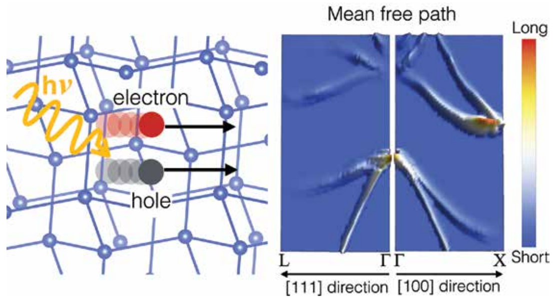
New Faculty

Marco Bernardi
Assistant Professor of Applied Physics and Materials Science

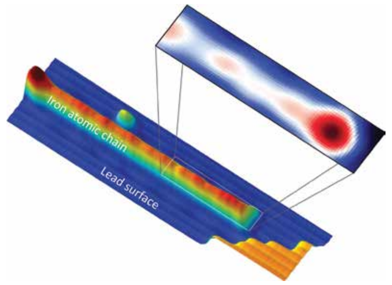
Marco Bernardi develops and applies *ab initio* quantum mechanical calculations to study the dynamics of electrons and excited states in materials. His research combines theory and cutting-edge computational tools based on density functional theory and related excited-state methods. Employing massively parallel computational algorithms and using the structure of the material as the only input, his new developments and techniques are enabling understanding of energy in materials with Angstrom space and femtosecond time resolutions. Applications of his research include novel materials and technologies for energy conversion, as well as optoelectronics and ultrafast science. Marco Bernardi holds a BS in materials science from the University of Rome in Italy. He obtained his PhD in materials science from the Massachusetts Institute of Technology in 2013. His PhD work combined theory and computation to study novel materials and physical processes in solar energy conversion. He was then a postdoctoral scholar in the Physics Department of UC Berkeley from 2013 to 2015, where his work focused on calculations of ultrafast dynamics of excited electrons in materials. He has received a number of awards, including the Endeavour Research Fellowship from the Australian government (2007) and the Intel PhD Fellowship (2012). His research has been featured in many online news articles and magazines, including *Wired*, *Scientific American*, and MIT's *Technology Review*.



This illustration depicts dynamics of excited electrons during the first picosecond (millionth of a millionth of a second) after sunlight is absorbed in a silicon solar cell. Shown on the right is the average distance excited electrons travel before losing energy to heat. This distance, called mean free path, is calculated for electrons with a range of energies and moving in different crystallographic directions.

Stevan Nadj-Perge
Assistant Professor of Applied Physics and Materials Science

Stevan Nadj-Perge is interested in the development of mesoscopic devices for applications in quantum information processing. Such devices also provide a playground for exploring exotic electronic states at (sub-)nanometer length scales. For his research, he is using scanning tunneling microscopy and electrical transport measurement techniques at cryogenic temperatures. Nadj-Perge received an MSc in theoretical physics from the University of Belgrade in 2006. He then moved to Delft University of Technology for a PhD in applied physics. During his graduate studies, he developed electrically controlled spin-orbit quantum bits based on semiconductor nanowire quantum dots. After obtaining his PhD in 2010, he became interested in topological states of matter, and in 2011 he was awarded the Marie Curie Fellowship to continue his scientific career. He worked as a postdoctoral researcher at Princeton University and Delft University of Technology. At Princeton he used scanning tunneling microscopy to investigate topological properties of engineered material systems and to pursue novel ways to create Majorana bound states, potential building blocks for a topological quantum computer. Currently in Delft, he is leading a research team that studies electrically tunable two-dimensional topological insulators and exotic states in superconductor-semiconductor junctions. He will join the EAS faculty in January 2016.



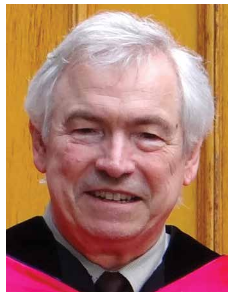
This image shows a self-assembled chain of iron (Fe) atoms on the surface of lead (Pb), taken using a scanning tunneling microscope (dimensions are 15 nm x 4 nm). At low temperatures, lead becomes a superconductor with a finite superconducting energy gap. Due to its magnetic properties, iron atoms create electronic states inside of this gap. The resulting electronic structure of the chain at zero energy is shown in the inset. Increased local density of states localized at the chain end (marked in red) suggests the existence of topological excitations, called Majorana bound states, in this system. Measurements were performed by Professor Ali Yazdani's group at Princeton University.

WHO'S NEW

Moore Scholar

The Moore Distinguished Scholars program was established by Gordon and Betty Moore to invite researchers of exceptional quality who are distinguished at both the national and international levels to visit the California Institute of Technology for three to six months. There are no teaching or other obligations during the appointment, allowing Moore Scholars to focus on research.

James R. Rice
Mallinckrodt Professor of Engineering Sciences and Geophysics, Harvard University



James R. Rice is jointly appointed in Harvard's School of Engineering and Applied Science and in its Department of Earth and Planetary Sciences. From 1965 to 1981 he was a faculty member in the Division of Engineering at Brown, and his education prior to that was at Lehigh, where he received an ScB in engineering mechanics and an ScM and PhD in applied mechanics.

His teaching has included solid and fluid mechanics, thermodynamics, fracture, computational mechanics, hydrology, geomechanics, earthquake processes, and applied math topics such as differential equations and complex function theory.

Rice's earlier work addressed cracking and plastic or creep deformation in engineering metals and ceramics. His more recent research is directed toward earth and environmental problems relating to such areas as friction and rupture in earthquake and landslide processes, tsunami propagation, glacier and ice sheet dynamics, and general hydrologic phenomena involving fluid interactions in deformation, flow, and failure of earth materials. His path-invariant *J*-integral methodology, originally developed with cracking of ductile metals in mind, was quickly extended to help model transitions to unstable slippage in landslides and tectonic earthquakes and has found recent applications in his ice-sheet mechanics studies of transitions from slipping to locked basal regions.

His work has been recognized through numerous awards, including the Timoshenko and Nadai Medals of the American Society of Mechanical Engineers, the von Karman and Biot Medals of the American Society of Civil Engineers, the Reid Medal of the Seismological Society of America, and the Bucher Medal of the American Geophysical Union. He has been elected to the National Academy of Engineering and the National Academy of Sciences and to foreign membership in the British Royal Society and the French Académie des Sciences, and he has received honorary doctorates from several universities.

Rice is scheduled to receive the 2015 ASME Medal (in November at the ASME 2015 Mechanical Engineering Congress & Exposition, Houston) "for seminal contributions in the field of applied mechanics, particularly the *J*-integral method in elastic-plastic fracture mechanics that has been broadly applied in mechanical engineering and related disciplines," and in early December he will receive the Sigma Xi Monie A. Ferst Award at Georgia Tech, "to recognize significant contributions to scientific research by an educator."