

Post-Exascale Computing for the National Nuclear Security Administration

Committee

Katherine A. Yelick

Chair

Kathy Yelick is the Vice Chancellor for Research and the Robert S. Pepper Distinguished Professor of Electrical Engineering and Computer Sciences at the University of California, Berkeley. She is an internationally recognized expert in high-performance computing. Her research interests include parallel programming languages, automatic performance tuning, parallel algorithms, and computational genomics. Yelick concurrently holds a senior faculty scientist appointment at Lawrence Berkeley National Laboratory, where she was an associate lab director of the Computing Sciences Area from 2010 through December 2019. Yelick was also Director of the National Energy Research Scientific Computing Center (NERSC) from 2008 through 2012. Dr. Yelick earned her Ph.D. in Electrical Engineering and Computer Science from the Massachusetts Institute of Technology

John B. Bell

Member

John Bell is a Senior Scientist at Lawrence Berkeley National Laboratory and Chief Scientist of Berkeley Lab's Applied Mathematics and Computational Research Division. His research focuses on the development and analysis of numerical methods for partial differential equations arising in science and engineering. Bell has made contributions in the areas of finite volume methods, numerical methods for low Mach number flows, adaptive mesh refinement, stochastic differential equations, interface tracking and parallel computing. Bell is a Fellow of the Society of Industrial and Applied Mathematics and a member of the National Academy of Sciences. He was recipient of the SIAM/ACM Prize in Computational Science and Engineering, the Sidney Fernbach Award and the Berkeley Lab Lifetime Achievement Award. Bell received his Ph.D. in Mathematics from Cornell University in 1977.

John Bell was a member of the review committee for FY2017 Institutional Science, Technology and Engineering Capability Review at Los Alamos National Laboratory for the Information Science and Technology Focus Area. The review took place between April 25-27, 2017, and Bell's work on the report was finished in June 2017.

Frederic T. Chong

Member

Fred Chong is the Seymour Goodman Professor in the Department of Computer Science at the University of Chicago and the Chief Scientist at Super.tech. He is the Lead Principal Investigator for the EPIQC Project (Enabling Practical-scale Quantum Computing), an NSF Expedition in Computing. He is a recipient of the NSF CAREER award, the Intel Outstanding Researcher Award, and 11 best paper awards. His research interests include emerging technologies for computing, quantum computing, multicore and embedded architectures, computer security, and sustainable computing. Prof. Chong has been funded by NSF, DOE, Intel, Google, AFOSR, IARPA, DARPA, Mitsubishi, Altera and Xilinx. He has led or co-led over \$40M in awarded research, and been co-PI on an additional \$41M. Chong received his Ph.D. from MIT in 1996.

Dr. Chong published several articles on the subject of quantum computing, including: “Emerging Technologies for Quantum Computing” in the IEEE Micro Special Issue on Quantum Computing in 2021; “Quantum Computer Systems for Scientific Discovery” in Physical Review Research in 2020; “Quantum Computer Systems: Research for Noisy Intermediate-Scale Quantum Computers” in Synthesis Lectures in Computing in 2020; “Quantum Computing for Enhancing Grid Security” in IEEE Power Engineering Letters in 2020; and “Greater Quantum Efficiency by Breaking Abstractions” in Proceedings of the IEEE in 2020. Quantum computing is a potential key technology to be considered for post-exascale computing.

Dona L. Crawford

Member

Dona L. Crawford retired as associate director for computation from the Lawrence Livermore National Laboratory (LLNL), where she led the laboratory's high-performance computing efforts. In that capacity, Ms. Crawford was responsible for the development and deployment of an integrated computing environment for petascale simulations of complex physical phenomena. Prior to her LLNL appointment in 2001, Ms. Crawford was with Sandia National Laboratories (SNL) since 1976 serving on many leadership projects including the Accelerated Strategic Computing Initiative and the Nuclear Weapons Strategic Business Unit. Ms. Crawford has served on a number of National Academies committees including the Committee to Review Governance Reform in the National Nuclear Security Administration and the Committee to Evaluate the NSF's Vertically Integrated Grants for Research and Education (VIGRE) Program. Additionally, she served on the NNSA Defense Programs Advisory Committee for High Performance Computing (2018-2019). She received her MS in operations research from Stanford University.

Mark E. Dean

Member

Mark E Dean is professor emeritus at the University of Tennessee, Knoxville. His research focus was in advanced computer architecture (neuromorphic computing). Prior to joining UTK, Dr. Dean had a 34 year career in the computer industry working in various executive, research and development positions at IBM. He served as an IBM Fellow, Chief Technology Officer of the Middle East and Africa, and VP World Wide Strategy and Operations for IBM Research. Dr. Dean holds three of the nine patents for the original IBM PC and created the Industry Standard Architecture (ISA), which permitted add-on devices like the keyboard, disk drives and printers to be connected to the motherboard, earning him election to the National Inventors Hall of Fame. Dr. Dean is currently a committee member for the Division on Engineering and Physical Sciences of the National Academies. Dr. Dean received a Ph.D. in Electrical Engineering from Stanford University and is a member of the American Academy of Arts and Sciences and National Academy of Engineering.

Jack J. Dongarra

Member

Jack Dongarra is a Distinguished Professor of Electrical Engineering and Computer Science at the University of Tennessee and Distinguished Research Staff member at Oak Ridge National Laboratory. He specializes in numerical algorithms in linear algebra, parallel computing, the use of advanced computer architectures, programming methodology, and tools for parallel computers. He was the first recipient of the SIAM Special Interest Group on Supercomputing's award for Career Achievement in 2010; in 2019 he received the ACM/SIAM Computational Science and Engineering Prize, and in 2020 he received the IEEE-CS Computer Pioneer Award. He is a Fellow of the AAAS, ACM, IEEE, and SIAM and a foreign member of the Russian Academy of Science, a foreign member of the British Royal Society, and a US National Academy of Engineering member. Dongarra served on the NRC Committee to study the Future of Supercomputing (2003), and the Committee for Technology Insight (2010). Dongarra received his Ph.D. in Computer Science from the University of New Mexico.

Ian T. Foster

Member

Ian Foster is the Arthur Holly Compton Distinguished Service Professor of Computer Science at the University of Chicago, he is also Senior Scientist and Distinguished Fellow, and director of the Data Science and Learning Division, at Argonne National Laboratory. Dr. Foster's research deals with distributed, parallel, and data-intensive computing technologies, and applications of those technologies to problems in such domains as materials science, climate change, and biomedicine. The Globus software that he co-invented is widely used in national and international cyberinfrastructures and science projects. Dr. Foster currently serves on the National Academies U.S. National Committee for CODATA. Dr. Foster is a fellow of the AAAS, ACM, BCS, and IEEE, and an US Department of Energy Office of Science Distinguished Scientists Fellow. He has received the BCS Lovelace Medal and the IEEE Babbage, Goode, and Kanai awards. Dr. Foster obtained a BSc degree from the University of Canterbury, New Zealand, and a PhD from Imperial College, United Kingdom, both in computer science.

Charles F. McMillan

Member

Charles McMillan is the retired director of Los Alamos National Laboratory. He has served in leadership roles in the nuclear weapons program at both Los Alamos National Laboratory and Lawrence Livermore National Laboratory in which high performance computing has been essential to program success. During the 1990s, he helped to create the Accelerated Scientific Computing Initiative (ASCI) and led the software development group that produced the first 3D, parallel simulations of a nuclear weapons primary. Dr. McMillan currently serves on the National Academies Committee on Assessment of High Energy Density (HED) Physics. Dr. McMillan received a PhD in Physics from MIT.

Dr. McMillan provided classified Annual Assessment letters the US President, in which he has provided evaluations of the state computing as one of the tools of stewardship as required by Congress. He has also provided congressional testimony on the US nuclear deterrent that includes the results of modeling and simulation using high performance computing.

Daniel I. Meiron

Member

Daniel Meiron is currently Prof. of Aerospace and Applied and Computational Math at Caltech. His interests include Computational Fluid Dynamics and Computational Materials Science. Dr. Meiron previously served on the National Academies NSF Graduate Panel on Applications of Mathematics. He received his ScD at MIT in Applied Math in 1981

Daniel A. Reed

Member

Daniel A. Reed is the Senior Vice President for Academic Affairs (Provost) at the University of Utah, where he is also a Professor of Computer Science and Electrical & Computer Engineering. Previously, he served as Microsoft's Corporate Vice President for Technology Policy and Extreme Computing, founding director of the Renaissance Computing Institute (RENCI), and director of the National Center for Supercomputing Applications (NCSA). Reed was one of the principal investigators and chief architect for the NSF TeraGrid, which became NSF XSEDE. Dr. Reed currently serves as a member of the National Science Board (NSB). He also chairs the Department of Energy's Department of Energy's Advanced Scientific Computing Advisory Committee (ASCAC). He is a Fellow of the ACM, the IEEE, and the AAAS. Dr. Reed is currently a member of the National Academies Army Research Laboratory Technical Assessment Board. He previously chaired the National Academies Panel on Computational Sciences at the Army Research Laboratory. Other National Academies committee membership includes the Committee on Future Directions of NSF Advanced Computing Infrastructures to Support U.S. Science in 2017-2020. Reed received his B.S. from Missouri University of Science and Technology and his M.S. and Ph.D. from Purdue University, all in computer science.

Dr. Reed is serving as chair of the Department of Energy's Advanced Scientific Computing Advisory Committee (ASCAC), 2016-present. ASCAC conducts studies and issues reports, based on requests from DOE leadership.

William Ward Carlson

Member

William Carlson is a member of the research staff at the IDA Center for Computing Sciences since 1990. His work has centered on innovations focused on computing at extreme scale and its applicability and relevance to a variety of scientific and mathematical applications. These include spearheading the design and implementation of the UPC programming language; work in major research programs such as HTMT, the DARPA HPCS program, and Project 38; and current efforts to understand the role of languages such as Rust in large-scale computations. Dr. Carlson is a member of the IEEE and the ACM. He received his Ph.D. and MSEE from Purdue University and his BS from Worcester Polytechnic Institute.

Karen E. Willcox

Member

Karen E. Willcox is Director of the Oden Institute for Computational Engineering and Sciences, Associate Vice President for Research, and Professor of Aerospace Engineering and Engineering Mechanics at the University of Texas at Austin. She holds the W. A. "Tex" Moncrief, Jr. Chair in Simulation-Based Engineering and Sciences and the Peter O'Donnell, Jr. Centennial Chair in Computing Systems. Prior to UT, Willcox spent 17 years as a professor at the Massachusetts Institute of Technology, where she served as the founding Co-Director of the MIT Center for Computational Engineering and the Associate Head of the MIT Department of Aeronautics and Astronautics. Dr. Willcox is currently a member of the National Academies Board on Mathematical Sciences and Analytics. She previously served on the National Academies Panel on Review of the Information Technology Laboratory at the National Institute of Standards and Technology. She is a Fellow of the Society for Industrial and Applied Mathematics (SIAM), a Fellow of the American Institute of Aeronautics and Astronautics (AIAA), and Member of the New Zealand Order of Merit (MNZM) for services to aerospace engineering and education. Willcox holds a Bachelor of Engineering Degree from the University of Auckland, New Zealand, and masters and PhD degrees in Aeronautics and Astronautics from MIT.

Dr. Willcox submitted oral and written testimony to the Subcommittee on Energy of the House Committee on Science, Space, and Technology hearing on Accelerating Discovery. The statement highlights several key strategies for the future of scientific computing at the Department of Energy.