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Article guidelines

Colloquium guidelines

1 **Instability, turbulence, and enhanced transport in accretion disks** — Steven A. Balbus, John F. Hawley

Accretion disks are ubiguitous in astrophysics as part of the gravitational consolidation of mass. Dramatic recent progress in their understanding has come about from the realization that turbulent transport is dominated by magnetic fields rather than hydrodynamic processes. This article reviews the theory of accretion disks emphasizing the new role of magnetohydrodynamics.

55 **Theoretical methods for the relativistic atomic many-body problem** — J. Sapirstein

The subject of atomic spectra has been revitalized by the needs of subatomic physics and is an ideal theoretical laboratory for the study of the many-body problem with a well-understood Hamiltonian. This article surveys the state of atomic theory, focusing on the high-accuracy calculation of observables for single atoms, using many-body perturbation theory.

77 **Quantum tunneling in nuclear fusion** — A. B. Balantekin, N. Takigawa

The fusion of two nuclei at very low energies—at energies below the Coulomb barrier—is a particularly interesting example of quantum tunneling in systems with many degrees of freedom. The authors of the present article review the theoretical developments of the last decade that have enhanced our understanding of multidimensional quantum tunneling and the nature of subbarrier fusion.

101 **The quantum-jump approach to dissipative dynamics in quantum optics**
M. B. Plenio
P. L. Knight

The ability to monitor the quantum state of individual atoms gives a new window into quantum dissipation processes as well as offering a promise for higher precision in atomic clocks. The theoretical description of these measurements is best carried out using wave functions rather than density matrices. This article discusses these descriptions, which go under the names of Quantum Jump, Monte Carlo wave function, and Quantum Trajectory methods, and compares them with the density-matrix approach. Applications are given to problems in quantum optics.

145 **Nonlinear optics of semiconductor and molecular nanostrucutres; a common perspective**
V. M. Axt
S. Mukamel

The nonlinear excitation of molecules and condensed media by radiation is a difficult problem of physics and chemistry. This article presents a formalism, expanding in the number of particle-hole pairs, the connects to other approaches, including the Frenkel exciton model and the semiconductor Bloch equations.

175 **Application of superconducting quantum interference devices to nuclear magnetic resonance**
Ya. S. Greenberg

Superconducting quantum interference devices offer a measurement tool for nuclear magnetic resonance that is sensitive in low magnetic fields, unlike conventional methods. This article presents a basic introduction to the methods, reviewing the basic limitations and the applications that have been made to date. Particularly noteworthy are the spectroscopic studies that can be made using the longitudinal magnetization.

223 **Stochastic resonance**
Luca Gammaitoni
Peter Hänggi
Peter Jung
Fabio Marchesoni

Stochastic resonace deals with the amplification of weak signals in nonlinear systems via noise. The phenomenon is widespread and has been observed experimentally in a wide variety of systems, of interest to physicists, chemists, and biologists alike. The authors review the present status of experimental evidence and the corresponding theoretical understanding of stochastic resonance, and they outline future areas of research in both theory and experiment.

RMP Colloquia:

289 **Natural patterns and wavelets**
C. Bowman
A. C. Newell

Similar patterns occur in nature in widely different physical contexts. This introduction to the study of patterns illustrates how one looks for common symmetries, general principles of formation, and connections between experimental data and the macroscopic order parameters defined by theory. The subject of pattern formation is multidisciplinary and holds promise for the study of complex systems as well as for numerous technological applications.

303 **Big-bang nucleosynthesis enters the precision era** — David N. Schramm, Michael S. Turner

Measurements of the primeval deuterium abundance hold the promise of determining the cosmic density of baryons to high precision (10% or better). The theory of big-bang nucleosynthesis (BBN) will then achieve its full promise as the link between cosmology and nuclear and particle physics, with applications as well to stellar and Galactic chemical evolution. This colloquium reviews the current status of BBN and surveys the manifold consequences of an accurate determination of the primeval deuterium abundance.

319 **Erratum: The extraordinary phases of liquid ^{3}He** [**Rev. Mod. Phys. 69, 645** (**1997**)] — David M. Lee

321 **Forthcoming articles**