Recent Articles in Phys. Rev. Lett.

**Essentially Entropic Lattice Boltzmann Model**
Author(s): Mohammad Atif, Praveen Kumar Kolluru, Chakradhar Thantanapally, and Santosh Ansumali
The entropic lattice Boltzmann model (ELBM), a discrete space-time kinetic theory for hydrodynamics, ensures nonlinear stability via the discrete time version of the second law of thermodynamics (the $H$ theorem). Compliance with the $H$ theorem is numerically enforced in this methodology and invol...

[Phys. Rev. Lett. 119, 240602] Published Thu Dec 14, 2017

**Observation of Top Quark Production in Proton-Nucleus Collisions**
Author(s): A. M. Sirunyan et al. (CMS Collaboration)
The top quark—previously seen in proton collisions—has now been identified in collisions between protons and lead nuclei.

[Phys. Rev. Lett. 119, 242001] Published Thu Dec 14, 2017

**Navigating at Will on the Water Phase Diagram**
Author(s): S. Pipolo, M. Salanne, G. Ferlat, S. Klotz, A. M. Saitta, and F. Pietrucci
Despite the simplicity of its molecular unit, water is a challenging system because of its uniquely rich polymorphism and predicted but yet unconfirmed features. Introducing a novel space of generalized coordinates that capture changes in the topology of the interatomic network, we are able to syste...

[Phys. Rev. Lett. 119, 245701] Published Thu Dec 14, 2017

**Covariant Conservation Laws and the Spin Hall Effect in Dirac-Rashba Systems**
Author(s): Mirco Milletari, Manuel Offidani, Aires Ferreira, and Roberto Raimondi
We present a theoretical analysis of two-dimensional Dirac-Rashba systems in the presence of disorder and external perturbations. We unveil a set of exact symmetry relations (Ward identities) that impose strong constraints on the spin dynamics of Dirac fermions subject to proximity-induced interacti...

[Phys. Rev. Lett. 119, 246801] Published Thu Dec 14, 2017

**Extracellular Processing of Molecular Gradients by Eukaryotic Cells Can Improve Gradient Detection Accuracy**
Author(s): Igor Segota and Carl Franck
Eukaryotic cells sense molecular gradients by measuring spatial concentration variation through the difference in the number of occupied receptors to which molecules can bind. They also secrete enzymes that degrade these molecules, and it is presently not well understood how this affects the local g...

[Phys. Rev. Lett. 119, 248101] Published Thu Dec 14, 2017

**Cascading Failures as Continuous Phase-Space Transitions**
Author(s): Yang Yang and Adilson E. Motter
In network systems, a local perturbation can amplify as it propagates, potentially leading to a large-scale cascading failure. Here we derive a continuous model to advance our understanding of cascading failures in power-grid networks. The model accounts for both the failure of transmission lines an...

[Phys. Rev. Lett. 119, 248302] Published Thu Dec 14, 2017

**Spin Entanglement Witness for Quantum Gravity**
Author(s): Sougato Bose, Anupam Mazumdar, Gavin W. Morley, Hendrik Ulbricht, Marko Toroš, Mauro Paternostro, Andrew A. Geraci, Peter F. Barker, M. S. Kim, and Gerard Milburn
Two proposals describe how to test whether gravity is inherently quantum by measuring the entanglement between two masses.


**Gravitationally Induced Entanglement between Two Massive Particles is Sufficient Evidence of Quantum Effects in Gravity**
Author(s): C. Marletto and V. Vedral
Two proposals describe how to test whether gravity is inherently quantum by measuring the entanglement between two masses.


**Estimating the Error of an Analog Quantum Simulator by Additional Measurements**
Author(s): Iris Schwenk, Sebastian Zanker, Jan-Michael Reiner, Juha Leppäkangas, and Michael Marthaler
We study an analog quantum simulator coupled to a reservoir with a known spectral density. The reservoir perturbs the quantum simulation by causing decoherence. The simulator is used to measure an operator average, which cannot be calculated using any classical means. Since we cannot predict the res...


**Effective Thermodynamics for a Marginal Observer**
Author(s): Matteo Polettini and Massimiliano Esposito
Thermodynamics is usually formulated on the presumption that the observer has complete information about the system he or she deals with: no parasitic current, exact evaluation of the forces that drive the system. For example, the acclaimed fluctuation relation (FR), relating the probability of time...


**SU(5) Unification without Proton Decay**
Author(s): Bartosz Fornal and Benjamín Grinstein
Recent Articles in Phys. Rev. Lett.

We construct a four-dimensional SU(5) grand unified theory in which the proton is stable. The standard model leptons reside in the 5 and 10 irreps of SU(5), whereas the quarks live in the 40 and 50 irreps. The SU(5) gauge symmetry is broken by the vacuum expectation values of the scalar 24 and 75 ir...


Hartree and Exchange in Ensemble Density Functional Theory: Avoiding the Nonuniqueness Disaster
Author(s): Tim Gould and Stefano Pittalis
Ensemble density functional theory is a promising method for the efficient and accurate calculation of excitations of quantum systems, at least if useful functionals can be developed to broaden its domain of practical applicability. Here, we introduce a guaranteed single-valued “Hartree-exchange” en...


Symmetry Breaking and Strong Persistent Plasma Currents via Resonant Destabilization of Atoms
The ionization rate of an atom in a strong optical field can be resonantly enhanced by the presence of long-living atomic levels (so-called Freeman resonances). This process is most prominent in the multiphoton ionization regime, meaning that the ionization event takes many optical cycles. Neverthel...


Laser-Induced Inelastic Diffraction from Strong-Field Double Ionization
Author(s): Wei Quan, XiaoLei Hao, XiaoQing Hu, RenPing Sun, YanLan Wang, YongJu Chen, ShaoGang Yu, SongPo Xu, ZhiLei Xiao, XuanYang Lai, XingYu Li, Wilhelm Becker, Yong Wu, JianGuo Wang, XiaoJun Liu, and Jing Chen
In this Letter, we propose a novel laser-induced inelastic diffraction (LIID) scheme based on the intense-field-driven atomic nonsequential double ionization (NSDI) process and demonstrate that, with this LIID approach, the doubly differential cross sections (DDCSs) of the target ions, e.g., $\text{...}$


High-$Q$ Supercavity Modes in Subwavelength Dielectric Resonators
Author(s): Mikhail V. Rybin, Kirill L. Koshelev, Zarina F. Sadrieva, Kirill B. Samusev, Andrey A. Bogdanov, Mikhail F. Limonov, and Yuri S. Kivshar
Recent progress in nanoscale optical physics is associated with the development of a new branch of nanophotonics exploring strong Mie resonances in dielectric nanoparticles with a high refractive index. The high-index resonant dielectric nanostructures form building blocks for novel photonic metadev...
| Title                                                                 | Authors                                                                 | Abstract                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------------------------------------------------------|------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------
| **Nonlinear Stimulated Raman Exact Passage by Resonance-Locked Inverse Engineering** | V. Dorier, M. Gevorgyan, A. Ishkhanyan, C. Leroy, H. R. Jauslin, and S. Guérin | We derive an exact and robust stimulated Raman process for nonlinear quantum systems driven by pulsed external fields. The external fields are designed with closed-form expressions from the inverse engineering of a given efficient and stable dynamics. This technique allows one to induce a controlled...                                                                                                                                                                                                                           |
| **Chimera States in Continuous Media: Existence and Distinctness**     | Zachary G. Nicolaou, Hermann Riecke, and Adilson E. Motter             | The defining property of chimera states is the coexistence of coherent and incoherent domains in systems that are structurally and spatially homogeneous. The recent realization that such states might be common in oscillator networks raises the question of whether an analogous phenomenon can occur in...                                                                                                                                                                                                 |
| **Distribution of Off-Diagonal Cross Sections in Quantum Chaotic Scattering: Exact Results and Data Comparison** | Santosh Kumar, Barbara Dietz, Thomas Guhr, and Achim Richter           | The exact distribution of the experimentally inaccessible off-diagonal cross sections of scattering in quantum chaotic systems are calculated analytically, solving an old problem in compound nucleus scattering.                                                                                                                                                                                                                          |
| **Saturation of the Hosing Instability in Quasilinear Plasma Accelerators** | R. Lehe, C. B. Schroeder, J.-L. Vay, E. Esarey, and W. P. Leemans      | The beam hosing instability is analyzed theoretically for a witness beam in the quasilinear regime of plasma accelerators. In this regime, the hosing instability saturates, even for a monoenergetic bunch, at a level much less than standard scalings predict. Analytic expressions are derived for the s...                                                                                                                                                                                                 |
| **Complete Many-Body Localization in the $t\text{-}J$ Model Caused by a Random Magnetic Field** | Gal Lemut, Marcin Mierzejewski, and Janez Bonča                      | The many body localization (MBL) of spin-$\frac{1}{2}$ fermions poses a challenging problem. It is known that the disorder in the charge sector may be insufficient to cause full MBL. Here, we study dynamics of a single hole in one dimensional $t\text{-}J$ model subject to a random magnetic field. We...                                                                                                                                                                                                 |