaged in the development of compact X-ray Free Electron Lasers at ASU and at DESY, Germany. She has been awarded the Lemberg Fellowship of the Australian Academy of Science, the Biologie 2001 Award of the Academy of Science of Göttingen, the Robin Hill Award of the International Photosynthesis Society and the Afinsen Award of the Protein Society. She is member of the Society for Biological Chemistry, International Society of Photosynthesis Research, Biophysical Society and American Chemical Society. She received her M.S. (Diplom) in Biochemistry from the Free University of Berlin and her Ph.D. in Chemistry and Habilitation in Physical Chemistry from the Technical University Berlin.

Lucio Frydman

Member

Lucio Frydman is Professor and Head for the Department of Chemical and Biological Physics at the Weizmann Institute of Sciences in Israel. He is also the Chief Scientist in Chemistry & Biology, National High Magnetic Field Laboratory, Tallahassee, FL and the Director of the The Clore Institute ultrahigh field NMR, Weizmann Institute of Sciences and the Director of the The Fritz Haber Center for Experimental Physical Chemistry at the Weizmann Institute of Sciences. Born in Argentina, Lucio Frydman earned BSc and PhD degrees at the University of Buenos Aires. After postdoctoral studies at UC-Berkeley, he joined the University of Illinois at Chicago, where he became Full Professor in 1999. In 2001, he joined the Weizmann Institute's Department of Chemical Physics which he currently heads. He is also Chief Scientist in Chem/Bio at the US National High Magnetic Field Laboratory in Florida. Prof. Frydman's research focuses on magnetic resonance spectroscopy (NMR) and imaging (MRI), techniques that enable researchers to characterize molecular structure and behavior with unprecedented precision, and shed new light on phenomena governing a wide range of biological, chemical, and physical processes. Among Prof. Frydman's awards are the Dreyfus, Sloan, Beckman, and US NSF Career Fellowships. He was also the recipient of the Laukien and Varian awards, of an European ERC Advanced Grant, of the Outstanding Immigrant Prize from Israel's Ministries of Science and Absorption, and of the Richard R. Ernst Prize in Magnetic Resonance. Prof. Frydman has chaired leading scientific conferences including the 50th Experimental NMR Conference and the EuroMAR Organization, and advised over 50 graduate students and postdocs. He is a fellow of the International Society of Magnetic Resonance and of the International Society for Magnetic Resonance in Medicine, and for a decade served as editor-in-chief of the Journal of Magnetic Resonance.

Efim Gluskin

Member

Efim Gluskin is an Argonne Distinguished Fellow at Argonne National Laboratory. During his more than three decades at Argonne's Advanced Photon Source (APS), Efim has held several executive and leadership positions. Prior to his APS tenure, he was Group Leader/Senior Scientist at the Budker Institute of Nuclear Physics in Novosibirsk, Russia, where he pioneered the development of light sources and synchrotron radiation research in Russia. Soon after joining the APS in 1990, Efim became the Group Leader at the Experimental Facilities Division and took responsibility for the design and construction of undulators—the main sources of radiation—at the U.S.'s newly constructed premier synchrotron radiation facility. Under his guidance, the APS not only met all the requirements of the country's most advanced x-ray source, but also developed world-recognized expertise in this field. From 1999-2004 Efim led the Experimental Facilities Division, and from 2004-2009 he led the Accelerator Facilities Division. Such experience is quite unique: it provided in-depth knowledge of the x-ray source itself as well as the experimental capabilities and potential of the APS facility. In the early 2000's expertise in undulators was in great demand for the emerging free electron laser (FEL) field. Under Dr. Gluskin's leadership, a team of APS physicists and engineers joined the Linac Coherent Light Source (LCLS) project at the Stanford Linear Accelerator Center, where they assumed responsibility for the design and construction of more than 30 novel undulators. These unique devices were at the heart of the remarkable success of the world first x-ray FEL, the LCLS-1 project; in 2015 the APS team, again led by Efim, developed the next-generation undulators that are currently in use at the LCLS-II FEL facility. In 2012 he initiated the development of superconducting undulators (SCUs) at the APS. These devices represent the forefront and the future of undulator development; the APS team is the world leader in this field. Dr. Gluskin has published over 100 peer-reviewed articles, co-authored 3 books, holds 3 U.S. patents, and has given over 80 invited talks. He is a Fellow of both the American Physical Society and the American Association for Advancement of Science. He serves on the International Advisory Committees for the Photon Factory in Japan and the Pohang Accelerator Laboratory in South Korea. He received an M.S. in physics from Novosibirsk University in 1968 and a Ph.D. in physics from the Siberian Division of the USSR Academy of Sciences in 1974.

Sophia Eugenie Hayes

Member

Sophia E. Hayes. Sophia Hayes is a Professor of Chemistry at Washington University, and she currently serves as the Vice Dean for Graduate Education in Arts & Sciences. She specializes in solid-state NMR and materials science, especially low-temperature NMR (at cryogenic temperatures) and high-field studies of inorganic species. Her group develops methods and instrumentation for optically-pumped NMR, combining laser excitation and NMR detection. She is an AAAS Fellow, and Sloan Foundation Fellow and an Alexander von Humboldt Postdoctoral Fellow. Prof. Hayes earned her B.S. in chemistry from UC Berkeley and her PhD in chemistry from UC Santa Barbara, with postdoctoral training collaboratively working between Lawrence Livermore National Lab and UC Berkeley (Chemical Engineering). She also had postdoctoral training at Technical University of Dortmund, Germany, in Experimental Physics.

Valeria Lauter

Member

Valeria Lauter is a Senior R&D Staff Scientist in the Neutron Scattering Division at Oak Ridge National Laboratory. Prior to taking on her position at ORNL in 2008, she held positions of Research Scientist at the Technical University of Munich and the University of Konstanz (Germany); was a visiting fellow at the Laue Langevin Institute in Grenoble (France). Her research interests include low-dimensional magnetic systems and thin film heterostructures, including topological insulator heterostructures, oxide heterostructures, superconductors, magnetic nanocomposites and soft matter nanocomposites, and development and application of advanced neutron scattering techniques. As the Lead Instrument Scientist at the Magnetism Reflectometer (MR) at the Spallation Neutron Source, she established MR a state-of-the-art instrument and enabled new directions in neutron scattering research engaging a diverse user community, enabling unique in operando experiments combining polarized neutron reflectometry with in situ ferromagnetic resonance setup, or with in situ laser photoexcitation. Valeria is a fellow of American Neutron Scattering Society, Chair of Magnetic Interfaces and Nanostructures Division of American Vacuum Society. She is recipient of Award for Excellence in Beam Line Science from SNS and HFIR user community and several Supplemental Performance and Significant Event awards at Oak Ridge National Laboratory. She received her Ph.D. in experimental and theoretical solid state physics at the Joint Institute for Nuclear Research (JINR) in Dubna and a M.Sc. in Solid States Physics and Quantum Electronics in Moscow Physics and Engineering Institute (MEPhI). Valeria served as a reviewer for the Office of Basic Energy Sciences (BES) within the Department of Energy, as a member of the Distinguished Fellowship Committee at Oak Ridge National Laboratory and of the Seed Review Committee within the Laboratory Directed Research & Development Program, external expert for The National Research, Development and Innovation Office, Hungary, external expert of the review board for promotion for Department of Physics and Astronomy of Uppsala University, Sweden.

Charles (Chuck) H. Mielke

Member

Charles (Chuck) H. Mielke is the Division Director of the Dynamic Experiments (M) Division at Los Alamos National Laboratory (LANL). M Division is home to all of LANL's large scale high explosive (HE) experimental capabilities and large scale HE manufacturing for support of research and development of advanced national defense systems. Chuck was the former division director of the Integrated Weapons Experiments (J) division which is known for the DARHT capability at LANL and execution of sub-critical experiments at the Nevada National Security Site. Prior to J Division Chuck was the Director of the NHMFL-PFF at LANL for nine years. Chuck has published over 160 research papers in high magnetic field science and condensed matter physics research and is an expert in pulsed power methods and generation of extremely high magnetic fields. Chuck earned his Ph.D. from Clark University where he studied organic molecular based superconductivity and constructed pulsed magnetic field apparatus and developed low temperature physics methods for pulsed magnetic fields. As the NHMFL-PFF Director Chuck contributed a presentation as part of the 2013 NAS High Magnetic Field Science and Its Applications in the United States.

Peter B. Roemer

Member

Peter B. Roemer retired from GE Healthcare in 2020 as a Chief Engineer in MRI and continues work as a consultant. During his nearly 40-year career he developed key MRI technology improvements that are in widespread use today and he oversaw the development of multiple new MRI systems. As co-founder of ONI Medical Systems he led the development of a dedicated extremity MRI helping to reduce the cost of healthcare. He is a Fellow of the International Society of Magnetic Resonance in Medicine and a Gold Medal recipient, the highest award given by the society. In 2014 his paper "The NMR Phased Array" was voted by his peers as one of the 30 most influential of all MRM papers over the prior 30 years. In 2021 he was inducted into National Academy of Engineering. In the mid 1990's he was a member of external advisory board for the then newly formed National High Field Magnet Laboratory in Tallahassee, FL. Dr Roemer received an undergraduate degree in electrical and computer science and a PhD in nuclear engineering from MIT where his doctoral dissertation related to optimization of magnetic fields topologies in Stellarator fusion reactors.

Robert Tycko

Member

Robert Tycko is a Senior Investigator in the Laboratory of Chemical Physics, which is a biophysics and biophysical chemistry research department within the Intramural Research Program of the National Institute of Diabetes and Digestive and Kidney Diseases, a component of the National Institutes of Health. His expertise is primarily in magnetic resonance spectroscopy and its applications to problems in biophysics, structural biology, physical chemistry, and materials science. His research focuses on solid state nuclear magnetic resonance methods and their use in structural studies of protein assemblies. His research also includes efforts in high-resolution magnetic resonance imaging and electron microscopy. Dr. Tycko was elected to the National Academy of Sciences in 2020. He is also a Fellow of the American Academy of Arts and Sciences, the American Physical Society, the International Society of Magnetic Resonance, and the American Association for the Advancement of Science. Awards include the Inge Grundke-Iqbal Award from the Alzheimer's Association (2018), the Christian B. Anfinsen Award from the Protein Society (2014), and the Earle K. Plyler Prize from the American Physical Society (2005). Dr. Tycko received his A.B. degree from Princeton University in 1980 and his Ph.D. in chemistry from the University of California at Berkeley in 1984. He did postdoctoral research at the University of Pennsylvania in 1984-1986 and was a Member of Technical Staff in the Physical Chemistry and Materials Chemistry Research Departments of AT&T Bell Laboratories in 1986-1994. Dr. Tycko served on the NRC's Committee on Opportunities in High Magnetic Field Science in 2003 and Committee to Assess the Current Status and Future Direction of High Magnetic Field Science in the United States in 2013.

Nai-Chang Yeh

Member

Nai-Chang Yeh is currently the Thomas W. Hogan Professor of Physics at California Institute of Technology (Caltech). From 2013 to 2019, she served as the Fletcher Jones Foundation Co-Director of the Kavli Nanoscience Institute at Caltech. Her principal research field is experimental condensed matter physics, with special emphasis on quantum materials, quantum devices, quantum science, nanoscience, and nanotechnology. She is an elected fellow of the American Physical Society, the American Association for the Advancement of Science, and the Institute of Physics in UK. Some of her other professional honors include: Highlight Yushan Scholar, Ministry of Education, Taiwan; Achievement Award, Tsien Excellence in Education Program, Tsinghua University, China; Wu Chien-Shiung Distinguished Lectureship Award, National Central University & Wu Chien-Shiung Foundation, Taiwan; Faculty Achievement Award, Southern California Chinese-American Faculty Association, US; Outstanding Young Researcher Award, International Organization of Chinese Physicists and Astronomers; Packard Fellowship for Science and Engineering, US; and Sloan Research Fellowship, US. Yeh received her BSc degree from National Taiwan University (1983) and her PhD degree in physics from Massachusetts Institute of Technology (1988). She was a visiting scientist at IBM Thomas J. Watson Research Center from 1988 to 1989 and joined the physics faculty of Caltech in 1989.

Yuhu Zhai

Member

Yuhu Zhai is a Principal Engineer at the Princeton Plasma Physics Laboratory. Since 2018 he has held an engineering management leadership role in the \$200+ M Recovery Project for PPPL's flagship fusion experimental device National Spherical Torus eXperiment Upgrade (NSTX-U). Previously he established the superconducting magnet lab and broadened Nat'l and Int'l collaboration as part of PPPL's R&D strategic planning on High Temperature Superconducting Magnets for Fusion. He was also the principal Investigator for Innovation on high performance s/c coil development for fusion. This effort spanned prototype coil fabrication, cryogenic testing of prototype coils, development of quench protection system to novel fusion conductor development. He has also been the chief engineering analyst for the design of ITER Diagnostic First Walls and US ITER Diagnostic Port Plugs and lead engineering analyst for lower ELM coils in the final design phase of ITER in vessel coils. He received the Tiger Award from Princeton University in 2022.

Michael Janicke

Staff Officer

Michael Janicke spent most of his career at Los Alamos National Laboratory (LANL) leading the NMR user program for the Chemistry Division before joining the National Academies as a senior program officer on the Nuclear and Radiation Studies Board. Dr. Janicke graduated from Rice University with a B.S. in chemical engineering and continued his education at the University of California, Santa Barbara, where he earned his Ph.D. in chemical engineering. His graduate research focused on solid-state NMR studies of complex organic-inorganic interfaces in materials. Following his studies, Dr. Janicke was an Alexander von Humboldt Fellow at the Max Planck Institute for Carbon Research in Mülheim an der Ruhr. While in Germany, he worked with Professor Ferdi Schüth, former vice president of the German National Science Foundation. In 2000, Dr. Janicke returned to New Mexico as a postdoctoral fellow at LANL and became a staff member in 2002. Most recently he was the center director for REFOCUS, the Resonance Center for Chemical Signatures, and spearheaded efforts in developing new methods to detect chemical threat agents and synthetic opioids at border and airport checkpoints using magnetic resonance techniques. At LANL he was also heavily involved in addressing chemical questions associated with Medical Isotope and Basic Energy Sciences Heavy Element programs, assisting the researchers in one of the world's leading radiochemistry laboratories.

Erik B. Svedberg

Staff Officer

Erik Svedberg is a National Materials and Manufacturing Board Scholar at the National Academies of Sciences, Engineering, and Medicine where he has been employed since 2008. In this role, he works with experts from across the nation to develop, negotiate, and oversee scientific and technical advisory studies for federal agencies related to questions of materials science, manufacturing and engineering design. His previous and current activities at the National Academies includes work as a study director for Materials Needs and R&D Strategy for Future Aerospace Propulsion Systems; Corrosion Research Grand Challenges; Opportunities in Protection Materials; Optics and Photonics, Essential Technologies for Our Nation; Review of the National Nanotechnology Initiative; Airport Passenger Screening; Frontiers of Materials Research, A decadal Survey; Participation by DoD in its Manufacturing USA Institutes; and High Performance Bolting Technology for Offshore Oil and Gas Operations. As well as overseeing workshops such as Big Data in Materials Research and Development; Limited Affordable Low-Volume Manufacturing; Materials and Manufacturing Capabilities for Sustaining Defense Systems; New and Novel Processes that are on the Verge of Industrial Modernization; and Emerging Needs in Quantum-Enabled Systems. Dr. Svedberg has a decade of industry experience with both small and large companies in the materials science area and has been a guest researcher at NIST for several years. He has been awarded and overseen five research grants and has published over 80 scientific articles, been granted two patents and is cited over 1,700 times with an h-index of 22. His Ph.D. and master's degree are in materials science and he is a fellow of the American Association for the Advancement of Science, the American Vacuum Society, and the Washington Academy of Science, including being their 2019 leadership in material science award recipient.