Nikta Fakhri
Assistant Professor of Physics, Division of Atomic, Biophysics, Condensed Matter & Plasma Physics

RESEARCH INTERESTS
Active processes in both living and non-living matter create a novel class of non-equilibrium materials composed of many interacting parts that individually consume energy and collectively generate motion or mechanical stresses. Active systems exhibit a wealth of intriguing properties, including anomalous fluctuations, non-equilibrium phase transitions, pattern formation on mesoscopic scales and unusual mechanical and rheological properties. In biology, active systems span a large range of length scales, from molecules to the cytoskeleton of individual cells, to tissues, whole organisms and their collective ensembles.

The Fakhri research group focuses on combining concepts from physics, biology and engineering to decode non-equilibrium mechanisms in active living matter; to exploit these mechanisms for engineering functional active materials; and to identify universal behavior in this broad class of internally driven systems.

Fakhri has pioneered the use and development of fluorescent single-walled carbon nanotubes as probes in soft matter and biophysics.

BIOGRAPHICAL SKETCH
Nikta Fakhri joined the MIT Physics Department as an assistant professor in January 2015. She completed her undergraduate degree at Sharif University of Technology, Tehran, Iran, and her PhD at Rice University. She was a Human Frontier Science Program postdoctoral fellow at Georg-August-Universität in Göttingen, Germany, before joining MIT.

For a list of Prof. Fakhri’s selected publications, please visit her faculty web page at web.mit.edu/physics/people/faculty/fakhri_nikta.html.
Lindley Winslow
Assistant Professor of Physics, Division of Experimental Nuclear & Particle Physics

Research Interests
Lindley Winslow is an experimental nuclear physicist whose primary focus is on neutrinoless double-beta decay. Neutrinoless double-beta decay is an extremely rare nuclear process which, if it is ever observed, would show that the neutrino is its own antiparticle—a Majorana particle. A Majorana neutrino would have profound consequences to particle physics and cosmology, among them an explanation of the universe’s matter-antimatter symmetry. Winslow takes part in two projects that search for double-beta decay at CUORE (Cryogenic Underground Observatory for Rare Events) and KamLAND-Zen, and works to develop new, more sensitive double-beta decay detectors.

Biographical Sketch
Lindley Winslow received her BA in physics and astronomy in 2001 and her PhD in physics in 2008, both from the University of California at Berkeley. After a postdoctoral fellowship at MIT, she was appointed an assistant professor at the University of California at Los Angeles, then in 2015, as an assistant professor at MIT. In 2010, she was awarded a L’Oréal for Women in Science Fellowship.

For a list of Prof. Winslow’s selected publications, please visit her faculty web page at web.mit.edu/physics/people/faculty/winslow_lindley.html.
David Kaiser
*Germeshausen Professor of the History of Science and Professor of Physics*

**Research Interests**
David Kaiser’s research interests focus primarily on early-universe cosmology. Much of his work has centered on whether successful models of cosmic inflation might be achieved using familiar particles from the Standard Model of particle physics, such as the Higgs boson. Recent work has focused on models with multiple interacting fields, comparing predictions from such models with recent high-precision measurements of the cosmic microwave background radiation.

Kaiser also investigates how an early period of cosmic inflation might have come to an end in a process called “reheating.” During that phase, the energy that had driven the rapid expansion of the universe was converted into particles more like the kind we see around us today. Understanding reheating is critical for connecting two well-tested cosmic epochs: early-universe inflation and big-bang nucleosynthesis.

A distinct line of inquiry focuses on devising feasible experimental tests of the foundations of quantum mechanics. Much of Kaiser’s work in this area has focused on quantum entanglement, as evinced in experimental violations of Bell’s inequality. Every prior test of Bell’s inequality has been compatible with the predictions from quantum mechanics; yet the experiments have been subject to one or more loopholes, which leave open the possibility (however remote) that some alternative theory might still be viable. In an upcoming series of experiments, in collaboration with Anton Zeilinger, Kaiser and his colleagues aim to address one of the most stubborn and subtle of the loopholes, known as “setting-independence,” using some of the oldest light in the universe. The new experiments should improve constraints on alternative models by 20 orders of magnitude.

**Biographical Sketch**
David Kaiser began teaching at MIT in 2000 and is presently the Germeshausen Professor of the History of Science and Department Head of MIT’s Program in Science, Technology, and Society. He served as Lecturer and Senior Lecturer in MIT’s Department of Physics between 2000-2015 before becoming a Professor of Physics. Since 2011 he has co-advised a research group with Alan Guth in MIT’s Center for Theoretical Physics on early-universe cosmology. To date the
group has sponsored more than 30 students via MIT’s Undergraduate Research Opportunities Program (UROP), alongside PhD students and postdocs.

Before coming to MIT, Kaiser earned his AB in physics at Dartmouth College and completed PhDs in physics and the history of science at Harvard University. Kaiser received the LeRoy Apker Award from the American Physical Society in 1993 and was elected a Fellow of the American Physical Society in 2010. He is also an MIT MacVicar Faculty Fellow. His recent book, How the Hippies Saved Physics: Science, Counterculture, and the Quantum Revival, was named “Book of the Year” by Physics World magazine. He is presently writing two books about gravitation and cosmology: an undergraduate textbook co-authored with Alan Guth, and an historical study of research on Einstein’s general relativity over the course of the twentieth century.

For a list of Prof. Kaiser’s publications, please visit his faculty web page at web.mit.edu/physics/people/faculty/kaiser_david.html.

Seth Lloyd
Professor of Mechanical Engineering and Engineering Systems and Physics; Director, Center for Extreme Quantum Information Theory (xQIT)

**Research Interests**

Research in the Lloyd lab focuses on problems of information in physical systems, with an emphasis on quantum computation and quantum communications. The lab collaborates with experimentalists to design and to build quantum information processors using superconducting devices and atom-optics, and to realize quantum communication systems using integrated linear optics.

The lab works on fundamental quantum limits to sensing and measurement, using quantum effects such as coherence and entanglement to achieve the ultimate limits to sensitivity for measurement of time and distance. The work on quantum metrology has implications for theories of quantum gravity and for experimental tests of such theories.

Other efforts focus on the role of coherence in quantum transport, including excitonic transport in photosynthesis. Researchers collaborate with
experimentalists to apply lessons learned from the high efficiency of quantum transport in naturally occurring systems to construct novel light-harvesting systems that take advantage of quantum effects. As part of these general investigations into the interplay between information and energy in quantum settings, the lab does research into quantum heat engines that use coherence and entanglement to attain high efficiency of energy conversion. The lab develops quantum algorithms for data analysis and quantum machine learning, including algorithms for clustering, principal component analysis, algebraic topology and discrete geometry. These algorithms could reveal features of data exponentially faster than classical algorithms.

Biographical Sketch
Seth Lloyd joined the MIT faculty of Mechanical Engineering in 1994, and the faculty of physics in 2015. He received his BA in physics in 1982 from Harvard, a Master’s of Advanced Study in mathematics from Cambridge University in 1983, an MPhil in history and philosophy of science from Cambridge University in 1984, and a PhD in physics from Rockefeller University in 1988. He did postdoctoral work at Caltech from 1988-91, and at Los Alamos from 1991-94. He has been an adjunct professor at the Santa Fe Institute since 1989. Lloyd is a fellow of the American Physical Society and received the 2012 prize in Quantum Measurement, Communication, and Computation.

For a list of Prof. Lloyd’s publications, please visit his faculty web page at web.mit.edu/physics/people/faculty/lloyd_seth.html.
Michael A. McDonald
Assistant Professor of Physics, Division of Astrophysics; MIT Kavli Institute for Astrophysics and Space Research

Research Interests
Michael McDonald is an astronomer in the MIT Kavli Institute for Astrophysics and Space Research. His research focuses on the most massive gravitationally-bound objects in the Universe: clusters of galaxies. In particular, he is attempting to understand the life cycle of gas, stars and galaxies in these rich environments, and how highly energetic processes such as supernovae and jets from supermassive black holes can influence the evolution of these systems. This research makes extensive use of both ground- and space-based telescopes at nearly all wavelengths, including (but not limited to) the Magellan and ALMA observatories in Chile, the South Pole Telescope in Antarctica, and the space-borne Chandra and Hubble telescopes.

Aside from research, McDonald has been involved in the development of the Maryland-Magellan Tunable Filter on the Baade telescope at Magellan and is a member of the Science Working Group for the European Athena X-ray telescope, scheduled to launch in the late 2020s.

Biographical Sketch
Michael McDonald is from Kingston, Ontario in Canada. He graduated from Queen’s University in Canada in 2005 with a bachelor’s degree in physics and in 2007 with a master’s of science under the supervision of Stephane Courteau. He received a PhD from the University of Maryland in 2011, after working with Sylvain Veilleux on an emission-line study of giant elliptical galaxies. In 2012, McDonald was named a Hubble postdoctoral fellow at the MIT Kavli Institute for Astrophysics and Space Research. In July 2015, he joined the faculty of the MIT Department of Physics as an assistant professor.

For a list of Prof. McDonald’s selected publications, please visit his faculty web page at web.mit.edu/physics/people/faculty/mcdonald_michael.html.
Hilke Schlichting
Assistant Professor of Physics, Division of Astrophysics; MIT Kavli Institute for Astrophysics and Space Research (July 2015); Assistant Professor of Earth, Atmospheric and Planetary Sciences (July 2013)

Research Interests
Hilke Schlichting’s research spans all aspects of planet formation theory, extrasolar planets and solar system dynamics. She is very interested in extrasolar planets, because their diversity exemplifies the range of possible outcomes of planet formation. Her research combines observations from our solar system, which is the only place where we can examine the outcome of planet formation in detail, with the new wealth of data from extrasolar planets to shed light onto the process of planet formation and subsequent dynamical evolution.

Biographical Sketch
Hilke Schlichting joined the MIT faculty as an assistant professor in the Department of Earth, Atmospheric and Planetary Sciences in July 2013, and the Department of Physics in July 2015. She received a BS and MS in physics from the University of Cambridge in 2004 and completed her doctoral work in astrophysics in 2009 at the California Institute of Technology, under the direction of Re’em Sari. In 2010, she was named a Hubble postdoctoral fellow at the University of California at Los Angeles.

For a list of Prof. Schlichting’s selected publications, please visit her faculty web page at web.mit.edu/physics/people/faculty/schlichting_hilke.html.