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Power of quantum measurement in simulating unphysical operations

Xuanqiang Zhao, Lei Zhang, Benchi Zhao, and Xin Wang

Phys. Rev. Research **7**, 013334 (2025) - Published 31 March, 2025

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Control of individual electron-spin pairs in an electron-spin bath

H. P. Bartling, N. Demetriou, N. C. F. Zutt, D. Kwiatkowski, M. J. Degen, S. J. H. Loenen, C. E. Bradley, M. Markham, D. J. Twitchen, and T. H. Taminiau

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Rapid discovering ground states in Lee-Huang-Yang spin-orbit coupled Bose-Einstein condensates via a coupled-TgNN surrogate model

Xiao-Dong Bai, Tianhong Xu, Jian Li, Yong-Kai Liu, Yujia Zhao, and Jincui Zhao

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Universal algorithm for transforming Hamiltonian eigenvalues

Tatsuki Odake, Hlér Kristjánsson, Philip Taranto, and Mio Murao

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Tom Marzin, Barath Venkateswaran, Thomas Baroux, and P.-T. Brun

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Finite-time thermodynamic bounds and trade-off relations for information processing

Takuya Kamijima, Ken Funo, and Takahiro Sagawa

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Chemically regulated conical channel synapse for neuromorphic and sensing applications

T. M. Kamsma, M. S. Klop, W. Q. Boon, C. Spitoni, B. Rueckauer, and R. van Roij

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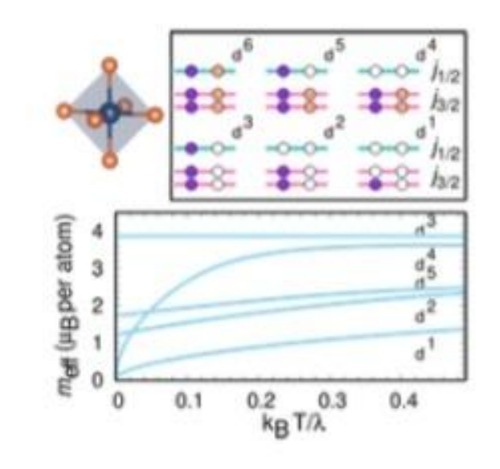

LETTER

Microscopic origin of temperature-dependent magnetism in spin-orbit-coupled transition metal compounds

Ying Li, Ram Seshadri, Stephen D. Wilson, Anthony K. Cheetham, and Roser Valentí

Phys. Rev. Research **7**, L012083 (2025) - Published 28 March, 2025

This work uncovers the origin for failures of the well-established Kotani model describing temperature-dependent magnetism in spin-orbit-coupled transition metal compounds and proposes a generalization of the model.

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Demographic consequences of damage dynamics in single-cell aging

Murat Tuğrul and Ulrich K. Steiner

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Alexander Felski and Flore K. Kunst

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Observables in non-Hermitian systems: A methodological comparison

Karin Sim, Nicolò Defenu, Paolo Molignini, and R. Chitra

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Pressure-induced enhancement of superfluid density in transition metal dichalcogenides with and without charge density wave

S. S. Islam, V. Sazgari, C. Witteveen, J. N. Graham, O. Gerguri, P. Král, M. Bartkowiak, H. Luetkens, R. Khasanov, F. O. von Rohr, and Z. Guguchia

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Coarse-grained description of anharmonic lattice environments affecting the quantum dynamics of charge carriers

Kuniyuki Miwa, Souichi Sakamoto, Ken Funo, and Akihito Ishizaki

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Quantum many-body scarring in a non-Abelian lattice gauge theory

Giuseppe Calajó, Giovanni Cataldi, Marco Rigobello, Darvin Wanisch, Giuseppe Magnifico, Pietro Silvi, Simone Montangero, and Jad C. Halimeh

Phys. Rev. Research **7**, 013322 (2025) - Published 27 March, 2025

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Tunable two-species spin models with Rydberg atoms in circular and elliptical states

Jacek Dobrzyniecki, Paula Heim, and Michał Tomza

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Theory of optical spin-polarization of axial divacancy and nitrogen-vacancy defects in 4H-SiC

Guodong Bian, Gergő Thiering, and Ádám Gali

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Modeling how lamellipodia-driven cells maintain persistent migration and interact with external barriers

Shubhadeep Sadhukhan, Cristina Martinez-Torres, Samo Penič, Carsten Beta, Aleš Iglič, and Nir Gov

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Coexistence of ergodic and nonergodic behavior and level spacing statistics in a one-dimensional model of a flat band superconductor

Meri Teeriaho, Ville-Vertti Linho, Koushik Swaminathan, and Sebastiano Peotta

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Nonlinear-response theory for lossy superconducting quantum circuits

V. Vadimov, M. Xu, J. T. Stockburger, J. Ankerhold, and M. Möttönen

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Collective nature of high-Q resonances in finite-size photonic metastructures

Thanh Xuan Hoang, Daniel Leykam, Hong-Son Chu, Ching Eng Png, Francisco J. García-Vidal, and Yuri S. Kivshar

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Robust microwave cavity control for NV ensemble manipulation

Iñaki Iriarte-Zendoia, Carlos Munuera-Javaloy, and Jorge Casanova

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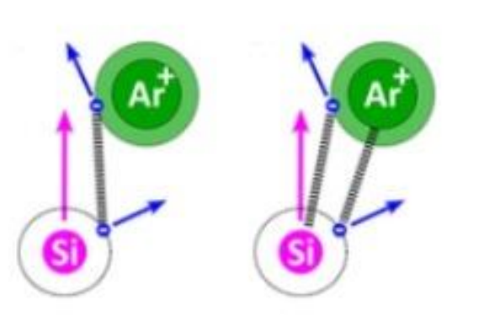

LETTER

Momentum imaging of electrons and recoil ions from anion–neutral interactions in a cryogenic ion storage ring

F. Herrmann, W. Zhang, M. Schulz, D. V. Chicharro, A. Dorn, M. Grieser, F. Grussie, H. Kreckel, O. Novotny, F. Trost, A. Wolf, T. Pfeifer, C. D. Schröter, and R. Moshammer

Phys. Rev. Research **7**, L012082 (2025) - Published 25 March, 2025

In detachment with simultaneous target ionization in anion-atom collisions, an electron can be ejected from each collision partner through two different channels: either by two independent interactions of each electron with the core of the other respective collision partner or by a single mutual interaction between the two electrons. Surprisingly, the latter is dominant.

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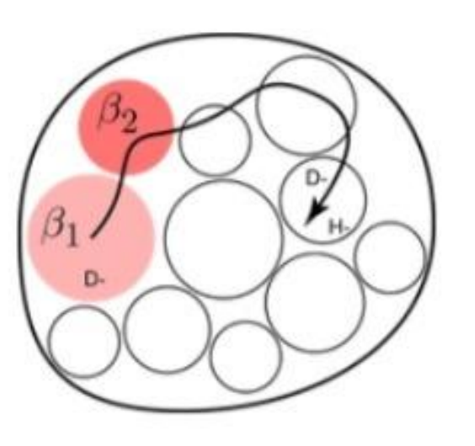

LETTER

Anomalous velocity distributions in slow quantum-tunneling chemical reactions

Christian Beck and Constantino Tsallis

Phys. Rev. Research **7**, L012081 (2025) - Published 25 March, 2025

By introducing a generalized statistical mechanics description involving temperature fluctuations, it is shown how anomalous velocity distributions arise in ion-trap experiments involving slow quantum-tunneling chemical reactions. The density dependence of the entropic index q, describing the shape of the distributions and the strength of temperature fluctuations, is analytically calculated and compared with experimental data.

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Topology and density control of satellite-defined photonic quantum networks

Xiaojuan Ma, Indranil Gupta, and Yan Wang

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Fault-tolerant optical interconnects for neutral-atom arrays

Josiah Sinclair, Joshua Ramette, Brandon Grinkemeyer, Dolev Bluvstein, Mikhail D. Lukin, and Vladan Vuletić

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Cluster formation and phase separation driven by mobile myosin motors in the motility assay

Brandon Slater, Alfredo Sciortino, Andreas R. Bausch, and Taeyoon Kim

Phys. Rev. Research **7**, 013312 (2025) - Published 25 March, 2025

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Quantum simulation with gauge fixing: From Ising lattice gauge theory to dynamical flux model

Junsen Wang, Xiangxiang Sun, and Wei Zheng

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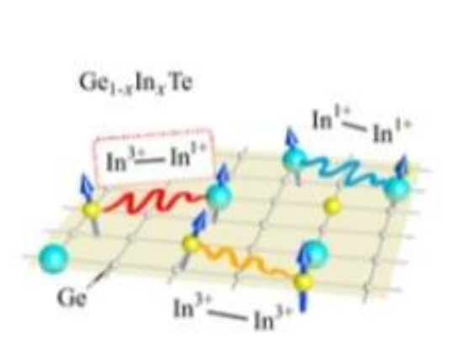

LETTER

Probing mixed valence states by nuclear spin-spin relaxation time measurements

Y. Ihara, M. Shimohashi, and M. Kriener

Phys. Rev. Research **7**, L012080 (2025) - Published 24 March, 2025

The appearance of mixed valences of In in GeInTe is probed by nuclear spin-spin relaxation rate measurements. The observed drastic shortening of is associated with the interaction between In and In, which induces and enhances the superconductivity in this material.

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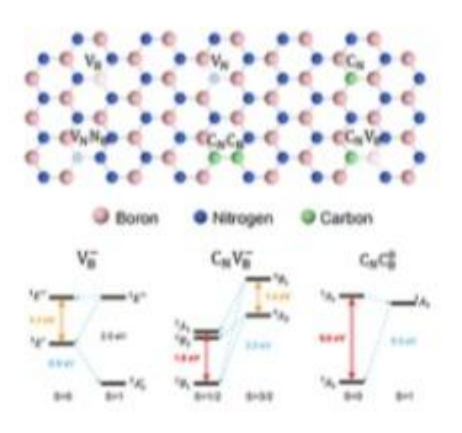

EDITORS' SUGGESTION | LETTER

Towards an accurate electronic structure of single photon emitters in hexagonal boron nitride

Yilin Chen, Haoxiang Chen, Nikolay Bogdanov, Kuang Yu, Ali Alavi, Enge Wang, and Ji Chen

Phys. Rev. Research **7**, L012079 (2025) - Published 24 March, 2025

Advanced many-body calculations demonstrate the decisive role of electron correlation effects in single-photon emitters in hexagonal boron nitride, clarifying previously disputed defect properties and identifying new luminescent transitions.

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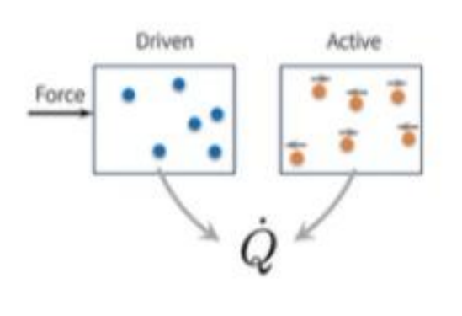

LETTER

Dissipation rates from experimental uncertainty

Aishani Ghosal and Jason R. Green

Phys. Rev. Research **7**, L012078 (2025) - Published 24 March, 2025

Motivated by recent experimental advances in active materials, this work reparametrizes the speed limit set by the Fisher information to infer dissipation rates from directly observable quantities without an analytically solvable model or full time-dependent probability distribution.

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Spintronic reservoir computing with interpretable nonlinearity

Jiaxuan Chen, Yicheng Song, and Akira Hirose

Phys. Rev. Research **7**, 013310 (2025) - Published 24 March, 2025

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Quantum sensing with driven-dissipative Su-Schrieffer-Heeger lattices

Oscar Arandes and Emil J. Bergholtz

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Societal self-regulation induces complex infection dynamics and chaos

Joel Wagner, Simon Bauer, Sebastian Contreras, Luk Fleddermann, Ulrich Parlitz, and Viola Priesemann

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Infinite variety of thermodynamic speed limits with general activities

Ryuna Nagayama, Kohei Yoshimura, and Sosuke Ito

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Exact block encoding of imaginary time evolution with universal quantum neural networks

Ermal Rrapaj and Evan Rule

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Wigner-function formalism for the detection of single microwave pulses in a resonator-coupled double quantum dot

Drilon Zenelaj, Peter Samuelsson, and Patrick P. Potts

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Discovery of a second type of high- magnetic spiral in layered type perovskites

Ruyong Li, Arnau Romaguera, Oscar Fabelo, Xiaodong Zhang, Francois Fauth, and José Luis García-Muñoz

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Gravity-dependent walk-run transition via saddle-node bifurcation and cusp catastrophe

Mau Adachi, Kazuo Tsuchiya, and Shinya Aoi

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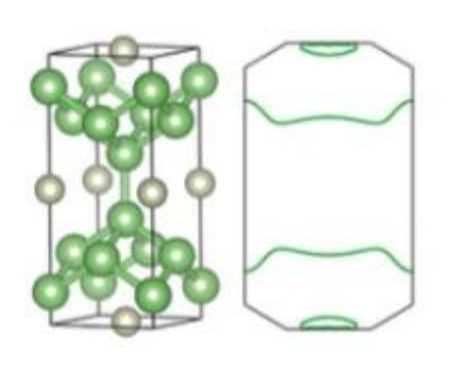

LETTER

Predicted superconductivity above 100 K in electride under high pressure

Zhiyao Guan, Tian Cui, and Da Li

Phys. Rev. Research **7**, L012077 (2025) - Published 21 March, 2025

This paper reports on the discovery of LiRh, the first high-pressure electride superconductor with a superconducting transition temperature () surpassing 100 K. The high value of stems from its unique electronic structure, featuring strong hybridization between nonnuclear attractors and atomic orbitals near the Fermi level.

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Cell size distributions in lineages

Kaan Öcal and Michael P. H. Stumpf

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Fluctuation-dissipation theorem and the discovery of distinctive off-equilibrium signatures of brain states

Juan Manuel Monti, Yonatan Sanz Perl, Enzo Tagliazucchi, Morten L. Kringelbach, and Gustavo Deco

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Escape cascades as a behavioral contagion process with adaptive network dynamics

Wenhan Wu, Xiaoping Zheng, and Pawel Romanczuk

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Niall Byrnes and Matthew R. Foreman

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Anomalous high-density spin noise in a strongly interacting atomic vapor

J. Delpy, N. Fayard, F. Bretenaker, and F. Goldfarb

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Reversible entanglement beyond quantum operations

Yu-Ao Chen, Xin Wang, Lei Zhang, and Chenghong Zhu

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Inverse solving the Schrödinger equation for precision alignment of a microcavity

Charlie Mattschas, Marius Puplauskis, Chris Toebes, Violetta Sharoglazova, and Jan Klaers

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Light control of intramolecular nuclear dynamics by vortex electron localization

Meng Han, Hao Liang, Jan Michael Rost, Artem Rudenko, Charles Lewis Cocke, Uwe Thumm, Liang-You Peng, and Yunquan Liu

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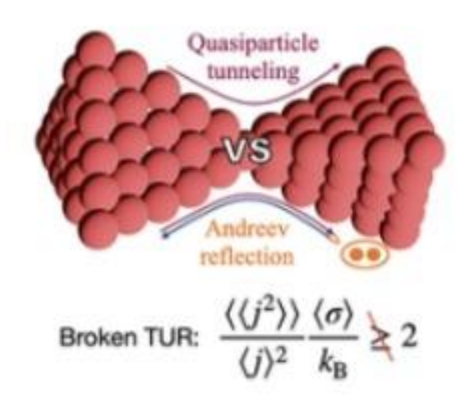

LETTER

Thermodynamic uncertainty relations in superconducting junctions

David Christian Ohnmacht, Juan Carlos Cuevas, Wolfgang Belzig, Rosa López, Jong Soo Lim, and Kun Woo Kim

Phys. Rev. Research **7**, L012075 (2025) - Published 20 March, 2025

The thermodynamic uncertainty relation is shown to be largely violated in highly transmissive superconducting contacts. This violation originates from the coexistence of tunneling processes involving different numbers of transmitted charges, namely quasiparticle tunneling and (multiple) Andreev reflections.

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Magnetic field generation in multipetawatt laser-solid interactions

Brandon K. Russell, Marija Vranic, Paul T. Campbell, Alexander G. R. Thomas, Kevin M. Schoeffler, Dmitri A. Uzdensky, and Louise Willingale

Phys. Rev. Research **7**, 013294 (2025) - Published 20 March, 2025

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Self-assembling clusters of particles on a shrinking liquid surface

Xin Li, Shuchen Zhang, Mark J. Bowick, and Duanduan Wan

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LETTER

Wannier center spectroscopy to identify boundary-obstructed topological insulators

R. A. M. Ligthart, M. A. J. Herrera, A. C. H. Visser, A. Vlasblom, D. Bercioux, and I. Swart

Phys. Rev. Research **7**, 012076 (2025) - Published 20 March, 2025

This article presents an experimental technique to elucidate the location of Wannier centers - as a proxy for the topological properties - in artificial lattices made of Cs/InAs(111)A by integrating the density of states. The results are further corroborated with tight-binding simulations.

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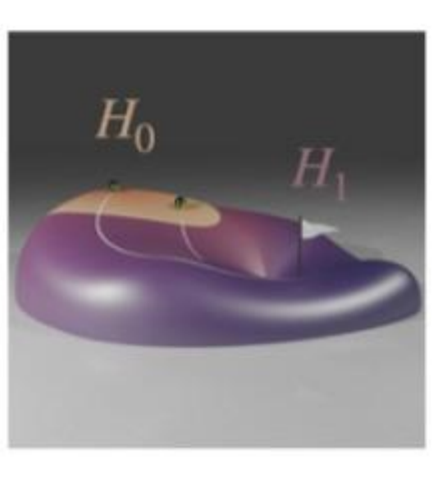

LETTER

Exponential optimization of adiabatic quantum-state preparation

Davide Cugini, Davide Nigro, Mattia Bruno, and Dario Gerace

Phys. Rev. Research **7**, L012074 (2025) - Published 19 March, 2025

The infidelity of a quantum state via linear adiabatic preparation decays exponentially with computational time. In this work the exponential characteristic time is derived analytically, enabling optimal Hamiltonian design, and validated with numerical experiments on prototypical spin models.

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Modeling of a continuous superradiant laser on the sub-mHz transition in neutral strontium-88

Swadheen Dubey, Georgy A. Kazakov, Benedikt Heizenreder, Sheng Zhou, Shayne Bennetts, Stefan Alaric Schäffer, Ananya Sitaram, and Florian Schreck (MoSaiQC Collaboration)

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Magnetic skyrmions and their stabilization mechanism in two-dimensional monolayers

Xiaohang Niu, Jingman Pang, Mengyuan Lin, Meiguang Zhang, Yu Qian, and Yun Zhang

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Unconventional gate-induced superconductivity in transition-metal dichalcogenides

Thibault Sohier, Marco Gibertini, Ivar Martin, and Alberto F. Morpurgo

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Explicit demonstration of the equivalence between and the Hartree-Fock limit of

Alberto Carta, Iurii Timrov, Peter Mlkvik, Alexander Hampel, and Claude Ederer

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Entanglement transfer of a Rydberg W-state to a multi-mode photonic state

Aneesh Ramaswamy and Svetlana A. Malinovskaya

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Reconfigurable metasurface based on plasma cylinders

Jiaruo Yan, Ioannis Katsantonis, Ioannis Draganidis, Konstantinos Kourtzanidis, Alessio Monti, Stefano Vellucci, Mirko Barbuto, Filiberto Bilotti, and Maria Kafesaki

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Collective decision-making with heterogeneous biases: Role of network topology and susceptibility

Yunus Sevinchan, Petro Sarkanych, Abi Tenenbaum, Yurij Holovatch, and Pawel Romanczuk

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Experimental demonstration of electric power generation from Earth's rotation through its own magnetic field

Christopher F. Chyba, Kevin P. Hand, and Thomas H. Chyba

Phys. Rev. Research **7**, 013285 (2025) - Published 19 March, 2025

Experiments support a controversial proposal to generate electricity from our planet's rotation by using a device that interacts with Earth's magnetic field.

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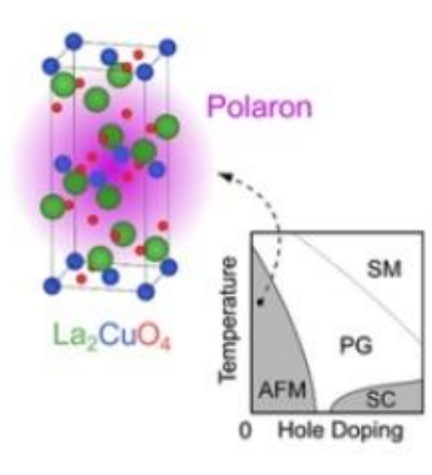

LETTER

First-principles electron-phonon interactions and polarons in the parent cuprate $\mathrm{La_2\,CuO_4}$

Benjamin K. Chang, Iurii Timrov, Jinsoo Park, Jin-Jian Zhou, Nicola Marzari, and Marco Bernardi

Phys. Rev. Research **7**, L012073 (2025) - Published 18 March, 2025

Accurate parameter-free calculations of correlated electron-phonon (e-ph) coupling and polaronic hole spectral functions in undoped lanthanum cuprate is demonstrated. The results capture features not explained by existing models and suggest that the universal strong e-ph coupling found experimentally in doped lanthanum cuprates also exists in the parent compound.

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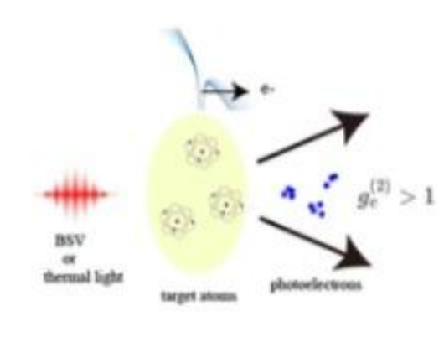

LETTER

Effect of photon quantum statistics on electrons in above-threshold ionization

Zijian Lyu, Fengxiao Sun, Yiqi Fang, Qiongyi He, and Yunquan Liu

Phys. Rev. Research **7**, L012072 (2025) - Published 18 March, 2025

How quantum light fields influence the statistical distribution of tunneling electrons in above-threshold ionization is explored. Using the quantum strong-field approximation, it is demonstrated that bunched photon statistics, such as those in bright squeezed vacuum, shape electron emission dynamics, leading to statistical modifications beyond classical expectations.

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Quantum heat engine based on quantum interferometry: The SU(1,1) Otto cycle

Alessandro Ferreri, Hui Wang (王惠), Franco Nori (野理), Frank K. Wilhelm, and David Edward Bruschi

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Spontaneous symmetry breaking in a $SO(3)$ non-Abelian lattice gauge theory in $2+1\mathrm{D}$ with quantum algorithms

Sandip Maiti, Debasish Banerjee, Bipasha Chakraborty, and Emilie Huffman

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Bifurcation and oscillations in fluidic nanopores: A model neuron for liquid neuromorphic networks

Alicia Cordero, Juan R. Torregrosa, and Juan Bisquert

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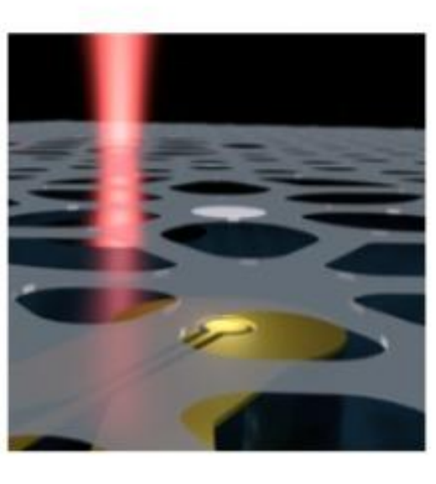

LETTER

Strong thermomechanical noise squeezing stabilized by feedback

Aida Mashaal, Lucio Stefan, Andrea Ranfagni, Letizia Catalini, Ilia Chernobrovkin, Thibault Capelle, Eric C. Langman, and Albert Schliesser

Phys. Rev. Research **7**, L012071 (2025) - Published 17 March, 2025

A study showcases parametric squeezing in soft-clamped silicon nitride membrane resonators, utilizing both piezoelectric and capacitive actuation. Through feedback stabilization, the research surpasses the parametric instability limit, with capacitive actuation achieving a noise squeezing of 21 dB.

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Quantum metrology of low-frequency electromagnetic modes with frequency upconverters

Stephen E. Kuenstner, Elizabeth C. van Assendelft, Saptarshi Chaudhuri, Hsiao-Mei Cho, Jason Corbin, Shawn W. Henderson, Fedja Kadribasic, Dale Li, Arran Phipps, Nicholas M. Rapidis, Maria Simanovskaia, Jyotirmai Singh, Cyndia Yu, and Kent D. Irwin

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Cubic Dirac semimetals: General theory and application to rare-earth magnets

Shouvik Sur and Chandan Setty

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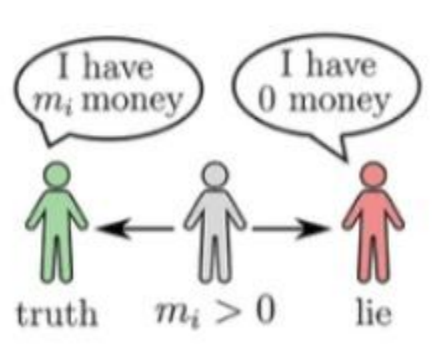

EDITORS' SUGGESTION

Hallmarks of deception in asset-exchange models

Kristian Blom, Dmitrii E. Makarov, and Aljaž Godec

Phys. Rev. Research **7**, 013279 (2025) - Published 17 March, 2025

The Bennati-Dragulescu-Yakovenko asset-exchange model is studied in the presence of probabilistic cheaters that can falsely claim they are bankrupt. It is shown how the presence of such (hidden) cheaters can be inferred from the variance of the overall wealth distribution and that there exists a critical cheating probability at which the money owned by a small pool of cheaters undergoes a second-order discontinuity.

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Sulfur in diamond and its effect on the creation of nitrogen-vacancy defect from *ab initio* simulations

Nima Ghafari Cherati, Anton Pershin, and Ádám Gali

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Precursor to quantum criticality in Ce-Au-Al quasicrystal approximants

A. Khansili, Y.-C. Huang, U. Häussermann, C. Pay Gomez, and A. Rydh

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Dissipative quantum chaos unveiled by stochastic quantum trajectories

Filippo Ferrari, Luca Gravina, Debbie Eeltink, Pasquale Scarlino, Vincenzo Savona, and Fabrizio Minganti

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Rigid clusters in shear-thickening suspensions: A nonequilibrium critical transition

Aritra Santra, Michel Orsi, Bulbul Chakraborty, and Jeffrey F. Morris

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Coherent dynamics of a nuclear-spin-isomer superposition

Tamar Levin and Ziv Meir

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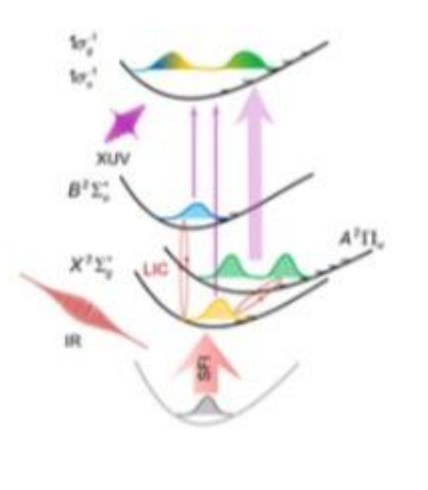

LETTER

Electronic-vibrational dynamics and coherence in x-ray transient absorption of N_2^+ induced by strong-field ionization

Jing Zhao, Guangru Bai, Qian Zhang, Bin Zhang, Wenkai Tao, Qianyu Qiu, Hongbin Lei, Yue Lang, Jinlei Liu, Xiaowei Wang, and Zengxiu Zhao

Phys. Rev. Research **7**, L012070 (2025) - Published 14 March, 2025

A theoretical framework is developed to investigate the strong-field-induced electronic and vibronic dynamics governing ionic radiation and absorption dynamics. By resolving the contributions of different electronic states and the effects of electronic-vibrational coupling in x-ray absorption spectra, this study helps to address the debate on nitrogen air lasing.

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Quantum Hall effect and current distribution in the three-dimensional topological insulator HgTe

S. Hartl, L. Freund, M. Kühn, J. Ziegler, E. Richter, W. Himmler, J. Bärenfänger, D. A. Kozlov, N. N. Mikhailov, J. Weis, and D. Weiss

Phys. Rev. Research **7**, 013273 (2025) - Published 14 March, 2025

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Generalized Josephson effect with arbitrary periodicity in quantum magnets

Anshuman Tripathi, Felix Gerken, Peter Schmitteckert, Michael Thorwart, Mircea Trif, and Thore Posske

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Quantum phase transitions in many-dipole light-matter systems

Daniele Lamberto, Omar Di Stefano, Stephen Hughes, Franco Nori, and Salvatore Savasta

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Harnessing time symmetry to fundamentally alter entanglement in photoionization

Axel Stenquist and Jan Marcus Dahlström

Phys. Rev. Research **7**, 013270 (2025) - Published 14 March, 2025

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Stochastic spatiotemporal growth model reproducing the universal statistical laws of the gut microbiome

Rie Maskawa, Hideki Takayasu, Lena Takayasu, Wataru Suda, and Misako Takayasu

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Ballistic entanglement cloud after a boundary quench

Bedoor Alkurtass, Abolfazl Bayat, Pasquale Sodano, Sougato Bose, and Henrik Johannesson

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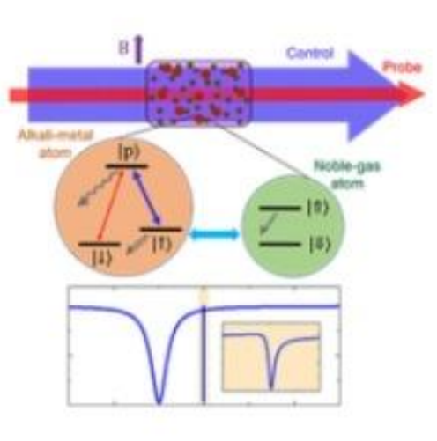

LETTER

Nuclear spin induced transparency

He-bin Zhang, Yuanjiang Tang, and Yong-Chun Liu

Phys. Rev. Research **7**, L012069 (2025) - Published 12 March, 2025

A novel quantum optical phenomenon termed nuclear spin induced transparency (NSIT) derived from the nuclear spin coherence of noble-gas atoms is predicted. Thanks to ultralong lifetimes of nuclear spins, the NSIT effect achieves an ultranarrow transparency window, reaching sub-mHz range, far smaller than the conventional electromagnetically induced transparency window.

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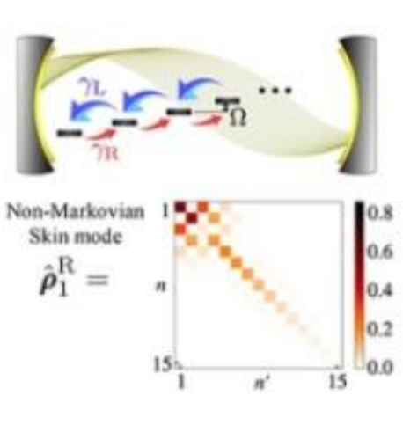

LETTER

Non-Markovian skin effect

Po-Chen Kuo, Shen-Liang Yang, Neill Lambert, Jhen-Dong Lin, Yi-Te Huang, Franco Nori, and Yueh-Nan Chen

Phys. Rev. Research **7**, L012068 (2025) - Published 12 March, 2025

A study examines how non-Markovian environments modify the Liouvillian skin effect, revealing a "thick skin effect" where skin modes broaden into the bulk. The work identifies that cross-site quantum coherence leads to coherence delocalization and oscillatory relaxation dynamics with linear system-size scaling.

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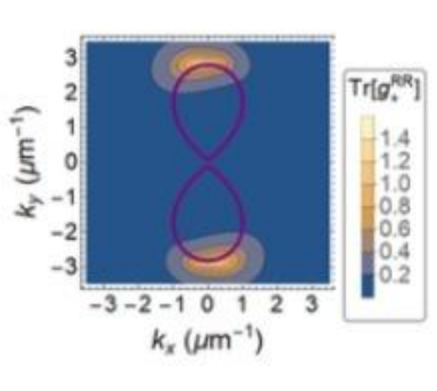

LETTER

Quantum geometric tensor and wavepacket dynamics in two-dimensional non-Hermitian systems

Y.-M. Robin Hu, Elena A. Ostrovskaya, and Eliezer Estrecho

Phys. Rev. Research **7**, L012067 (2025) - Published 12 March, 2025

Wave-packet dynamics in two-dimensional non-Hermitian systems using a first-order perturbation theory are investigated. The results reveal that two different non-Hermitian generalizations of the quantum geometric tensor play a significant role in the accurate description of the dynamics.

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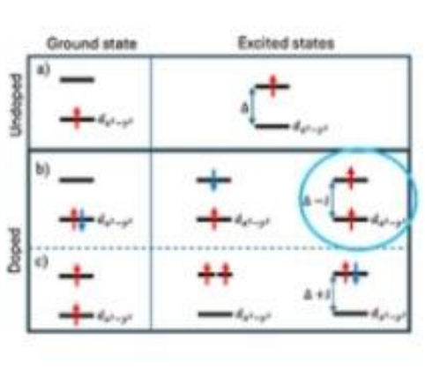

LETTER

Softening of dd excitation in the resonant inelastic x-ray scattering spectra as a signature of Hund's coupling in nickelates

Umesh Kumar, Corey Melnick, and Gabriel Kotliar

Phys. Rev. Research **7**, L012066 (2025) - Published 12 March, 2025

The role of Hund's coupling in superconducting nickelates remains an open question. This study demonstrates that Hund's coupling is responsible for the softening of dd excitations in doped nickelates, providing a theoretical explanation for the recent resonant inelastic x-ray scattering experiment. The findings highlight the competition between Hund's coupling and crystal-field splitting, offering new insights into the electronic structure and superconductivity of these materials.

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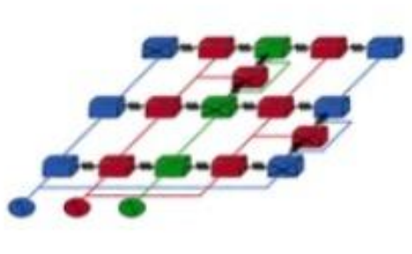

LETTER

Globally driven superconducting quantum computing architecture

Roberto Menta, Francesco Cioni, Riccardo Aiudi, Marco Polini, and Vittorio Giovannetti

Phys. Rev. Research **7**, L012065 (2025) - Published 12 March, 2025

A globally driven superconducting quantum computing architecture is introduced that uses the always-on interqubit longitudinal ZZ coupling as a resource. By exploiting this interaction in the strong-coupling (i.e., blockade) regime, together with suitably engineered drive pulses, the architecture enables universal quantum computation without individual qubit control.

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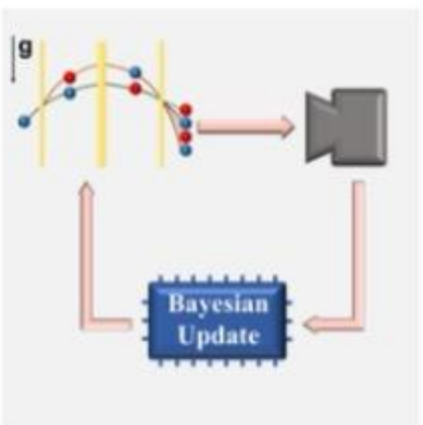

LETTER

Adaptive robust high-precision atomic gravimetry

Jinye Wei, Jiahao Huang, and Chaohong Lee

Phys. Rev. Research **7**, L012064 (2025) - Published 12 March, 2025

An adaptive Bayesian quantum estimation for atomic gravimetry is developed, which can achieve enhanced sensitivity while maintaining high dynamic range and robustness. This approach can be widely used for various interferometry-based quantum sensors.

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Ion energization in perpendicular collisionless shock driven by laboratory-scale colliding plasmas

Peng Liu, Dong Wu, Dawei Yuan, Gang Zhao, Zhengmao Sheng, Xiantu He, and Jie Zhang

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Space-time supercrystals from non-Abelian electric translation symmetries

Jian Wang, James Jun He, and Qian Niu

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Pablo Rodriguez-Grasa, Ruben Ibarrondo, Javier Gonzalez-Conde, Yue Ban, Patrick Rebentrost, and Mikel Sanz

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Aleksei Khindanov, Yongxin Yao, and Thomas Iadecola

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Optimal mixed control of networked reaction-diffusion systems

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Quantum entanglement without nonlocal causation in (3,2)-dimensional spacetime

Marco Pettini

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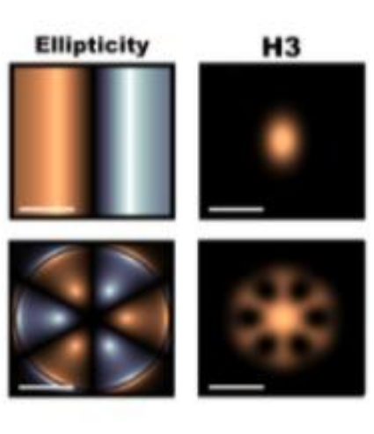

LETTER

Spatial polarization gating of high-harmonic generation in solids

Pieter J. van Essen, Brian de Keijzer, Tanya van Horen, Eduardo B. Molinero, Álvaro Jiménez Galán, Rui. E. F. Silva, and Peter M. Kraus

Phys. Rev. Research **7**, L012063 (2025) - Published 11 March, 2025

This work proposes spatial polarization gating, that is, using a spatially varying ellipticity of a driving laser pulse to reduce the spatial profile of high-harmonic emission below the diffraction limit and hence increase spatial resolution. It is shown experimentally and by numerical simulations that the method is generally applicable and provides a step toward all-optical femtosecond-to-attosecond label-free superresolution imaging.

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Anomalous conductance steps in three-dimensional topological insulator HgTe-based quantum point contacts

Elisabeth Richter, Michael Barth, Dmitriy A. Kozlov, Angelika Knothe, Nikolay N. Mikhailov, Juliane Steidl, Cosimo Gorini, Stefan Hartl, Wolfgang Himmler, Klaus Richter, and Dieter Weiss

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Revealing the sound, flow excitation, and collision dynamics of human handclaps

Yicong Fu, Akihito Kiyama, Guoqin Liu, Likun Zhang, and Sunghwan Jung

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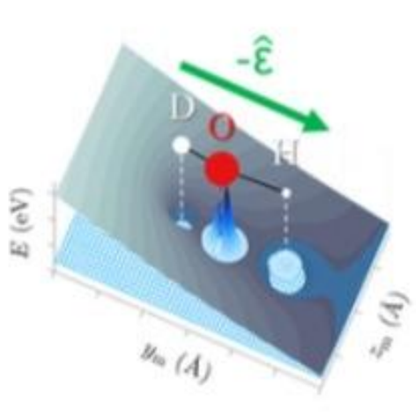

LETTER

Isotope-selective strong-field ionization of semiheavy water

A. J. Howard, M. Britton, Z. L. Streeter, C. Cheng, R. R. Lucchese, C. W. McCurdy, and P. H. Bucksbaum

Phys. Rev. Research **7**, L012062 (2025) - Published 10 March, 2025

Semiheavy water (HOD) is one of the simplest molecules in which the bonds are labeled by isotope. It is demonstrated that a pair of intense few-femtosecond infrared laser pulses can be used to selectively tunnel ionize along one of the two bonds.

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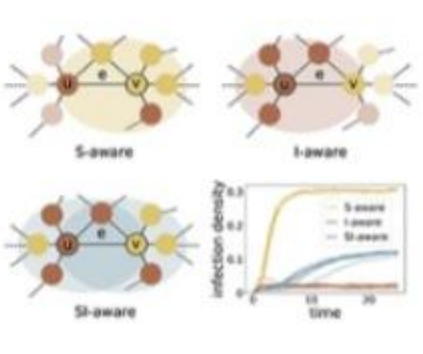

LETTER

Epidemic paradox induced by awareness driven network dynamics

Csegő Balázs Kolok, Gergely Ódor, Dániel Keliger, and Márton Karsai

Phys. Rev. Research **7**, L012061 (2025) - Published 10 March, 2025

Epidemic spreading and adaptive self-protection behaviors are inherently coupled processes. Epidemic dynamics is studied in scale-free networks with local awareness behavior adopted by only susceptible, only infected, or all nodes. It is found that fewer potentially aware nodes reduce the epidemic size more effectively compared to systems where all nodes can be aware; a phenomenon reminiscent of Braess's paradox.

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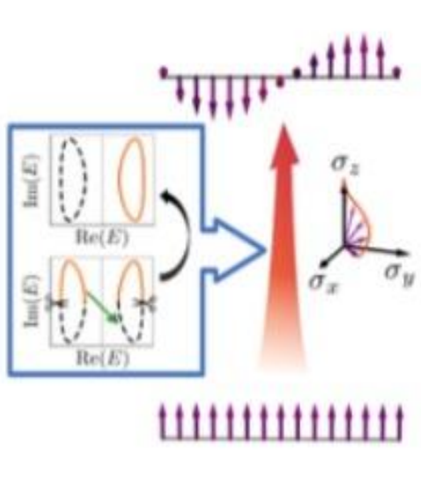

LETTER

Measuring non-Hermitian topological invariants directly from quench dynamics

Xiao-Dong Lin and Long Zhang

Phys. Rev. Research **7**, L012060 (2025) - Published 10 March, 2025

A unified quench-dynamics framework is established to measure line-gap winding numbers, point-gap braiding degrees, and non-Bloch topological invariants in odd-dimensional systems with sublattice or chiral symmetry, with a proposed cold-atom implementation demonstrating experimental feasibility.

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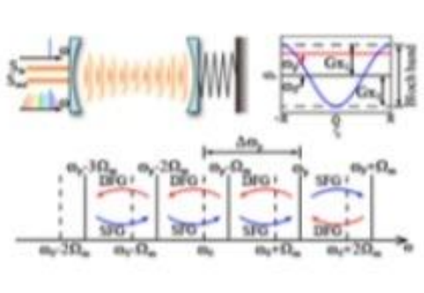

LETTER

Bloch-band structure of cavity optomechanical oscillations

Shulin Ding, Bing He, Yucheng Wu, Yong Hu, Han Wang, Wenjie Wan, Min Xiao, and Xiaoshun Jiang

Phys. Rev. Research **7**, L012059 (2025) - Published 10 March, 2025

A correspondence is established between the Bloch-band structure and the coupled sideband dynamics of optomechanical oscillations. The results offer simple but effective guidance for the optomechanical generation of optical frequency combs with broadband and low repetition rates.

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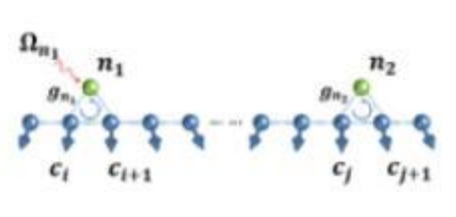

LETTER

Generation and optimization of entanglement between atoms chirally coupled to spin cavities

Jia-Bin You, Jian Feng Kong, Davit Aghamalyan, Wai-Keong Mok, Kian Hwee Lim, Jun Ye, Ching Eng Png, and Francisco J. García-Vidal

Phys. Rev. Research **7**, L012058 (2025) - Published 10 March, 2025

Entanglement generation between atoms chirally coupled to finite one-dimensional spin chains acting as spin cavities is investigated. By employing a variational matrix product state algorithm, the work reveals parity effects in entanglement dynamics, demonstrates the influence of classical driving fields, and explores the role of disorder in optimizing entanglement generation, showing that controlled disorder can significantly enhance entanglement efficiency.

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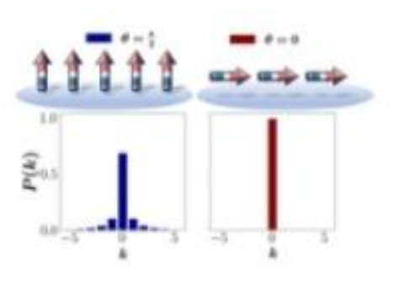

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Diminished quantum depletion and correlated droplets in one-dimensional dipolar Bose gas

Buğra Tüzemen, Maciej Marciniak, and Krzysztof Pawłowski

Phys. Rev. Research **7**, L012057 (2025) - Published 10 March, 2025

A study of a one-dimensional dipolar Bose gas with strong short-range repulsion and long-range attraction shows that the interplay of these interactions suppresses quantum depletion and restores the applicability of the Bogoliubov–de Gennes (BdG) method. The research compares BdG predictions with exact many-body calculations and demonstrates that the condensate fraction remains significant even in regimes exhibiting strong antibunching.

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N. Mousavi, J. Qiu, L. Zhao, B. Mehlig, and K. Gustavsson

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Interaction quench of dipolar bosons in a one-dimensional optical lattice

Paolo Molignini and Barnali Chakrabarti

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Li-Li Ye and Ying-Cheng Lai

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Optical interference by amplitude measurement

Yunxiao Zhang, Xuan Tang, Xueshi Guo, Liang Cui, Xiaoying Li, and Z. Y. Ou

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Quantum many-body simulation of finite-temperature systems with sampling a series expansion of a quantum imaginary-time evolution

Norifumi Matsumoto, Shoichiro Tsutsui, Yuya O. Nakagawa, Yuichiro Hidaka, Shota Kanasugi, Kazunori Maruyama, Hirotaka Oshima, and Shintaro Sato

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Thermodynamics of photoelectric devices

Samuel L. Jacob, Artur M. Lacerda, Yonatan Dubi, and John Goold

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High-purity single-photon generation based on cavity QED

Seigo Kikura, Rui Asaoka, Masato Koashi, and Yuuki Tokunaga

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Off-equilibrium kinetic Ising model: The metric case

Luca Di Carlo

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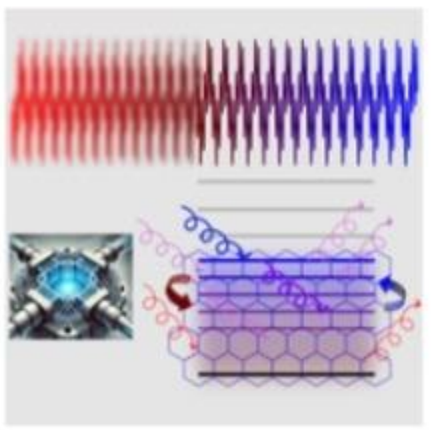

LETTER

Spectrum analysis with parametrically modulated transmon qubits

Nir Gavrielov, Santiago Oviedo-Casado, and Alex Retzker

Phys. Rev. Research **7**, L012056 (2025) - Published 6 March, 2025

Understanding the noise spectrum affecting superconducting qubits is crucial for achieving long gate times and high fidelities. This work introduces parametric spectroscopy, a protocol that merges parametric modulation of a qubit's energy gap with dynamical decoupling sequences to enable accessing the high-energy spectrum of the noise with large frequency resolution, strong leakage resilience, and long coherence times.

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Fault-tolerant quantum architectures based on erasure qubits

Shouzhen Gu, Alex Retzker, and Aleksander Kubica

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Microwave Andreev bound state spectroscopy in a semiconductor-based Planar Josephson junction

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Arrested coalescence, aging, and stability of asters composed of microtubules and kinesin motors

Bibi Najma, Saptorshi Ghosh, Christopher Amey, Peter J. Foster, Michael F. Hagan, Aparna Baskaran, and Guillaume Duclos

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Universal gate set for optical lattice based atom interferometry

Catie LeDesma, Kendall Mehling, John Drew Wilson, Marco Nicotra, and Murray Holland

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Force-current structure in Markovian open quantum systems and its applications: Geometric housekeeping-excess decomposition and thermodynamic trade-off relations

Kohei Yoshimura, Yoh Maekawa, Ryuna Nagayama, and Sosuke Ito

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XY-mixer ansatz assisted by counterdiabatic driving for combinational optimization

Yue Ruan, Pengyue Chen, Qi Li, Ling Yang, Zhiqiang Yuan, Xiling Xue, Xi Li, and Zhihao Liu

Phys. Rev. Research **7**, 013243 (2025) - Published 6 March, 2025

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LETTER

Wakefield regeneration in a plasma accelerator

J. P. Farmer and G. Zevi Della Porta

Phys. Rev. Research **7**, L012055 (2025) - Published 5 March, 2025

By spreading the witness charge in a resonantly driven plasma wakefield accelerator over several bunches, a higher total charge can be accelerated. This allows the luminosity of accelerators such as AWAKE at CERN to be increased.

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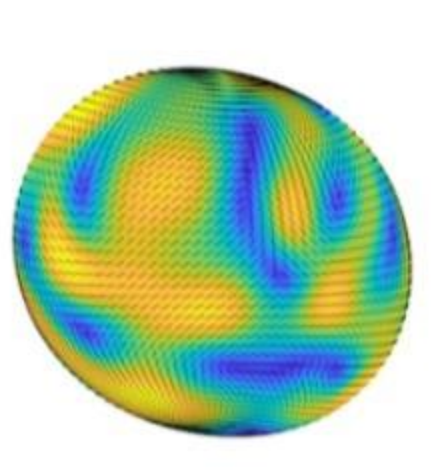

LETTER

Self-organized dynamics of a viscous drop with interfacial nematic activity

Mohammadhossein Firouznia and David Saintillan

Phys. Rev. Research **7**, L012054 (2025) - Published 5 March, 2025

How nematic order, activity-driven flows, and interfacial deformations interact in a viscous drop with surface nematic activity is examined. Simulations reveal emergent behaviors, including braiding motions of topological defects, chaotic defect dynamics, active turbulence, spontaneous shape changes, and directed translation, offering insights into morphological dynamics in active fluid interfaces.

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Analytic model reveals local molecular polarizability changes induced by collective strong coupling in optical cavities

Jacob Horak, Dominik Sidler, Thomas Schnappinger, Wei-Ming Huang, Michael Ruggenthaler, and Angel Rubio

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Special relativity effects on chaos and periodic orbits - a semianalytic approach

Jun-Yin Huang, Hong-Ya Xu, Liang Huang, and Ying-Cheng Lai

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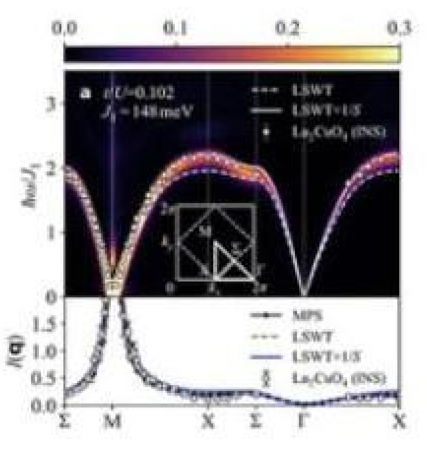

LETTER

Magnon spectra of cuprates beyond spin wave theory

Jiahui Bao, Matthias Gohlke, Jeffrey G. Rau, and Nic Shannon

Phys. Rev. Research **7**, L012053 (2025) - Published 4 March, 2025

The single-band Hubbard model at half-filling is considered to be the starting point for cuprate materials such as La_2CuO_4 or $CaCuO_2$. This work explores the limitations of its effective spin model by using numerical matrix product methods to explore magnetic excitations beyond spin-wave theory.

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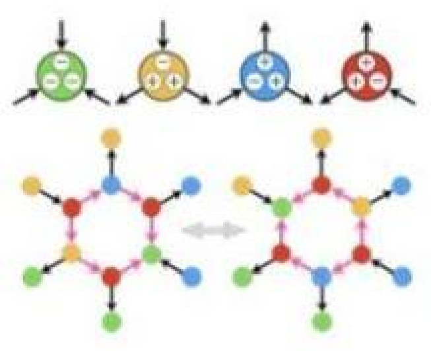

LETTER

Classical $\mathbb{Z}_2$ spin liquid on the generalized four-color Kitaev model

Han Yan (闫寒) and Rico Pohle

Phys. Rev. Research **7**, L012052 (2025) - Published 4 March, 2025

It is demonstrated that the four-color Kitaev model hosts a classical $\mathbb{Z}_2$ spin liquid. A gauge theory framework is used to explicitly illustrate how “charge condensation” emerges in the effective Gauss’s law.

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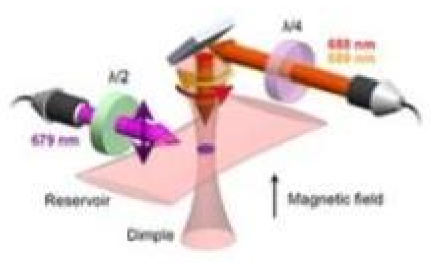

LETTER

Coherent three-photon excitation of the strontium clock transition

Junyu He (何君鈺), Benjamin Pasquiou, Rodrigo González Escudero, Sheng Zhou (周晟), Mateusz Borkowski, and Florian Schreck

Phys. Rev. Research **7**, L012050 (2025) - Published 4 March, 2025

This work demonstrates coherent three-photon excitation of the strontium clock transition using a Bose-Einstein condensate. It provides a method to outcouple a continuous atom laser beam and a fast excitation mechanism for quantum simulation using bosonic alkaline-earth-like atoms.

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High-repetition rate ion acceleration driven by a two-plasmon decay instability

S. V. Rahul, R. Sabui, R. M. G. M Trines, R. Gopal, A. Mondal, T. Sairam, D. Sahu, S. Khanna, A. Robinson, and M. Krishnamurthy

Phys. Rev. Research **7**, 013240 (2025) - Published 4 March, 2025

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Detecting and protecting entanglement through nonlocality, variational entanglement witness, and nonlocal measurements

Haruki Matsunaga and Le Bin Ho

Phys. Rev. Research **7**, 013239 (2025) - Published 4 March, 2025

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Two-photon decay enhanced even photon bundle emission

Biao Xiong, Qian Bin, Shi-Lei Chao, Ji-Bing Liu, and Xin-You Lü

Phys. Rev. Research **7**, 013238 (2025) - Published 4 March, 2025

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Stable and efficient differentiation of tensor network algorithms

Anna Francuz, Norbert Schuch, and Bram Vanhecke

Phys. Rev. Research **7**, 013237 (2025) - Published 4 March, 2025

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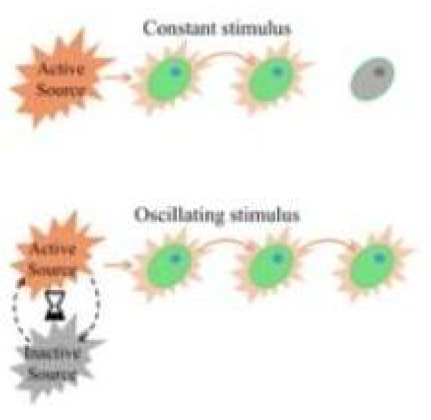

LETTER

Signal transmission through excitable media by an oscillatory source

Lukas W. Kristensen, Michael Lisby, Mogens H. Jensen, and Mathias S. Heltberg

Phys. Rev. Research **7**, L012051 (2025) - Published 3 March, 2025

In a simplified model, it is shown that oscillating stimulus promotes more efficient signal propagation across cells whose internal processes are subject to noise. A mathematical model is derived that shows how the propagation strongly depends on the frequency of the oscillation.

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Renormalization of human mobility based on a revised electric circuit model and a new gravity relation

Zhihua Zhong, Hideki Takayasu, and Misako Takayasu

Phys. Rev. Research **7**, 013235 (2025) - Published 3 March, 2025

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Phase coexistence in nonreciprocal quorum-sensing active matter

Yu Duan, Jaime Agudo-Canalejo, Ramin Golestanian, and Benoît Mahault

Phys. Rev. Research **7**, 013234 (2025) - Published 3 March, 2025

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Evaluation of $\mathrm{Ho}_{100-x-y}\,\mathrm{Er}_x\,\mathrm{Ce}_y$ magnetic refrigerants using advanced multisample neutron transmission spectroscopy

Hiroaki Mamiya, Noriki Terada, Simon Rosenqvist Larsen, Naohito Tsujii, Kosuke Hiroi, Takenao Shinohara, and Hossein Sepehri-Amin

Phys. Rev. Research **7**, 013233 (2025) - Published 3 March, 2025

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Measurement of Casimir-Polder interaction for slow atoms through a material grating

Julien Lecoffre, Ayoub Hadi, Matthieu Bruneau, Charles Garcion, Nathalie Fabre, Éric Charron, Naceur Gaaloul, Gabriel Dutier, and Quentin Bouton

Phys. Rev. Research **7**, 013232 (2025) - Published 3 March, 2025

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Quantum-enhanced Markov chain Monte Carlo for systems larger than a quantum computer

Stuart Ferguson and Petros Wallden

Phys. Rev. Research **7**, 013231 (2025) - Published 3 March, 2025

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