# Reviews of Modern Physics

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**041001** ***Colloquium*: Quantum heat transport in condensed matter systems**

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As nanotechnology has led to smaller devices and thermal detectors have become more sensitive, the problem of heat transport in the quantum regime has become more important. Initially driven by theory, the field has expanded in recent years as experiments have become feasible to test these theories. As a result, controlling quantum heat currents and constructing heat engines and related devices on the nanoscale may soon become feasible. This Colloquium discusses these developments from both a fundamental and an applied point of view.

**041002** ***Colloquium:* Nonthermal pathways to ultrafast control in quantum materials**

Alberto de la Torre
Dante M. Kennes
Martin Claassen
Simon Gerber
James W. McIver
Michael A. Sentef

Ultrafast laser pulses can be used to drive materials into nonequilibrium states that have unusual properties and are promising for technological applications. Different classes of phenomena are observed during and after the optical illumination. This Colloquium discusses the recent developments in this field, and the prospects for using these techniques to create materials with novel functionalities in a controlled way.

**045001** **The Fibonacci quasicrystal: Case study of hidden dimensions and multifractality**

Anuradha Jagannathan

The one-dimensional Fibonacci chain is a toy model central to theoretical studies of the physics of electronic states in quasiperiodic structures. This review surveys the state of the art of methods to study the energy spectra and states of Fibonacci chain models, including exact solutions, renormalization group, perturbation theory, and numerical analysis. Results highlight distinctive properties of Fibonacci chain systems, including projection from higher dimensions, nontrivial topological properties, multifractal states, and hyperuniformity. Questions of current interest include the effects of disorder and interactions and experimental realizations in electronic, cold atom, phononic, and photonic systems.

**045002** **Water vapor and lapse rate feedbacks in the climate system**

Robert Colman
Brian J. Soden

Water vapor is the most important greenhouse gas in Earth's atmosphere, absorbing more solar terrestrial radiation than any other atmospheric constituent. Because vapor concentrations increase exponentially with temperature, the interaction of water vapor with the vertical thermal structure of the atmosphere introduces a critical positive climate feedback to planetary warming induced by anthropogenic greenhouse gases. This article describes the relevant physical processes, empirical evidence for the feedbacks, representation of these processes in global models of the Earth system, and gaps requiring further research.

045003

**Matrix product states and projected entangled pair states: Concepts, symmetries, theorems**

J. Ignacio Cirac
David Pérez-García
Norbert Schuch
Frank Verstraete

Many-body wave functions can be described effectively by local tensors in matrix product states and projected entangled pair states. This article reviews how these theories provide not only numerical methods but also insights of a more fundamental nature into the structures of states with global entanglement patterns and topological quantum order.