Reviews of Modern Physics

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463 **Theory of Bose-Einstein condensation in trapped gases**

Franco Dalfovo
Stefano Giorgini
Lev P. Pitaevskii
Sandro Stringari

The experimental realization of Bose-Einstein condensation in trapped clouds of alkali-metal atoms has provided a new quantum fluid alongside familiar ones like the helium liquids, superconductors, and atomic nuclei. This article surveys the theoretical understanding of these systems which has developed since the condensates were first observed in 1995. Since the condensates are dilute, the theory of weakly interacting bosons provides a comprehensive and accurate description of most phenomena. In addition new physical effects not present in bulk matter arise because these gases are very inhomogenous.

513 **Top-quark condensation**

G. Cvetič

The origin of masses and electroweak symmetry breaking is a fundamental problem in the standard theory of particle physics. This review explores top-quark condensation as an alternative to the usual Higgs mechanism to explain these features of the theory. It introduces the basic ideas and problems of top-quark condensation and discusses in detail computational methods such as the renormalization group and extensions of the models.

575 **Precision tests of the electroweak interaction at the *Z* pole**

M. Martinez
R. Miquel
L. Rolandi
R. Tenchini

The properties of the Z boson, measured at e^+e^- colliders, provide an unprecedented test of the standard model of electroweak interactions. This review discusses the empirical properties of the Z as well as the implications for theory. The precision of the measurements is now high enough to test higher-order electroweak theory, as well as to give an interesting constraint on the mass of the Higgs boson.

631 **High-transition-temperature superconducting quantum interference devices**

D. Koelle
R. Kleiner
F. Ludwig
E. Dantsker
John Clarke

An important application of high-T_c superconductivity is in SQUIDs for magnetic-field measurements. Noise considerations are important and are the focus of this review. Models are described for the white noise in both dc and rf SQUIDs. The issue of 1/f noise is reviewed, and methods used to ameliorate it are described. Several applications of high-T_c SQUIDs are outlined.

687 **The electrodynamic response of heavy-electron compounds**

L. Degiorgi

Heavy electrons are conduction electrons in metals and alloys that have acquired, by strong interactions, extremely large effective masses. This review deals with the optical properties of heavy-electron materials and their relation to the often anomalous electronic excitation spectra of these systems. Some of the data may be interpreted as non-Fermi-liquid behavior or as an effect of a metal-insulator transition.

735 **Drift waves and transport**

W. Horton

Drift waves are the waves spontaneously generated in nonuniformly magnetized plasmas. They are ubiquitous in real, finite plasmas and are responsible for the transport of particles and energy across magnetic-field lines. The review presents the current status of this vast subject.

779 **Structure and phase transitions in Langmuir monolayers**

Vladimir M. Kaganer
Helmuth Möhwald
Pulak Dutta

In the last decade there has been dramatic evolution in our understanding of the structures and phase transitions of lipid monolayers on the surface of water, due largely to advances in x-ray diffraction experiments. The layers exhibit complex phase diagrams, many features of which can be described compactly in terms of a phenomenological free-energy function containing a limited number of order parameters.

RMP Colloquia:

821 **Adventures of a Rydberg electron in an anisotropic world** — William Clark, Chris H. Greene

While polarization effects of an orbiting electron on an ionic core have long been known and understood, only recently have orientation-dependent interactions of electrons in Rydberg orbits been predicted and observed. Such subtle effects can now be studied experimentally owing to the great sensitivity of Rydberg-state spectroscopy. This colloquium discusses recent developments and provides a qualitative physical interpretation.

835 **Chaotic motion in the solar system** — Jack J. Lissauer

The Newtonian description of the planets moving about the Sun seemingly implies that their motions are completely determined. However, as discussed in this colloquium, such determinism does not apply to smaller-mass objects in the Solar System nor even to the planets themselves over long time scales owing to the possibility of chaotic behavior. Such behavior has profound implications for the formation of planetary systems.

847 **Dynamic transitions and hysteresis** — Bikas K. Chakrabarti, Muktish Acharyya

The authors describe recent advances in understanding the response of a coupled, many-body system, such as a magnet, to a time-dependent external perturbation, such as an oscillatory magnetic field. The response may be described by a hysteresis loop, whose shape depends sensitively on both the relaxation time of the system and the time dependence of the external perturbation. The responses to time-dependent perturbations are generally quite different from the well-known responses of such systems to adiabatically varying perturbations and have important technological applications.

861 **Forthcoming articles**