Novel Phenomena, Material Structures, Processes, and Properties

Opportunity

The discovery of the novel phenomena and material structures that appear at the nanoscale will affect the entire range of applications that the grand challenges identify, and more.

Priorities

Research in this area supports the discovery of the fundamental physics, chemistry, materials science, and mechanics of nanostructures; the development of new experimental tools to characterize and measure nanostructures and phenomena;

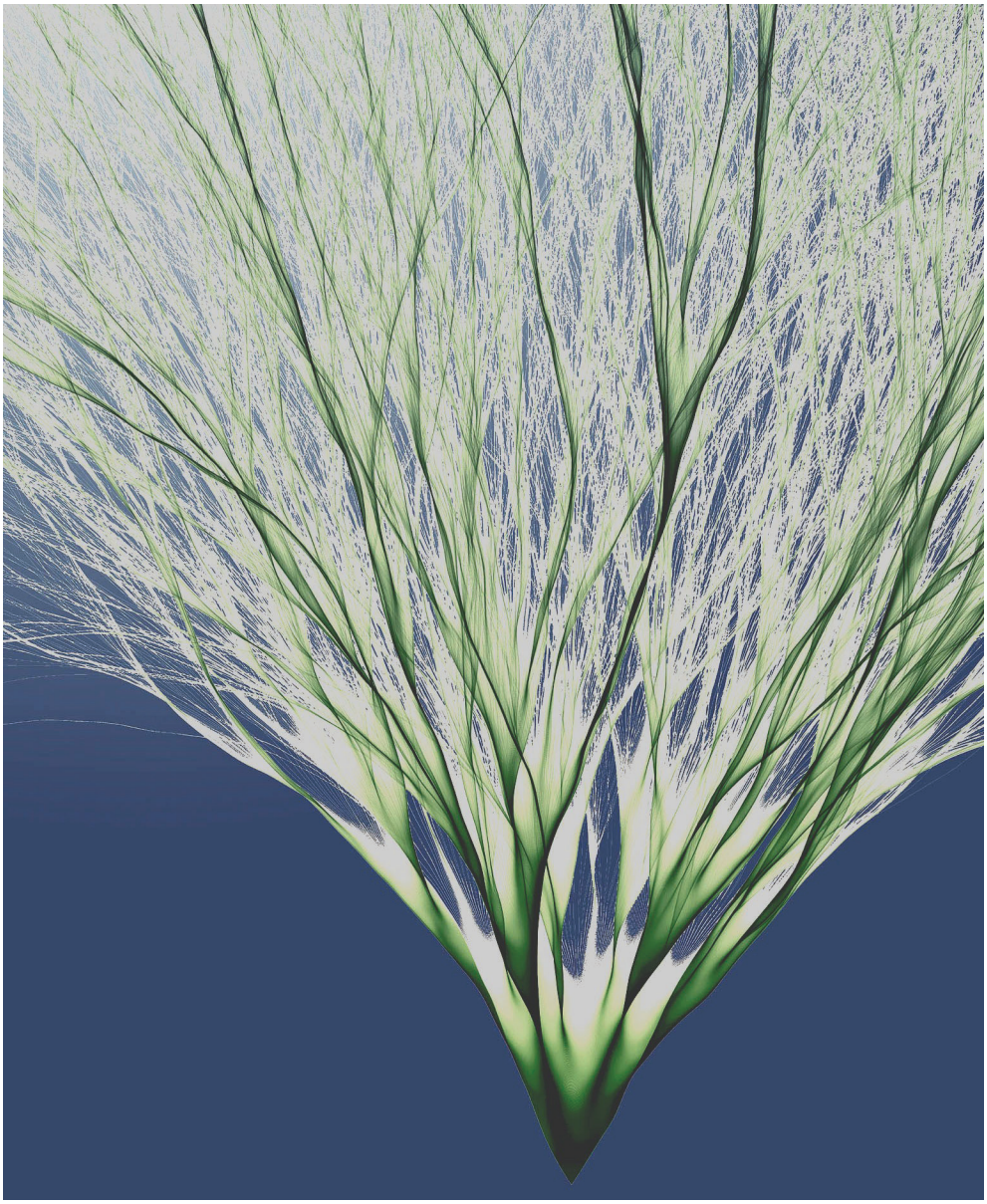

Figure 3a. Theoretical simulations of electron flow in nanostructures: Two-dimensional flow of electrons injected at the bottom of the image. (courtesy E.J. Heller, Harvard University).

novel synthesis or fabrication techniques; and the development of new mathematical and simulation tools to aid our understanding of nanoscale phenomena.

Research Example: Imaging Coherent Electron Flow in Nanostructures (supported by NSF)

As electronic devices get smaller, electron-transport properties will play an increasingly important role in device operation and performance. At the nanometer scale, real surfaces have imperfections that affect electron flow patterns. A Harvard group is conducting systematic investigations on the flow of electrons in nanostructures (Figures 3a and 3b). This research will provide a foundation for the design of electronic circuits in future nanodevices.

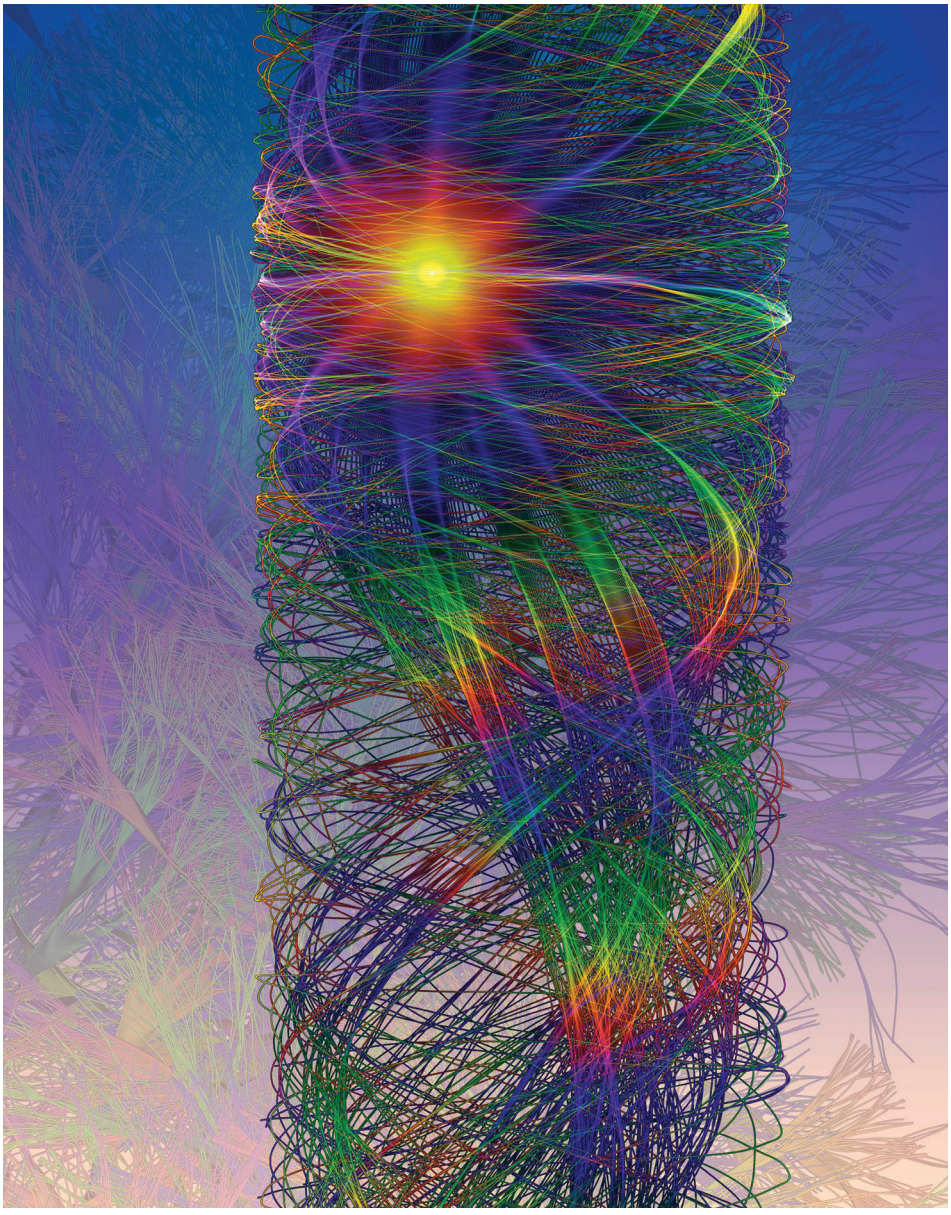

Figure 3b. Theoretical simulations of electron flow in nanostructures: Flow of electrons injected at the "bright spot" into a 500 nm diameter "nanowire." Electrons are scattered due to interactions at the wire surface. Variation in the quantum phase of the scattered electron waves is indicated by changes in color. The dynamics of such electron scattering affects the electronic properties of the wire, its resistance, the speed of response to external stimuli, and coherence of information flow along its length (courtesy E.J. Heller, Harvard University).