

REVIEWS of MODERN PHYSICS

Volume 89

Number 4

October–December 2017

040501 **Nobel Lecture: Topological defects and phase transitions** John Michael Kosterlitz

040502 **Nobel Lecture: Topological quantum matter** F. Duncan M. Haldane

The 2016 Nobel Prize for Physics was shared by David J. Thouless, F. Duncan M. Haldane, and John Michael Kosterlitz. These papers are the text of the address given in conjunction with the award.

041001 ***Colloquium: Strong optical forces on atoms in multifrequency light*** Harold Metcalf

One of the fundamental processes in physics is the interaction of matter with light. One learns early in quantum mechanics how electrons in a hydrogen atom absorb light with well-defined energy or frequency and make transitions between different quantized energy levels. However, the physical behavior is rather different when an atom interacts with multiple light beams with different frequencies because the optical forces change tremendously. This Colloquium discusses this and its consequences in atom cooling.

041002 ***Colloquium: Astromaterial science and nuclear pasta*** M. E. Caplan
C. J. Horowitz

What is the nature of matter in the interior of cold white dwarfs and in the crust of neutron stars? To shed light on this question, theoretical simulations have been carried out to describe intricate phases of nucleonic matter, such as “pasta” structures in terms of competition between nuclear attraction and electrostatic repulsion. This Colloquium reviews current theoretical developments in astromaterial science relevant to multimessenger astronomical observations.

041003 ***Colloquium: Quantum coherence as a resource*** Alexander Streltsov
Gerardo Adesso
Martin B. Plenio

The dictum that “information is physical” indicates that we should understand how features of quantum physics, in particular, the phenomenon of quantum coherence, can be understood to be, and quantified as, a resource for the processing of information. This Colloquium discusses how to characterize, quantify, and manipulate quantum coherence in application areas ranging from many-body and solid state physics to biological and nanoscale systems.

041004 ***Colloquium: Zoo of quantum-topological phases of matter*** Xiao-Gang Wen

The subject of this Colloquium is related to the topic of the 2016 Physics Nobel Prize that was awarded to David J. Thouless, F. Duncan M. Haldane, and J. Michael Kosterlitz “for theoretical discoveries of topological phase transitions and topological phases of matter.” This Colloquium provides a pedagogical introduction to topological phases of matter from a comprehensive point of view of many-body entanglement which is important in quantum physics.

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| 045001 | Coupling functions: Universal insights into dynamical interaction mechanisms | Tomislav Stankovski
Tiago Pereira
Peter V. E. McClintock
Aneta Stefanovska |
| | Dynamical systems in science with examples ranging from physics, chemistry, and biology up to population dynamics, communication, and climate are rarely isolated but generally interact with each other. One particular way of characterizing the interactions is to use coupling functions which possess the property of enabling one not only to understand but also to control and predict the underlying interaction dynamics. This article demonstrates the usefulness of coupling functions for studying the interaction mechanisms of dynamical systems in different research fields. | |
| 045002 | Nucleon-nucleon correlations, short-lived excitations, and the quarks within | Or Hen
Gerald A. Miller
Eli Piasetzky
Lawrence B. Weinstein |
| | What happens to nucleon-nucleon interactions at very short distances, below the radius of the proton? Does the structure of a nucleon bound in a nucleus differ from that of a free nucleon? The answer to both questions can be provided in terms of the internal quark structure of a nucleon. This article reviews current experimental and theoretical developments providing the high-resolution picture of correlated nucleonic pairs at a short-distance scale. | |
| 045003 | Hybrid photonic-crystal fiber | Christos Markos
John C. Travers
Amir Abdolvand
Benjamin J. Eggleton
Ole Bang |
| | Optical fibers provide much more than a means to transport light between different locations. This article reviews how integration of functional fluid, solid, and gaseous materials in photonic-crystal fibers enables control of their linear and nonlinear properties with applications in optoelectronics, sensing, and laser-matter interactions. | |
| 045004 | Optically polarized ^3He | T. R. Gentile
P. J. Nacher
B. Saam
T. G. Walker |
| | This article reviews advances in the theory and practice of producing polarized ^3He by spin-exchange and metastability-exchange optical pumping. The advances have enhanced applications to charged particle and photon scattering targets, neutron spin filters, magnetic resonance imaging, and precision measurements. | |
| 045005 | Nodal portraits of quantum billiards: Domains, lines, and statistics | Sudhir Ranjan Jain
Rhine Samajdar |
| | The 200-year old studies by Chladni, of the sand figures of vibrating plates, live on today in the investigation of the wave mechanics of nonintegrable systems. This review gives an in-depth survey of the contemporary mathematical analysis of the wave function statistics of the billiard problem, uncovering the manifestations of classical chaos in the wave mechanical world. The extensive experiments of recent years are surveyed. The illustrations show the continuing Chladnian splendor of the current-day subject. | |
| 049901 | Erratum: Hidden variables and the two theorems of John Bell [Rev. Mod. Phys. 65, 803 (1993)] | N. David Mermin |