

703 Quantum transport in carbon nanotubes

Carbon nanotubes with multifunctional capabilities are prime candidates for quantum wires for use in a variety of novel electronic devices. Unlike conventional semiconductor nanowires, electrons confined to nanotubes have two angular momentum quantum numbers from spin and valley degrees of freedom. This review describes the energy levels associated with the interplay of each of these degrees of freedom and how the spin-orbit interaction affects electronic transport through single and multiple quantum dots created by external field gating. The emphasis on experimental evidence provides essential concepts which are placed into context with recent theoretical advances such as on electron-electron interactions in one dimension.

Edward A. Laird
Ferdinand Kuemmeth
Gary A. Steele
Kasper Grove-Rasmussen
Jesper Nygård
Karsten Flensberg
Leo P. Kouwenhoven

765 Attosecond chronoscopy of photoemission

Recent advances in ultrafast laser spectroscopy have made it possible to study the electron dynamics for physical and chemical processes at the atomic level in real time. This article reviews the concepts and techniques that are necessary to understand and interpret these experiments with the focus on time-resolved photoemission.

Renate Pazourek
Stefan Nagele
Joachim Burgdörfer

803 Anderson's considerations on the flow of superfluid helium: Some offshoots

The aim of this review, based on Anderson's ideas on phase slippage in superfluid helium, is to convey a physical meaning to the superfluid order parameter and its phase. This embraces an understanding of the superfluid order parameter phase and the associated processes that involve phase slip, the motion of vortices, critical velocities, Josephson effects, and phase slip associated with flow through small apertures. The review proceeds from a historical overview to a description of how the hydrodynamics of superfluid helium evolves from large to small scale, ultimately breaking down at close distance revealing the perplexingly elusive quantum properties of these fluids.

Eric Varoquaux

855 Antiferromagnetic order and spin dynamics in iron-based superconductors

In contrast to conventional BCS superconductors, the observation that superconductivity in unconventional high temperature materials appears in close proximity to a static antiferromagnetic phase suggests that magnetism plays a fundamental role in the microscopic origins of superconductivity. This review provides an overview of how elastic and inelastic neutron scattering is used to determine the magnetic structures and the doping evolution of spin excitations in iron-based superconductors. The interplay between magnetism and superconductivity is contrasted with related behavior in the copper oxide and heavy fermion superconductors and is important to future theoretical efforts.

Pengcheng Dai

- | | | |
|------|---|---|
| 897 | Density functional theory: Its origins, rise to prominence, and future | R. O. Jones |
| | Density functional theory has been spectacularly successful in physics, chemistry, and related fields, and it keeps finding new applications. This paper gives an overview of the history of the method and its many applications since it gained wide acceptance, as well as a discussion of its likely future. | |
| 925 | Epidemic processes in complex networks | Romualdo Pastor-Satorras
Claudio Castellano
Piet Van Mieghem
Alessandro Vespignani |
| | Complex networks arise in a wide range of biological and sociotechnical systems. Epidemic spreading is central to our understanding of dynamical processes in complex networks and is of interest to physicists, mathematicians, epidemiologists, and computer and social scientists. This review presents the main results and paradigmatic models in infectious disease modeling and generalized social contagion processes. | |
| 981 | Surface nanobubbles and nanodroplets | Detlef Lohse
Xuehua Zhang (张雪花) |
| | The existence of surface nanobubbles and nanodroplets is surprising, as classical estimates suggest they should dissolve in microseconds. The crucial insight is that pinning of their contact line accounts for their long lifetime. This review discusses how to make, observe, and understand nanobubbles and nanodroplets and also covers their potential technological relevance. | |
| 1037 | Random-matrix theory of Majorana fermions and topological superconductors | C. W. J. Beenakker |
| | Random-matrix theory has a long history of applications, from nuclear physics to electron localization to quantum dots. This review discusses yet another application of this very versatile framework: topological superconductors. An introduction to the basic concepts is followed by a discussion of transport properties that are susceptible to the predicted existence of Majorana excitations in these exotic materials. | |
| 1067 | Quantum Monte Carlo methods for nuclear physics | J. Carlson
S. Gandolfi
F. Pederiva
Steven C. Pieper
R. Schiavilla
K. E. Schmidt
R. B. Wiringa |
| | Quantum Monte Carlo techniques aim at providing a description of complex quantum systems such as nuclei and nucleonic matter from first principles, i.e., realistic nuclear interactions and currents. The methods are similar to those used for many-electron systems in quantum chemistry and condensed matter physics, but are extended to include spin-isospin, tensor, spin-orbit, and three-body interactions. This review shows how to build the atomic nucleus from the ground up. Examples include the structure of light nuclei, electroweak response of nuclei relevant in electron and neutrino scattering, and the properties of dense nucleonic matter. | |