Reviews of Modern Physics

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Author guidelines

1 **Gauge theory: historical origins and some modern developments**

Lochlainn O'Raifeartaigh
Norbert Straumann

Gauge theories provide an elegant description of the fundamental interactions found in nature. Their intellectual development has a fascinating history. This paper highlights some of the major advances. Starting with Einstein's general relativity, it describes scientific and mathematical breakthroughs that eventually led to Yang-Mills theory and the emergence of the standard model. Some recent ideas beyond the gauge theory concept are also briefly described.

25 **Dynamical supersymmetry breaking**

Yael Shadmi
Yuri Shirman

There are good reasons to believe that, at very short distances, the laws of Nature exhibit a symmetry between fermions and bosons, called supersymmetry. On the other hand, the spectrum of elementary particles is not supersymmetric, so it is of great importance to enumerate those theories in which supersymmetry is broken by some underlying dynamics. The last few years have witnessed great progress in the understanding of dynamical supersymmetry breaking in quantum field theory. This article reviews these developments.

65 **Theory of the *CP*-violating parameter ε'/ε**

Stefano Bertolini
Marco Fabbrichesi
Jan O. Eeg

Direct *CP* violation in kaon decays is parametrized by ε'/ε. Recent experiments indicate a nonvanishing value for that important parameter. To test the standard model and probe for new sources of *CP* violation, an accurate theoretical prediction for ε'/ε is also required. This review describes several different theoretical approaches to computing that quantity. It discusses the general framework of such calculations and outlines the difficulties faced in obtaining a reliable prediction.

95 **Final-focus systems in linear colliders**
T. O. Raubenheimer
F. Zimmermann

Linear colliders are expected to be the next-generation electron-positron accelerators at the energy frontier. Their final-focus system plays a crucial role in demagnification of the beams to very small sizes at the intersection points to achieve the high luminosities. The authors analyze limitations that must be considered in final-focus design and discuss advanced ideas for overcoming some of these limitations.

109 **Suppression of turbulence and transport by sheared flow**
P. W. Terry

The suppression of turbulence by a shear in the flow is an established plasma phenomenon also occurring in neutral fluids—from fusion plasmas to the atmosphere. The reduction of turbulent transport fusion plasmas has been remarkable. The author reviews the turbulence theory underlying the phenomena, as well as experimental results.

167 **The physics of fast *Z* pinches**
D. D. Ryutov
M. S. Derzon
M. K. Matzen

Recently, implosions of annular current sheaths (*Z* pinches) have produced very high energy densities—opening new possibilities for research in x-ray generation, controlled fusion, and astrophysics. The plasma physics, hydrodynamics, and applications of *Z* pinches are reviewed by the authors.

225 **Dipolar effects in magnetic thin films and quasi-two-dimensional systems**
K. De'Bell
A. B. MacIsaac
J. P. Whitehead

A wide range of magnetic ordering phenomena are observed in thin films and quasi-two-dimensional systems. The general features are illustrated in this review by two systems of particular interest, metal films of a few atomic layers on nonmagnetic surfaces and layered media similar to high-temperature superconductor materials. The review also presents the theoretical understanding of the ordering patterns in terms of the competition between short-range exchange and long-range dipolar interactions.

259 **Heteropolymer freezing and design: Towards physical models of protein folding**
Vijay S. Pande
Alexander Yu. Grosberg
Toyoichi Tanaka

Understanding protein folding is one of the outstanding challenges to contemporary molecular biophysics. Insights into this problem may be gained from a number of different approaches: from molecular biology, from polymer physics, and from the theory of disordered systems. Many aspects of protein behavior can be captured by a model in which the protein is considered to be a polymer made up of a disordered sequence of monomers. This review describes what has been learned about properties of heteropolymers from analytical studies and numerical simulations.

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315 **Pulsed laser vaporization and deposition** — P. R. Willmott, J. R. Huber

The ability to control film deposition of novel high-purity materials on substrates is essential for advances in optoelectronics, nanotechnology, and semiconductor technology, among others. This article provides an overview of the issues involved with the deposition of materials by pulsed laser ablation. In particular, crossing laser ablation plumes with pulsed gas jets, gives an additional control that might produce better deposited films.

329 **Erratum: Application of superconducting quantum interference devices to nuclear magnetic resonance** [**Rev. Mod. Phys. 70, 175** (**1998**)] — Ya. S. Greenberg

331 **Forthcoming articles**