

REVIEWS of MODERN PHYSICS

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2835 *Colloquium: An introduction to consistent quantum theory*

P. C. Hohenberg

Quantum mechanics is probably the most important theory of the last 100 years in the physical sciences. It has revolutionized the way we understand the Universe, and also the way we live. Its predictions have been confirmed by an enormous amount of experimental data, from particle physics to condensed matter, to chemistry. In this Colloquium a formulation and interpretation of quantum mechanics, the so-called consistent quantum theory, is discussed on the basis of simple examples. It is an excellent introduction for readers interested in the fundamental basis of quantum mechanics.

2845 *Random matrices and chaos in nuclear physics: Nuclear reactions*

G. E. Mitchell
A. Richter
H. A. Weidenmüller

The connection between nuclear reactions, random matrix theory, and chaotic dynamics dates back to Bohr's theory of the compound nucleus and the statistical description of nuclear resonances by Wigner. While this review focuses on the application of random matrix theory to nuclear reactions, the discussion is extended to a generic theory of quantum chaotic scattering that pertains to mesoscopic systems. Various tests of the theory are reviewed, with close attention given to violation of symmetries (isospin, parity, and time-reversal).

2903 *DNA electrophoresis in microfabricated devices*

Kevin D. Dorfman

The separation of DNA molecules by size is one of the essential tasks of molecular biology. The past decade has seen the emergence of DNA electrophoresis in microfabricated devices such as arrays of posts or entropic traps. These microfluidic devices are excellent tools for studying polymer dynamics in controlled and confined geometries. In this review, the physics of polymer transport in these devices is examined, with a focus on three fundamental problems: (i) collision of a polymer with an isolated post, (ii) polymer transport in an array of posts, and (iii) entropic trapping and filtration in the slit-well motif.

2949 *Hadron properties in the nuclear medium*

Ryugo S. Hayano
Tetsuo Hatsuda

Properties of hadrons, strongly interacting particles, are modified in nuclear medium. These modifications have possible relation with spontaneous breaking of chiral symmetry of quantum chromodynamics at finite baryon density and temperature. This review article discusses the experimental and theoretical status of the field.

- 2991 Nucleon and pion distribution functions in the valence region** Roy J. Holt
Craig D. Roberts
- The most stable hadrons, i.e., the proton, neutron, and pions, are all made of partons (quarks and gluons). Parton distribution functions describe the probability to find partons in a hadron. This review provides an experimental and theoretical perspective on the behavior of unpolarized distribution functions for the nucleon and pion in the valence-quark region.
- 3045 *Colloquium: Topological insulators*** M. Z. Hasan
C. L. Kane
- Topological insulators are exotic materials that are insulating in their bulk, have spin-polarized surface states with Dirac-like spectrum, and carry gapless nonchiral (or spin-polarized) currents at their edge. These unique physical properties are due to the interplay between the lattice structure and spin-orbit coupling. The materials, which even share some properties of the quantum Hall effect and graphene, have thus attracted much attention. This Colloquium provides a unified experimental and theoretical characterization of topological insulators and the exciting new venues of research that they are opening up are provided.
- 3069 Black-hole binaries, gravitational waves, and numerical relativity** Joan Centrella
John G. Baker
Bernard J. Kelly
James R. van Meter
- This article reviews recent breakthroughs in numerical studies of general relativity, especially simulating the infall of binary black holes and the gravitational waves that are generated. This progress is essential for the construction of templates that can be used in the analysis of signals in gravitational wave detectors. Since the detectors are close to achieving the requisite sensitivity, this article is especially timely.
- 3121 The Galactic Center massive black hole and nuclear star cluster** Reinhard Genzel
Frank Eisenhauer
Stefan Gillessen
- The center of our Milky Way can be assessed by observations with exquisite resolution and sensitivity covering 18 orders of magnitude in energy of electromagnetic radiation. The orbits of more than two dozen stars and the measurements of the size and motion of the central compact radio source, Sgr A^{*}, demonstrate the presence or existence, of a massive black hole of about 4 million solar masses. This review summarizes the recent progress in observational and theoretical work on the central parsec, emphasizing the empirical evidence for a central massive black hole and the processes in the surrounding dense nuclear star cluster, including the apparent recent star formation.
- 3197 Publisher's Note: Jammed hard-particle packings: From Kepler to Bernal and beyond [Rev. Mod. Phys. 82, 2633 (2010)]** S. Torquato
F. H. Stillinger
- 3199 Publisher's Note: Nobel Lecture: Spontaneous symmetry breaking in particle physics: A case of cross fertilization [Rev. Mod. Phys. 81, 1015 (2009)]** Yoichiro Nambu

Forthcoming articles