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010001 **Editorial: The Role of *Colloquia* in *Reviews of Modern Physics***
Dietrich Belitz
Randall D. Kamien

011001 ***Colloquium*: Physical properties of group-IV monochalcogenide monolayers**
Salvador Barraza-Lopez
Benjamin M. Fregoso
John W. Villanova
Stuart S. P. Parkin
Kai Chang

Monolayers of group-IV monochalcogenides, such as GeS, GeSe, SnS, SnSe, and SnTe, display interesting properties such as ferroelectricity, ferroelasticity, and unusual spin textures. This makes these materials interesting from both fundamental and applied perspectives. This Colloquium explains recent progress in the experimental characterization and theoretical understanding as well as their potential for device applications.

015001 **Probing the interior physics of stars through asteroseismology**
C. Aerts

By studying the oscillations of a star's surface, it is possible to extract information about stellar strata, age, and dynamics. Though one might guess that observation of surface oscillatory motions would be limited to our Sun, high-precision brightness measurements of distant stars, performed over many years, have enabled the field of asteroseismology. This comprehensive review covers the recent development of this field, the necessary blending of numerical simulation and data, and the way in which this new information enhances our understanding of stellar evolution.

015002 **Origin of the heaviest elements: The rapid neutron-capture process**
John J. Cowan
Christopher Sneden
James E. Lawler
Ani Aprahamian
Michael Wiescher
Karlheinz Langanke
Gabriel Martínez-Pinedo
Friedrich-Karl Thielemann

The rapid neutron-capture process plays a major role in the production of heavy elements from Fe to U. This review surveys the history and current understanding of *r*-process nucleosynthesis, covering new data from atomic and nuclear physics, astrophysical modeling of *r*-process sites, astronomical observations of stellar abundances, and galactic chemical evolution. It includes a timely and thorough discussion of plausible *r*-process astrophysical environments, following the first multimessenger observation of a binary neutron-star merger.

015003 **Novel Probes Project: Tests of gravity on astrophysical scales**
Tessa Baker
Alexandre Barreira
Harry Desmond
Pedro Ferreira
Bhuvnesh Jain
Kazuya Koyama
Baojiu Li
Lucas Lombriser
Andrina Nicola
Jeremy Sakstein
Fabian Schmidt

Modern instruments and observational programs in astrophysics and cosmology have opened new perspectives for probing general relativity on previously unexplored scales. This review provides both a methodological and an observational survey of the constraints on modified-gravity models using astrophysical objects in the cosmological, weak-field regime. It is embedded in the framework of the Novel Probes Project, a forum connecting observers and theorists involved in the study of astrophysical tests of dark sector interactions.

015004 **Invisible axion search methods**

Pierre Sikivie

Originally hypothesized to explain the absence of *CP* violation in the strong interactions, the axion has emerged as a candidate constituent of dark matter. This review guides the reader through the search methods for the QCD axion as well as for new kinds of particles with axionlike properties. For each case, the physics of the method, the signatures, and the background are discussed in depth. A must-have addition to the quiver of axion hunters.

015005 **Exceptional topology of non-Hermitian systems**

Emil J. Bergholtz
Jan Carl Budich
Flore K. Kunst

Quantum systems that are coupled to an external bath can often be described in terms of a non-Hermitian effective Hamiltonian. In isolated systems with Hermitian Hamiltonians, topological aspects of the band structure, and resulting topological phases, have been of interest. The combination of the two concepts, i.e., topological properties of open systems, leads to qualitatively new effects. This review provides an introduction to these quantum mechanical concepts and their classical analogs, and discusses a number of applications ranging from mechanical metamaterials to dissipative cold-atom systems.

015006 **Modern and future colliders**

V. Shiltsev
F. Zimmermann

Particle accelerators have been engines of discovery for many decades. The most powerful ones are used in particle physics where intense particle beams collide to study new particles. This has led to groundbreaking discoveries in our understanding of matter and forces. In this article the key concepts behind the development of such colliders are reviewed and a historical perspective is provided of the evolution of these machines. Approaches for next-generation colliders are presented and technology developments for far-future colliders that will have the further benefit of enabling new applications in the use of accelerators for science and society are discussed.

015007 **Lepton flavor symmetries**

Ferruccio Feruglio
Andrea Romanino

Quarks and leptons, which have the same electroweak interactions, markedly differ in their masses and mixing patterns. Neutrino masses are very small while quark masses are large and the lepton mixing matrix contains two large angles while quark mixings are small. Concentrating on the lepton sector, this review presents the flavor puzzles with effective field theories. Beyond standard model theories are discussed that contain organizing principles designed to provide natural explanations of neutrino masses and mixings.

015008 **Simulation methods for open quantum many-body systems**

Hendrik Weimer
Augustine Kshetrimayum
Román Orús

This article reviews theoretical methods to deal with interacting quantum particles that are in contact with their environment and are thus described by a master equation rather than a Schrödinger equation. The similarities and differences are discussed between the pursuit of pure many-body ground states and mixed steady states by different methods, and an outlook is provided on the advances toward simulation of large open many-body system.