REVIEWS of MODERN PHYSICS

Volume 78 **Number 4** **October–December 2006**

1043 **The physics of hadronic tau decays**

Michel Davier
Andreas Höcker
Zhiqing Zhang

The decays of the tau lepton are an excellent testing ground for high precision QCD. Many observables can be computed accurately and compared with experiment to test the theory, and to determine fundamental parameters such as the strong coupling constant, quark masses, and mixing angles. This article reviews the current status of both the experimental results and theoretical predictions, and discusses their implications.

1111 ***Colloquium*: Weakly interacting, dilute Bose gases in 2D**

Anna Posazhennikova

The spontaneous transformation to long-range ordering of a cooled dilute weakly interacting gas of bosons (Bose-Einstein condensation) can occur in two dimensions only with the aid of an inhomogeneous trapping potential. This article reviews some basic Bose-Einstein condensation physics and various current theoretical approaches that are able to explain experimental observations of such condensation, pointing out both successes and controversial questions requiring further work.

1135 **Supercontinuum generation in photonic crystal fiber**

John M. Dudley
Goëry Genty
Stéphane Coen

The discovery in the late 1990s that photonic crystal fibers could dramatically enhance supercontinuum generation—the generation by nonlinear processes in glass of a broadband spectrum that can approach white light—has led to revolutionary advances in optical frequency metrology, optical coherence tomography, spectroscopy, and numerous other applications. However, the underlying processes that lead to the spectral broadening are complex and have not been clearly understood. This article presents a unified discussion of the various nonlinear supercontinuum spectral broadening processes. The review is illustrated by numerical simulations that illustrate the supercontinuum generation characteristics for conditions covering the typical experimental parameter range. The discussion encompasses picosecond, nanosecond, and also continuous wave fields, with particular attention given to the femtosecond regime.

1185 **Electrostatic modification of novel materials**

C. H. Ahn
A. Bhattacharya
M. Di Ventra
J. N. Eckstein
C. Daniel Frisbie
M. E. Gershenson
A. M. Goldman
I. H. Inoue
J. Mannhart
Andrew J. Millis
Alberto F. Morpurgo
Douglas Natelson
Jean-Marc Triscone

The classic example of electrostatic modification of material properties is the silicon-based field-effect transistor, in which the external field of a gate electrode controls the conductivity of the substrate. In recent years there has been much effort devoted to making and observing field-effect behavior in new materials, such as correlated oxide films, organic films, single-molecule devices, and ferromagnetic materials. This article reviews the progress on different materials, drawing attention to the challenges for future research.

1213 **Dynamical principles in neuroscience**

Mikhail I. Rabinovich
Pablo Varona
Allen I. Selverston
Henry D. I. Abarbanel

One of the more challenging problems in nonlinear science is the goal of understanding the properties of neuronal circuits. This review covers the dynamical description of individual neurons, advances in understanding the emergent properties of circuits containing them, aspects of information transmission and processing, and the generation of spatiotemporal patterns related to learning and behavior.

1267 **Nobel Lecture: One hundred years of light quanta**

Roy J. Glauber

1279 **Nobel Lecture: Defining and measuring optical frequencies**

John L. Hall

1297 **Nobel Lecture: Passion for precision**

Theodor W. Hänsch

The 2005 Nobel Prize for Physics was shared by Roy J. Glauber, John L. Hall, and Theodor W. Hänsch. These papers are the text of the addresses given in conjunction with the award.

1311 **Production of cold molecules via magnetically tunable Feshbach resonances**

Thorsten Köhler
Krzysztof Góral
Paul S. Julienne

In recent years ultracold atomic gases have entered completely novel regimes, where the interactions between atoms can be varied at will. This has led to the generation of cold molecules under very controlled conditions. This review contains a thorough theoretical description of the key ingredient of all those experiments: the ability to use magnetic fields to manipulate the collisional properties of atoms.

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