Reviews of Modern Physics

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1253 **Nobel Lecture: Electronic structure of matter—wave functions and density functionals** W. Kohn

1267 **Nobel Lecture: Quantum chemical models** John A. Pople

The 1998 Nobel Prize in Chemistry was shared by Walter Kohn and John A. Pople. These papers are the texts of their addresses on the occasion of the award.

1275 **HERA collider physics** Halina Abramowicz, Allen C. Caldwell

The electron-proton collider HERA offers the unique possiblity of probing proton structure down to 10^{-16} cm and partons down to very small fractions of the proton momentum. This article is a comprehensive review of the results obtained by the H1 and ZEUS experiments at HERA. Of particular interest is a possible deviation from standard-model expectations at very high momentum transfer. The authors also discuss experiments that are planned for HERA after a forthcoming luminosity upgrade.

1411 **Light-meson spectroscopy** Stephen Godfrey, Jim Napolitano

Quantum chromodynamics predicts a rich spectrum of bound-state hadrons, which includes ordinary quark-antiquark mesons as well as more exotic glueballs and multiquark excitations. This article reviews the status of light-quark spectroscopy, comparing the constituent-quark model with experimental findings. The model works surprisingly well, but puzzles and gaps remain. The character of the observed scalar mesons is still uncertain, and there are many predicted states above 1.5 GeV that future experiments might identify.

1463 **Electroweak baryogenesis** Mark Trodden

The asymmetry between baryonic matter and antimatter in our universe is an outstanding problem of big-bang cosmology. This article outlines the problem and the necessary elementary-particle physics ingredients for its solution. It describes some electroweak phase-transition scenarios for producing the baryon asymmetry and discusses what new physics is required for their realization.

1501 **Suppression of bremsstrahlung and pair production due to environmental factors**

Spencer Klein

At very high energies, bremsstrahlung and pair creation can be suppressed by multiple scattering (the Landau-Pomeranchuk-Migdal effect) and other processes. Recent accurate measurements of bremsstrahlung have inspired several improved calculations of these effects. This article surveys these recent developments and discusses connections with related problems, such as the energy loss of quarks and gluons in dense media.

1539 **The spatial behavior of nonclassical light**

Mikhail I. Kolobov

Modern optics deals with nonclassical photon statistics in the time domain and transverse nonlinear phenomena in the optical dimension. This article presents the theoretical framework for treating these two complementary aspects together. This allows one to analyze the statistics of photons collected in small areas of a beam, with applications to optical imaging, amplification of faint images, and optical parallel processing of information.

1591 **Nonlinear optics of normal-mode-coupling semiconductor microcavities**

G. Khitrova
H. M. Gibbs
F. Jahnke
M. Kira
S. W. Koch

The interaction of light with quantum wells in microcavities is a topic of considerable interest, both theoretical and practical. The cavity transmission may be strongly affected by the coupling of the single cavity mode to exciton absorption in the quantum well, a property useful for solid-state information processing. This article presents the theory for the light-semiconductor interactions and reviews recent experiments with these devices. The comparison with the theory points to the challenging problems that still have to be solved to observe genuine quantum effects with solid-state microcavity systems.

1641 **Studying conduction-electron/interface interactions using transverse electron focusing**

V. S. Tsoi
J. Bass
P. Wyder

The decreasing size and the multilayer structure of modern electronic devices imply the increasing importance of the scattering of electrons at surfaces and interfaces. In this review the authors describe the method of transverse electron focusing used to investigate the interactions of conduction electrons with interfaces, from the inside of the conductor. Applications include the study of smoothness of metallic and other conductor interfaces, the study of surface states, and the observation of Andreev reflection from superconductors.

1695 **Growth of nanostructures by cluster deposition: Experiments and simple models**

Pablo Jensen

The quest to shrink the size of devices has stimulated research on growing tailored structures in the nanometer size range. Cluster deposition offers one way to grow such nanostructures. This review

describes the physical processes in this method and discusses how they can be modeled by computer simulation.

RMP COLLOQUIA

1737 History of the search for continuous melting — J. G. Dash

Our understanding of the melting of crystals has been significantly advanced by two-dimensional theoretical model calculations and experiments on thin films, both of which have elucidated the crucial role of surface effects.

1745 Molecular chirality and chiral parameters — A. B. Harris, Randall D. Kamien, T. C. Lubensky

The chiral nature of many molecules is an essential and ubiquitous feature of important biological processes. While a given molecule is either chiral or not, quantifying the extent of any chirality is a difficult problem. In this Colloquium, the nature of chiral symmetry is explored and ways of quantifying features stemming from chirality are identified.

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