New Faculty

JANUARY 2008

Nuh Gedik

Assistant Professor of Physics, Division of Atomic, Biological, Condensed Matter & Plasma Physics

RESEARCH INTERESTS

Nuh Gedik's research centers on developing and using advanced optical techniques for investigating ultrafast processes in solids, nanostructures and interfacial molecular assemblies. The typical timescale for these events are *femtoseconds* (billionth of a millionth of a second), and typical length scales are *angstroms* (tenth of a billionth of a meter). In order to resolve these fast processes, ultrafast laser pulses with femtosecond durations are used. To achieve spatial sensitivity in the angstrom scale, the Gedik group generates ultrashort electron packets from ultrafast laser pulses via photoelectric effect. After acceleration to high energies, diffraction of these electron packets is used to record atomic scale "movies" with femtosecond time resolution and angstrom scale spatial resolution.

The Gedik group uses these techniques to search for answers to important problems in condensed matter physics. One primary focus is to understand strongly correlated electron systems. In these materials, the interplay between spin, charge and lattice excitations leads to fascinating properties such as high temperature superconductivity and colossal magneto-resistance. Using the aforementioned experimental techniques, spatiotemporal dynamics of these excitations are studied with the goal of identifying the mechanisms behind the striking macroscopic behavior of these materials.

Darren Stahlman

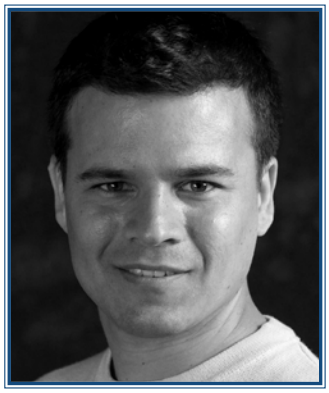
BIOGRAPHICAL SKETCH

Nuh Gedik joined the MIT Physics Department as an assistant professor in January 2008. He received his B.S. in Physics in 1998 from Bogazici University, Istanbul, Turkey, and his Ph.D. in Physics in 2004 from the University of California, Berkeley. After his Ph.D, he moved to Caltech where worked as a postdoctoral scholar until coming to MIT.

For a list of Prof. Gedik's selected publications, please visit his faculty web page at web.mit.edu/physics/facultyandstaff/index.html.

Pablo Jarillo-Herrero

Assistant Professor of Physics, Division of Atomic, Biological, Condensed Matter & Plasma Physics



Darren Sahlman

RESEARCH INTERESTS

Pablo Jarillo-Herrero's research interests lie in the area of experimental condensed matter physics, in particular quantum electronic transport in novel low dimensional nanomaterials, such as graphene and carbon nanotubes. Graphene and carbon nanotubes (CNTs) are the two- and one-dimensional forms of graphite, respectively, and constitute ideal 2-D and 1-D systems to study the behavior of electrons in low dimensions. Since their discovery (~1993 for single wall CNTs, and ~2004 for graphene), these materials have fascinated physicists, chemists, engineers and even biologists because of their amazing properties. Jarillo-Herrero's group focuses on understanding the novel electronic properties of these materials stemming from their unique electronic structure. On the fundamental side, electrons in graphene, for example, behave in many ways similar to "charged neutrinos." On a more "technological" side, the spin dynamics of confined electrons in CNTs and graphene are expected to be very rich, and will enable many basic experiments in the area of spintronics and quantum information processing.

BIOGRAPHICAL SKETCH

Pablo Jarillo-Herrero joined MIT as an assistant professor of physics in January 2008. He received his M.Sc. in Physics from the University of Valencia, Spain, in 1999. Then he spent two years at the University of California in San Diego, where he received a second M.Sc. degree before going to the Delft University of Technology in The Netherlands, where he earned his Ph.D. in 2005. After a one-year postdoc in Delft, he moved to Columbia University, where he most recently worked as a NanoResearch Initiative Fellow.

For a list of Prof. Jarillo-Herrero's selected publications, please visit his faculty web page at web.mit.edu/physics/facultyandstaff/index.html.

Janet Conrad

Professor of Physics, Division of Experimental Nuclear & Particle Physics

RESEARCH INTERESTS

The lightest and most elusive of the known matter particles are neutrinos. Their number far exceeds the atoms in the universe. Yet we know surprisingly little about these particles. It is only within the last decade, for example, that we came to realize these particles have mass, albeit very tiny. This became clear when neutrinos were shown to live a double life, transforming from one type into another through the quantum mechanical effect of neutrino oscillations, an effect that requires neutrino mass.

While their masses may be small, the impact of neutrinos on particle physics is enormous. In the Standard Model, which describes particle interactions, neutrinos are massless. So the discovery of mass challenges us to rethink our theory. It also provokes us to ask: "What other properties of neutrinos might be outside of the Standard Model?"

Janet Conrad's research uses neutrinos as tools to probe for new physics. Until 2007, she was co-spokesperson of the MiniBooNE experiment, which searched for a new neutrino beyond the three types known in the Standard Model. This was motivated by an oscillation result from the Liquid Scintillator Neutrino Detector (LSND) experiment at Los Alamos, which indicated an oscillation wavelength inconsistent with other experiments, perhaps pointing to the existence of a fourth neutrino species. MiniBooNE provided a strict test of this hypothesis, and ruled out the explanation of a fourth type of neutrino.

However, while one neutrino anomaly has been resolved, another has sprung up. At low neutrino energy, MiniBooNE saw an excess of events above the Standard Model expectation and inconsistent with neutrino oscillations. Its source remains a mystery, which is best explored through a more sensitive detector. To this end, Conrad is involved in the MicroBooNE experiment, which is developing a state-of-the-art detector that makes use of liquid Argon.

At the same time, Conrad has shifted her focus to exploring the properties of the three Standard Model species. While many combinations of oscillations between neutrinos have been observed, there is one which is yet to be seen. The purpose of the Double Chooz experiment, on which Conrad collaborates, is to observe, for the first time, this rare transmutation.

BIOGRAPHICAL SKETCH

Janet Conrad received her B.A. from Swarthmore College in 1985, M.Sc. from Oxford University in 1987, and Ph.D. from Harvard in 1993. She began as a postdoctoral associate at Columbia University and was promoted to Assistant Professor in 1996. Most recently, she was the Walter O. Lecroy Professor of Physics at Columbia University.

For a list of Prof. Conrad's selected publications, please visit her faculty web page at web.mit.edu/physics/facultyandstaff/index.html.