

REVIEWS of MODERN PHYSICS

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1 *Colloquium:* Comparison of astrophysical and terrestrial frequency standards

John G. Hartnett
Andre N. Luiten

The comparison between terrestrial and astrophysical time standards is discussed in terms of their accuracy and stability. This is an interdisciplinary field of research that covers topics from atomic physics to astrophysics and is at the heart of modern technology.

11 *Data tables for Lorentz and CPT violation*

V. Alan Kostelecký
Neil Russell

There have been many precise experimental searches for Lorentz and *CPT* violation in such diverse fields as atomic, molecular, and optical physics, gravitational physics, particle physics, astrophysics, and cosmology. This review summarizes the experimental results and interprets them in a model-independent way using an effective operator expansion known as the standard-model extension.

33 *Quantum repeaters based on atomic ensembles and linear optics*

Nicolas Sangouard
Christoph Simon
Hugues de Riedmatten
Nicolas Gisin

Quantum mechanics offers secure and efficient ways of communication. The basic obstacle to the development of quantum communication systems is the absorption of photons, the carriers of the information. This limits current experimental setups to distances of the order of a few hundred kilometers. Quantum repeaters constitute the best way to circumvent such a problem. This paper shows how those devices operate, as well as how they are currently being built with the help of atomic systems.

81 *Intermittent search strategies*

O. Bénichou
C. Loverdo
M. Moreau
R. Voituriez

At the macroscopic scale, many foraging animals search for food by moving slowly and scanning an area intently, and then moving rapidly to a new area for a new slow scan. At the microscopic scale, vesicles inside cells sometimes move diffusively, and sometimes move ballistically along rigid biopolymers. DNA binding proteins also have periods of slow diffusion motion and fast motion along the DNA. These disparate processes can be described using the mathematics of intermittent search strategies. In this review, the theoretical framework for such search strategies is described, paying particular question to their efficiency.

131 *Colloquium:* Heat flow and thermoelectricity in atomic and molecular junctions

Yonatan Dubi
Massimiliano Di Ventra

The physical behavior of many-particle systems depends strongly on their dimensionality and scale. With the advent of nanoscience, researchers had to revisit many of the problems of bulk materials at this new scale and have found several interesting surprises. In this Colloquium, the particular problem of heat flow in nanoscopic materials is discussed from the theoretical and experimental perspective. This work is of importance for anyone interested in nanoscience and technology.

- 157 The s process: Nuclear physics, stellar models, and observations** F. Käppeler
R. Gallino
S. Bisterzo
Wako Aoki
- About half of all heavy elements between Cu and Bi are produced in the slow-neutron-capture process. Its functioning depends on nuclear physics, stellar models, including their mass, and initial fraction of heavy elements due to previous stellar generations. The abundances resulting from neutron capture in He-burning layers of low mass stars and He- and C-burning layers of massive stars are confronted with the growing body of detailed observations, posing exciting challenges and constraints for stellar model calculations. The review addresses all these problems in detail.
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- 195 Solar fusion cross sections. II. The pp chain and CNO cycles** E. G. Adelberger *et al.*
- Generation of energy in the Sun (and other hydrogen-burning stars) and the production of solar neutrinos depend critically on nuclear fusion reactions and their respective cross sections. The latter and their understanding in terms of nuclear models are crucial to the so-called standard solar model and the neutrino fluxes it predicts. The present review summarizes the experimental and theoretical progress made within the last decade in the laboratory and theoretical nuclear astrophysics relevant to solar fusion cross sections in the pp chain and CNO cycles, enabling thereby more precise analyses of future solar neutrino experiments.
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- 247 Solitons in nonlinear lattices** Yaroslav V. Kartashov
Boris A. Malomed
Lluís Torner
- Solitons are self-supporting solutions of nonlinear wave equations, which maintain their shape during propagation. They appear in many branches of science, from applied mathematics and physics to chemistry and biology. This review presents recent theoretical progress on the existence and properties of solitons and soliton complexes in one- and two-dimensional nonlinear lattices, i.e., periodic media where the nonlinearity is spatially modulated. It also provides examples from various fields of physics, such as nonlinear optics and Bose-Einstein condensates.