MAR08-2007-005018

Abstract for an Invited Paper
for the MAR08 Meeting of
the American Physical Society

Integrating Condensed Matter Physics into a Liberal Arts Physics Curriculum[1]

JEFFREY COLLETT, Department of Physics, Lawrence University, Appleton, WI

The emergence of nanoscale science into the popular consciousness presents an opportunity to attract and retain future condensed matter scientists. We inject nanoscale physics into recruiting activities and into the introductory and the core portions of the curriculum. Laboratory involvement and research opportunity play important roles in maintaining student engagement. We use inexpensive scanning tunneling (STM) and atomic force (AFM) microscopes to introduce students to nanoscale structure early in their college careers. Although the physics of tip-surface interactions is sophisticated, the resulting images can be interpreted intuitively. We use the STM in introductory modern physics to explore quantum tunneling and the properties of electrons at surfaces. An interdisciplinary course in nanoscience and nanotechnology course team-taught with chemists looks at nanoscale phenomena in physics, chemistry, and biology. Core quantum and statistical physics courses look at effects of quantum mechanics and quantum statistics in degenerate systems. An upper level solid-state physics course takes up traditional condensed matter topics from a structural perspective by beginning with a study of both elastic and inelastic scattering of x-rays from crystalline solids and liquid crystals. Students encounter reciprocal space concepts through the analysis of laboratory scattering data and by the development of the scattering theory. The course then examines the importance of scattering processes in band structure and in electrical and thermal conduction. A segment of the course is devoted to surface physics and nanostructures where we explore the effects of restricting particles to two-dimensional surfaces, one-dimensional wires, and zero-dimensional quantum dots.

[1]Work supported by grants from the W.M. Keck Foundation and the NSF-NUE program.