Volume 16, Issue 1

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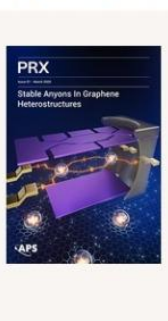


On the Cover

Anyons, collective excitations of fractional quantum Hall systems, are shown to exhibit unprecedented stability in graphene heterostructures, enabling their practical manipulation for use in fault-tolerant quantum computing.

From the article:

[Slow Quasiparticle Dynamics and Anyonic Statistics in a Fractional Quantum Hall Fabry-Pérot Interferometer](#)

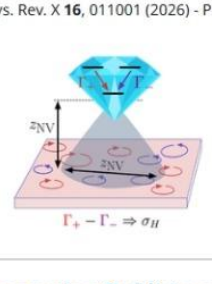
Noah L. Samuelson, Liam A. Cohen, Will Wang, Simon Blanch, Takashi Taniguchi, Kenji Watanabe, Michael P. Zaletel, and Andrea F. Young

Phys. Rev. X **16**, 011062 (2026)

Nanoscale Defects as Probes of Time-Reversal Symmetry Breaking

Suman Jyoti De, T. Pereg-Barnea, and Kartiek Agarwal

Phys. Rev. X **16**, 011001 (2026) - Published 2 January, 2026

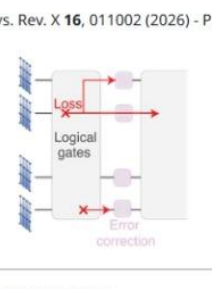


A new technique using diamond NV centers detects time-reversal symmetry breaking in 2D materials by comparing spin relaxation due to opposite circular magnetic polarizations, enabling nanoscale probes of Hall conductivity and other chiral quantum effects.

Leveraging Qubit Loss Detection in Fault-Tolerant Quantum Algorithms

Gefen Baranes, Madelyn Cain, J. Pablo Bonilla Ataides, Dolev Bluvstein, Josiah Sinclair, Vladan Vuletić, Hengyun Zhou, and Mikhail D. Lukin

Phys. Rev. X **16**, 011002 (2026) - Published 2 January, 2026



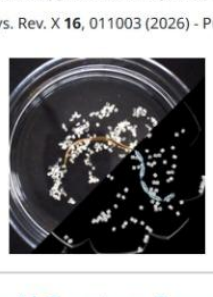
Many quantum algorithms naturally detect and tolerate qubit loss. Combining them with a delayed-erasure decoding method that corrects missing qubits offers a simpler path toward scalable, fault-tolerant quantum computing.

FEATURED IN PHYSICS

Particle Sweeping and Collection by Active and Living Filaments

R. Sinaasappel, K. R. Prathyusha, H. Tuazon, E. Mirzahossein, P. Illien, S. Bhamla, and A. Deblais

Phys. Rev. X **16**, 011003 (2026) - Published 5 January, 2026

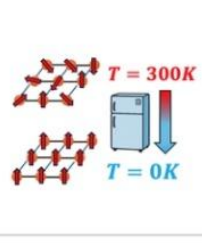


Active filaments collect nearby particles through sweeping motions driven by body bending. The size of the resulting clusters follows a simple geometric rule set by filament length and flexibility that unifies living, robotic, and simulated systems.

Rapid Quantum Ground State Preparation via Dissipative Dynamics

Yongtao Zhan, Zhiyan Ding, Jakob Huhn, Johnnie Gray, John Preskill, Garnet Kin-Lic Chan, and Lin Lin

Phys. Rev. X **16**, 011004 (2026) - Published 6 January, 2026



Dissipative algorithms offer an efficient and robust route to preparing ground states of complex quantum systems.

Pseudogap with Fermi Arcs and Fermi Pockets in Half-Filled Twisted Transition Metal Dichalcogenides

Yong-Yue Zong, Zhao-Long Gu, and Jian-Xin Li

Phys. Rev. X **16**, 011005 (2026) - Published 6 January, 2026

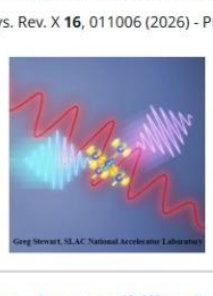
A theoretical work on twisted bilayer tungsten diselenide reveals how tuning the electron bandwidth drives a complex sequence of electronic phases, including Mott insulator, pseudogap states, and strange metal.

FEATURED IN PHYSICS

Second-Order Microscopic Nonlinear Optical Susceptibility in a Centrosymmetric Material: Application to Imaging Valence Electron Motion

Chance Ornelas-Skarin, Tatiana Bezriadina, Matthias Fuchs, Shambhu Ghimire, J. B. Hastings, Quynh L. Nguyen, Gilberto de la Peña, Takahiro Sato, Sharon Shwartz, Mariano Trigo, Diling Zhu, Daria Popova-Gorelova, and David A. Reis

Phys. Rev. X **16**, 011006 (2026) - Published 7 January, 2026

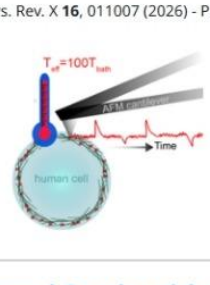


Nonlinear x-ray diffraction is used to isolate the valence electron density in silicon, demonstrating a powerful imaging technique useful across a range of complex materials.

Time Irreversibility, Entropy Production, and Effective Temperature Are Independently Regulated in the Actin Cortex of Living Cells

N Narinder and Elisabeth Fischer-Friedrich

Phys. Rev. X **16**, 011007 (2026) - Published 8 January, 2026

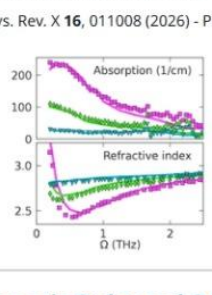


Atomic force microscope observations of dividing human cells suggest that effective temperature alone cannot reliably gauge how far a living system is from equilibrium.

Beyond-Quasiparticle Transport with Vertex Correction: Self-Consistent Ladder Formalism for Electron-Phonon Interactions

Jae-Mo Lihm and Samuel Poncé

Phys. Rev. X **16**, 011008 (2026) - Published 13 January, 2026

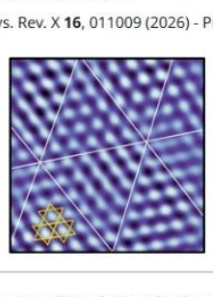


A theoretical framework simultaneously captures quasiparticle breakdown and conservation laws, achieving high accuracy in modeling electron transport in materials with strong electron-phonon interactions.

Nematic Order and Orbital Selective Mott State in a Partially Filled Kagome Flat Band

Caiyun Chen, Jiangchang Zheng, Yuman He, Siqi Wu, Xuzhe Ying, Soumya Sankar, Luanjing Li, Yizhou Wei, Xi Dai, Hoi Chun Po, and Berthold Jäck

Phys. Rev. X **16**, 011009 (2026) - Published 13 January, 2026

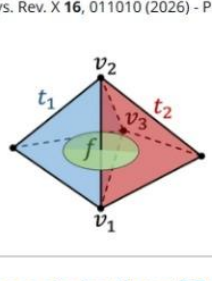


This scanning tunneling microscopy study of kagome flat bands in Fe-doped CoSn identifies orbital-selective Mott states and nematic order, revealing how geometric frustration and Coulomb interactions drive exotic quantum phases.

Generalized Statistics on Lattices

Ryohei Kobayashi (小林良平), Yuyang Li (李雨阳), Hanyu Xue (薛寒玉), Po-Shen Hsin (辛柏伸), and Yu-An Chen (陳昱安)

Phys. Rev. X **16**, 011010 (2026) - Published 14 January, 2026



The notion of statistics is generalized from particles to loops and membranes using Berry phases of microscopic unitary processes on lattices.

Characterization of Drive-Induced Unwanted State Transitions in Superconducting Circuits

W. Dai, S. Hazra, D. K. Weiss, P. D. Kurilovich, T. Connolly, H. K. Babla, S. Singh, V. R. Joshi, A. Z. Ding, P. D. Parakh, J. Venkatraman, X. Xiao, L. Frunzio, and M. H. Devoret

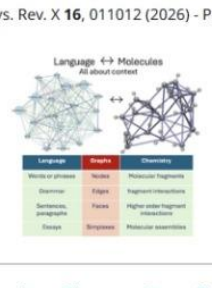
Phys. Rev. X **16**, 011011 (2026) - Published 15 January, 2026

A systematic framework is developed to identify and categorize three distinct mechanisms of drive-induced unwanted state transitions in superconducting circuits, enabling predictable mitigation of errors to advance high-fidelity quantum operations.

Large Language Model-Type Architecture for High-Dimensional Molecular Potential Energy Surfaces

Xiao Zhu and Srinivasan S. Iyengar

Phys. Rev. X **16**, 011012 (2026) - Published 22 January, 2026

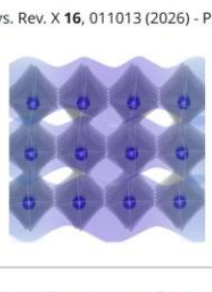


Bridging language model architectures and graph-theory-based molecular fragmentation achieves a sub-kilocalorie-per-mole-accurate potential energy surface for a 186-dimensional water cluster.

Lattice-Charge Coupling in a Trilayer Nickelate with Intertwined Density Wave Order

Xun Jia, Yao Shen, Harrison LaBollita, Xinglong Chen, Junjie Zhang, Yu Li, Hengdi Zhao, Mercouri G. Kanatzidis, Matthew Krogstad, Hong Zheng, Ayman H. Said, Ahmet Alatas, Stephan Rosenkranz, Daniel Phelan, Mark P. M. Dean, M. R. Norman, J. F. Mitchell, Antia S. Botana, and Yue Cao

Phys. Rev. X **16**, 011013 (2026) - Published 23 January, 2026

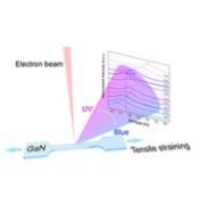


A combined high-resolution x-ray scattering and theoretical study of trilayer nickelate superconductors reveals an intertwined charge and spin order driven by the spin degree of freedom, challenging existing paradigms that emphasized the role of the lattice.

Deep Elastic Strain Engineering of Free-Standing GaN Microbridge

Sufeng Fan, Heyi Wang, Chang-Ti Chou, Juzheng Chen, Ying Han, Jingzhuo Zhou, Xiaocui Li, Jyh-Pin Chou, Ju Li, and Yang Lu

Phys. Rev. X **16**, 011014 (2026) - Published 23 January, 2026



Mechanical bandgap tuning of GaN presents a flexible alternative to chemical doping.

Programmable Quantum Anomalous Hall Insulator in Twisted Crystalline Flatbands

Wenxuan Wang, Yijie Wang, Zaizhe Zhang, Zihao Huo, Gengdong Zhou, Shu Zhang, Kenji Watanabe, Takashi Taniguchi, Xiaoxia Yang, Qing Dai, X. C. Xie, Kaihui Liu, Zhida Song, and Xiaobo Lu

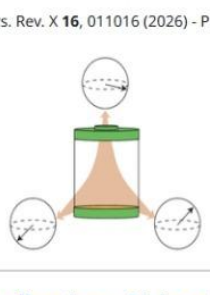
Phys. Rev. X **16**, 011015 (2026) - Published 26 January, 2026

Twisted rhombohedral trilayer graphene hosts programmable quantum anomalous Hall insulators, enabling electrical switching between topological states with integer Chern numbers at both integer and fractional moiré fillings.

Powering Quantum Computation with Quantum Batteries

Yaniv Kurman, Kieran Hymas, Arkady Fedorov, William J. Munro, and James Quach

Phys. Rev. X **16**, 011016 (2026) - Published 26 January, 2026

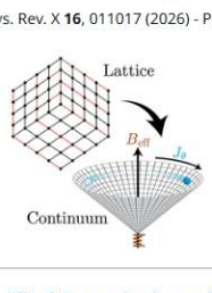


A framework is introduced to power universal quantum computation with internal quantum batteries, reducing heat load and wiring overhead to potentially increase qubit density fourfold.

Disclinations, Dislocations, and Emanant Flux at Dirac Criticality

Maissam Barkeshli, Christopher Fechisin, Zohar Komargodski, and Siwei Zhong

Phys. Rev. X **16**, 011017 (2026) - Published 3 February, 2026

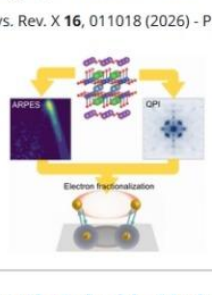


Topological quantization of artificial magnetic flux at lattice defects in gapless crystals provides a measurable mechanism for generating electrical currents and observing new topological invariants.

Unified Description of Cuprate Superconductors by Fractionalized Electrons Emerging from Integrated Analyses of Photoemission Spectra and Quasiparticle Interference

Shiro Sakai, Youhei Yamaji, Fumihiro Imoto, Tsuyoshi Tamegai, Adam Kaminski, Takeshi Kondo, Yuhki Kohsaka, Tetsuo Hanaguri, and Masatoshi Imada

Phys. Rev. X **16**, 011018 (2026) - Published 4 February, 2026

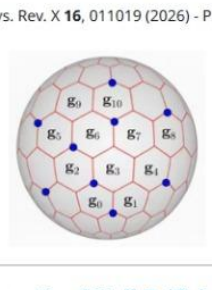


An analysis of photoemission and scanning tunneling microscopy data reveals a possible novel type of electron fractionalization in cuprates based on a unified theoretical framework to address the unresolved mechanism of high-temperature superconductivity.

Exactly Solvable Models for Fermionic Symmetry-Enriched Topological Phases and Fermionic 't Hooft Anomaly

Jing-Ren Zhou and Zheng-Cheng Gu

Phys. Rev. X **16**, 011019 (2026) - Published 5 February, 2026

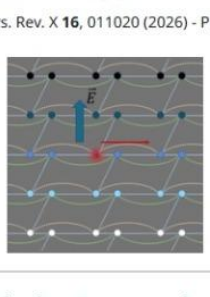


Research provides a class of exactly solvable lattice models to describe a diverse array of 2 + 1D fermionic symmetry-enriched topological phases, including those featuring the important 't Hooft anomaly.

Quantized Hall Drift in a Frequency-Encoded Photonic Chern Insulator

A. Chénier, B. d'Aligny, F. Pellerin, P.-É. Blanchard, T. Ozawa, I. Carusotto, and P. St-Jean

Phys. Rev. X **16**, 011020 (2026) - Published 5 February, 2026

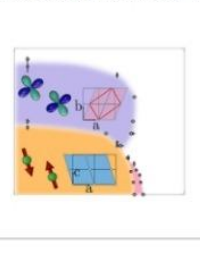


By encoding the Haldane model in the optical modes of a frequency comb, a photonic Chern insulator is realized that exhibits a driven-dissipative analogue of quantized Hall conductance.

Inducing Ferroquadrupolar Order with Applied Magnetic Field in TbPO$_4$

Paola Caterina Forino, Jens Jensen, Jian Rui Soh, Sonia Francoual, Oksana Zaharko, Steffen Sloth, Alexandra Turrini, Ralf Feyerherm, Karel Prokes, Sofie Holm-Janas, Ivica Zivkovic, Yong Liu, Arnaud Magrez, Niels Bech Christensen, Henrik M. Rønnow, and Rasmus Toft-Petersen

Phys. Rev. X **16**, 011021 (2026) - Published 6 February, 2026

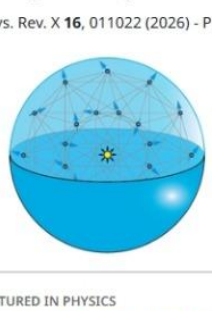


Magnetic fields are demonstrated to be able to be used to switch hidden electronic orders on and off in rare-earth magnets, uncovering a mechanism where field application induces rather than suppresses these elusive states

Yang-Lee Quantum Criticality in Various Dimensions

Erick Arguello Cruz, Igor R. Klebanov, Grigory Tarnopolsky, and Yuan Xin

Phys. Rev. X **16**, 011022 (2026) - Published 9 February, 2026



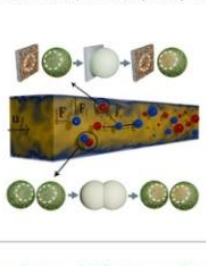
A study of the Yang-Lee universality class of critical phenomena, which arise in the Ising model with an imaginary magnetic field, finds broad agreement between $\mathcal{PT}$-symmetric Hamiltonians and conformal field theory.

FEATURED IN PHYSICS

Unifying Same- and Different-Material Particle Charging through Stochastic Scaling

Holger Grosshans, Gizem Ozler, Vyshnavi Veeravalli, and Simon Jantač

Phys. Rev. X **16**, 011023 (2026) - Published 11 February, 2026

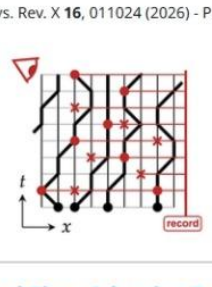


A model that predicts charging for different types of small particle collisions enables realistic simulations of electrostatic effects.

Monitored Fluctuating Hydrodynamics

Sarang Gopalakrishnan, Ewan McCulloch, and Romain Vasseur

Phys. Rev. X **16**, 011024 (2026) - Published 12 February, 2026

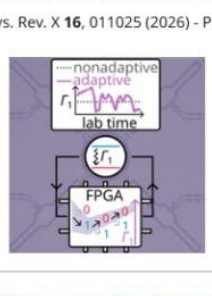


A monitored fluctuating hydrodynamics framework is introduced to study what can be learned about classical many-body dynamics from partial data. It is found that classical stochastic processes undergo phase transitions in learnability, mirroring striking effects in quantum systems.

Real-Time Adaptive Tracking of Fluctuating Relaxation Rates in Superconducting Qubits

Fabrizio Berritta, Jacob Benestad, Jan A. Krzywda, Oswin Krause, Malthe A. Marciniak, Svend Krøjer, Christopher W. Warren, Emil Hogedal, Andreas Nylander, Irshad Ahmad, Amr Osman, Janka Biznárová, Marcus Rommel, Anita Fadavi Roudsari, Jonas Bylander, Giovanna Tancredi, Jeroen Danon, Jacob Hastrup, Ferdinand Kuemmeth, and Morten Kjaergaard

Phys. Rev. X **16**, 011025 (2026) - Published 13 February, 2026

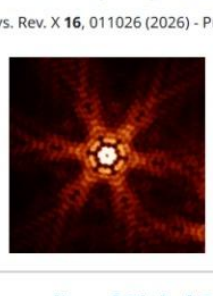


A field-programmable-gate-array-based Bayesian protocol is developed to track qubit relaxation fluctuations in real time, revealing environmental noise dynamics 10 000 times faster than previously reported.

Microscopic Fingerprint of Chiral Superconductivity

Xuefeng Wu, Xuan Hao, Zhuo Chen, Yuchang Cai, Minghao Wu, Congrun Chen, Kedong Wang, Fangfei Ming, Steven Johnston, Rui-Xing Zhang, and Hanno H. Weitering

Phys. Rev. X **16**, 011026 (2026) - Published 17 February, 2026

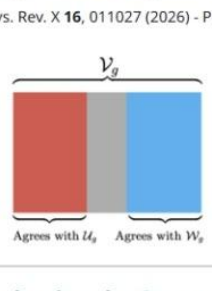


Direct imaging of electron scattering from atomic defects in a tin monatomic layer provides a clear microscopic signature of chiral superconductivity.

Anomalies of Global Symmetries on the Lattice

Yi-Ting Tu, David M. Long, and Dominic V. Else

Phys. Rev. X **16**, 011027 (2026) - Published 18 February, 2026

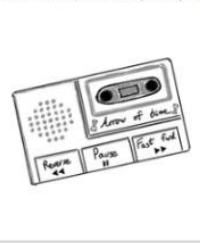


A rigorous framework is established to define and classify lattice anomalies, revealing unique "IR-trivial" invariants that constrain the physics of many-body-localized systems and more beyond the reach of standard field theories.

Reshaping the Quantum Arrow of Time

Luis Pedro García-Pintos, Yi-Kai Liu, and Alexey V. Gorshkov

Phys. Rev. X **16**, 011028 (2026) - Published 19 February, 2026

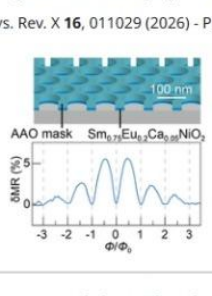


A quantum control Hamiltonian is developed that can blur or even reverse the perceived arrow of time in monitored systems, enabling new ways to emulate backward-in-time dynamics and extract energy to power measurement-driven engines.

Bosonic Phases across the Superconductor-Insulator Transitions in Infinite-Layer Samarium Nickelate

Menghan Liao, Heng Wang, Mingwei Yang, Chuanwu Cao, Jiayin Tang, Wenjing Xu, Xianfeng Wu, Guangdi Zhou, Haoliang Huang, Kaiwei Chen, Yuying Zhu, Peng Deng, Jianhao Chen, Zhuoyu Chen, Danfeng Li, Kai Chang, and Qi-Kun Xue

Phys. Rev. X **16**, 011029 (2026) - Published 19 February, 2026

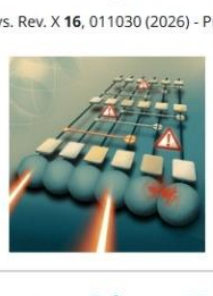


Magnetoresistance oscillations in nanofabricated nickelate networks reveal the existence of $2e$ Cooper pairing and exotic bosonic phases, clarifying the nature of superconductivity in these high-temperature materials.

Characterizing Physical and Logical Errors in a Transversal CNOT Gate via Cycle Error Reconstruction

Nicholas Fazio, Robert Freund, Debankan Sannamoth, Alex Steiner, Christian D. Marciniak, Manuel Rispler, Robin Harper, Thomas Monz, Joseph Emerson, and Stephen D. Bartlett

Phys. Rev. X **16**, 011030 (2026) - Published 20 February, 2026

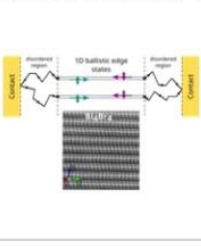


A scalable benchmarking framework using cycle error reconstruction is demonstrated to precisely identify and predict physical errors in a 14-qubit transversal CNOT, enabling a clearer path to fault-tolerant quantum computing.

Quantum Coherent Transport of 1D Ballistic States in Second-Order Topological Insulator Bi$_4$Br$_4$

Jules Lefeuvre, Masaru Kobayashi, Gilles Patriarche, Nathaniel Findling, David Troadec, Meydi Ferrier, Sophie Guéron, Hélène Bouchiat, Takao Sasagawa, and Richard Deblock

Phys. Rev. X **16**, 011031 (2026) - Published 20 February, 2026

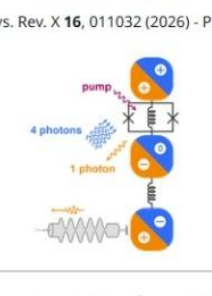


The transport measurements on Bi$_4$Br$_4$ single crystals here reveal the presence of 1D ballistic hinge states, confirming its status as a second-order topological insulator with exceptionally long phase coherence.

Dissipating Quartets of Excitations in a Superconducting Circuit

A. Vanselow, B. Beauseigneur, L. Lattier, M. Villiers, A. Denis, P. Morfin, Z. Leghtas, and P. Campagne-Ibarcq

Phys. Rev. X **16**, 011032 (2026) - Published 23 February, 2026

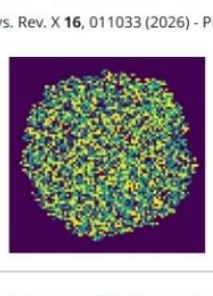


Four-photon dissipation in superconducting circuits moves quantum hardware toward stronger error protection.

Emergent Random Matrix Universality in Quantum Operator Dynamics

Oliver Lunt, Thomas Kriecherbauer, Kenneth T-R McLaughlin, and Curt von Keyserlingk

Phys. Rev. X **16**, 011033 (2026) - Published 23 February, 2026



Researchers prove that the dynamics of complex quantum operators has a universal random matrix description, enabling a new "spectral bootstrap" algorithm to accurately calculate physical properties like conductivities.

Emulating 2D Materials with Magnons

Bobby Kaman, Jinho Lim, Yingkai Liu, and Axel Hoffmann

Phys. Rev. X **16**, 011034 (2026) - Published 24 February, 2026

Patterning holes into magnetic thin films enables the emulation of electrons in 2D quantum materials and the precise control of magnon transport through topological band engineering.

Molecular Motion at the Experimental Glass Transition

Romain Simon, Jean-Louis Barrat, and Ludovic Berthier

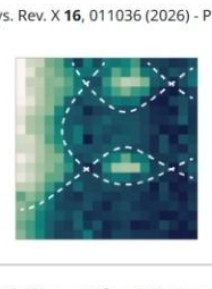
Phys. Rev. X **16**, 011035 (2026) - Published 24 February, 2026

A tailored algorithm allows for the simulation of molecular liquids near the experimental glass transition.

Exploring Light-Induced Phases of 2D Materials in a Modulated 1D Quasicrystal

Yifei Bai, Anna R. Dardia, Toshihiko Shimasaki, and David M. Weld

Phys. Rev. X **16**, 011036 (2026) - Published 25 February, 2026



Mapping a one-dimensional quasicrystal to a two-dimensional quantum Hall system allows for the study of light-induced metal-insulator transitions, revealing an exotic multifractal phase stabilized by elliptically polarized driving.

Stabilizer Rényi Entropy and Conformal Field Theory

Masahiro Hoshino, Masaki Oshikawa, and Yuto Ashida

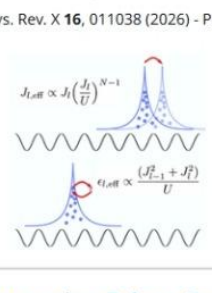
Phys. Rev. X **16**, 011037 (2026) - Published 25 February, 2026

Conformal field theory is used to uncover universal behaviors in nonstabilizerness. Like entanglement, this resource is governed by fundamental numbers such as the g factor.

Quantum Theory of Fractional Topological Pumping of Lattice Solitons

Julius Bohm, Hugo Gerlitz, Christina Jörg, and Michael Fleischhauer

Phys. Rev. X **16**, 011038 (2026) - Published 26 February, 2026

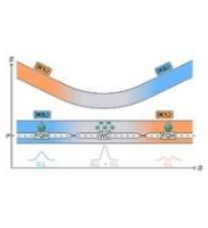


Self-bound many-particle objects (solitons) in topological pumps exhibit transitions between integer and fractional transport phases, controlled by interaction strength.

Interaction-Driven Quantum Phase Transitions between Topological and Crystalline Orders of Electrons

André Haug, Ravi Kumar, Tomer Firon, Misha Yutushui, Kenji Watanabe, Takashi Taniguchi, David F. Mross, and Yuval Ronen

Phys. Rev. X **16**, 011039 (2026) - Published 26 February, 2026

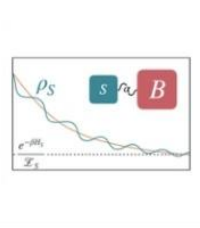


Electric-field-tunable Landau-level orbital composition in bilayer graphene provides a mechanism for stabilizing electron crystals and driving transitions into exotic topological liquid states.

Thermalization in Open Many-Body Systems and KMS Detailed Balance

Matteo Scandi and Álvaro M. Alhambra

Phys. Rev. X **16**, 011040 (2026) - Published 27 February, 2026

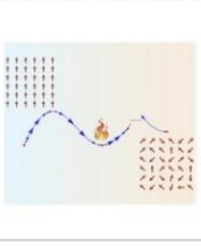


A new many-body thermalization model is derived using KMS detailed balance that avoids the rotating wave approximation, enabling more accurate tracking of quantum dynamics and efficient simulation on quantum computers.

Floquet Thermalization via Instantons near Dynamical Freezing

Rohit Mukherjee, Haoyu Guo, and Debanjan Chowdhury

Phys. Rev. X **16**, 011041 (2026) - Published 27 February, 2026

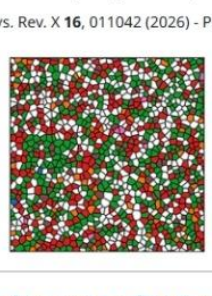


Researchers use flow renormalization to reveal that rare, sudden events called instantons puncture frozen states blocking the dynamics in periodically driven systems, triggering slow thermalization.

Hyperuniformity of Weighted Particle Systems

Salvatore Torquato, Jaeuk Kim, Michael A. Klatt, Roberto Car, and Paul J. Steinhardt

Phys. Rev. X **16**, 011042 (2026) - Published 2 March, 2026

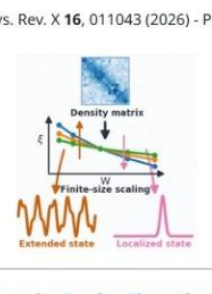


The concept of hyperuniform particle arrangements is generalized to treat particles with internal degrees of freedom.

Anderson Localization: A Density Matrix Approach

Ziyue Qi, Yi Zhang, Mingpu Qin, Hongming Weng, and Kun Jiang

Phys. Rev. X **16**, 011043 (2026) - Published 2 March, 2026

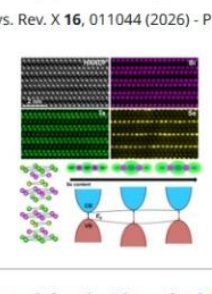


Characterization of the one-body density matrix provides a direct measure of the localization length, revealing how interactions can suppress or enhance insulating behavior in disordered quantum systems.

Atomic-Scale Chemical Inhomogeneity as a Determinant of Thermoelectric Transport in Bi$_2$Te$_3$-Based Materials

Wu Wang, Juan Cui, Zhongbin Wang, Jianrui Wang, Mingyuan Hu, Lin Xie, Lin Gan, and Jiaqing He

Phys. Rev. X **16**, 011044 (2026) - Published 3 March, 2026

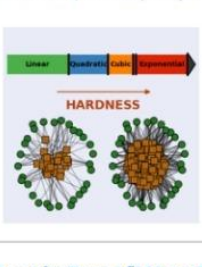


Atomic-scale imaging and theory show Se site preference in Bi$_2$Te$_3$ tunes the bonding and band gap, enabling intrinsic control of thermoelectric performance.

Algorithmic Thresholds in Combinatorial Optimization Depend on the Time Scaling

M. C. Angelini, M. Avila-González, F. D'Amico, D. Machado, R. Mulet, and F. Ricci-Tersenghi

Phys. Rev. X **16**, 011045 (2026) - Published 3 March, 2026



A quantitative study of simulated annealing in random K-satisfiability and q-coloring problems reveals that algorithmic thresholds in combinatorial optimization are heavily dependent on the time scaling relative to system size.

Entropic Tug of War: Topological Constraints Spontaneously Rectify the Dynamics of a Polymer with Heterogeneous Fluctuations

Adam H. T. P. Höfler, Iurii Chubak, Christos N. Likos, and Jan Smrek

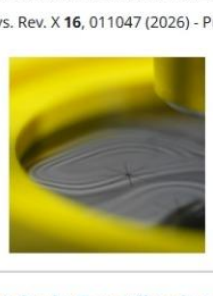
Phys. Rev. X **16**, 011046 (2026) - Published 4 March, 2026

By breaking translational symmetry, topological constraints together with heterogeneous fluctuations can induce persistent directional motion in dense polymer systems, providing a deeper understanding of living chromatin dynamics.

Microscale Architected Materials for Elastic Waveguiding: Fabrication and Dynamic Characterization across Length and Time Scales

Vignesh Kannan, Charles Dorn, Ute Drechsler, and Dennis M. Kochmann

Phys. Rev. X **16**, 011047 (2026) - Published 5 March, 2026

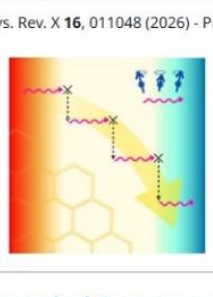


An experimental protocol for fabricating and characterizing microarchitected materials overcomes prior limitations.

Extrinsic Contribution to Bosonic Thermal Hall Transport

Léo Mangeolle and Johannes Knolle

Phys. Rev. X **16**, 011048 (2026) - Published 5 March, 2026

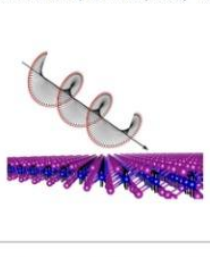


Disorder-induced side-jump effects, often neglected, are proven to be a crucial contributor to the thermal Hall conductivity in insulating quantum materials.

Dynamical Response of Noncollinear Spin Systems at Constrained Magnetic Moments

Miquel Royo and Massimiliano Stengel

Phys. Rev. X **16**, 011049 (2026) - Published 6 March, 2026

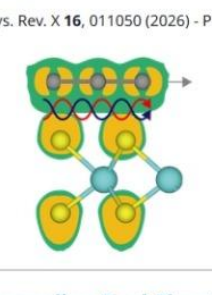


Constrained magnetic-moment simulations provide a stable and efficient framework for modeling coupled spin-lattice dynamics, enabling precise predictions of subgap optical responses in magnetic insulators.

On-Device Control of Electronic Friction

Zhaokuan Yu, Jinbo Bian, Jin Wang, Zonghuiyi Jiang, Xuanyu Huang, Linxin Zhai, Xin Lu, Xiaofei Liu, Quanshui Zheng, and Zhiping Xu

Phys. Rev. X **16**, 011050 (2026) - Published 6 March, 2026

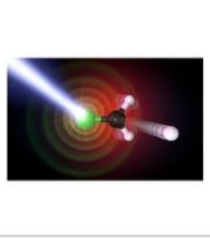


Superlubric graphite-MoS$_2$ contacts are constructed to demonstrate the isolation and control of electronic friction, showing a path toward on-demand tuning of energy dissipation in microscale devices.

Unraveling Real-Time Chemical Shifts in the Ultrafast Regime

Daniel E. Rivas, Lorenzo Paoloni, Rebecca Boll, Alberto De Fanis, Ana Martínez Gutiérrez, Tommaso Mazza, Solène Oberli, Oliver Alexander, André Al-Haddad, Thomas M. Baumann, Christoph Bostedt, Simon Dold, Gianluca Geloni, Markus Ilchen, Dooshaye Moonshiram, Daniel Rolles, Artem Rudenko, Philipp Schmidt, Svitozar Serkez, Sergey Usenko, Ángel Martín Pendás, Michael Meyer, Jesús González-Vázquez, and Antonio Picón

Phys. Rev. X **16**, 011051 (2026) - Published 9 March, 2026

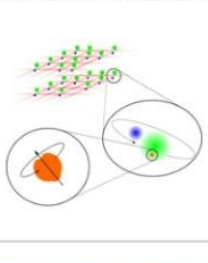


Combining ultrafast x-ray measurements with a theoretical model allows for tracking bond breaking, molecular motion, and chemical reactions.

Ultracold High-Spin Σ-State Polar Molecules for New Physics Searches

Alessio Ciamei, Adam Koza, Marcin Gronowski, and Michał Tomza

Phys. Rev. X **16**, 011052 (2026) - Published 9 March, 2026

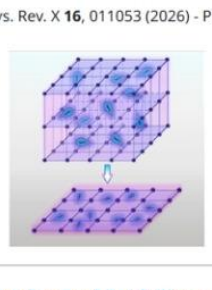


Ultracold YbCr molecules, featuring large internal electric fields and an ideal rotational structure controllable with modest laboratory fields, are proposed as a sensitive platform for probing physics beyond the standard model.

Dimensionality Tuning of Heavy-Fermion States in Ultrathin CeSi$_2$ Films

Yi Wu, Weifan Zhu, Teng Hua, Yuan Fang, Yanan Zhang, Jiawen Zhang, Yanen Huang, Hao Zheng, Shanyin Fu, Xinying Zheng, Zhengtai Liu, Mao Ye, Ye Chen, Tulai Sun, Michael Smidman, Johann Kroha, Chao Cao, Huiqiu Yuan, Frank Steglich, Hai-Qing Lin, and Yang Liu

Phys. Rev. X **16**, 011053 (2026) - Published 10 March, 2026

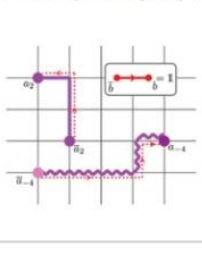


Thickness-dependent studies of CeSi$_2$ films reveal that the transition from three to two dimensions suppresses crystal electric field excitations and reduces the effective Kondo energy in heavy-fermion systems.

Topological Stabilizer Models on Continuous Variables

Julio C. Magdalena de la Fuente, Tyler D. Ellison, Meng Cheng, and Dominic J. Williamson

Phys. Rev. X **16**, 011054 (2026) - Published 11 March, 2026

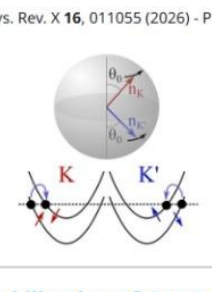


Researchers develop topological stabilizer codes that leverage infinite-dimensional local degrees of freedom. These codes realize quantum phases with universal properties that go beyond discrete variable stabilizer codes.

Superconductivity from Spin-Canting Fluctuations in Rhombohedral Graphene

Zhiyu Dong, Étienne Lantagne-Hurtubise, and Jason Alicea

Phys. Rev. X **16**, 011055 (2026) - Published 12 March, 2026

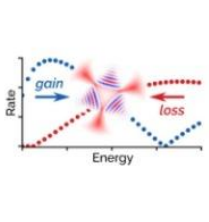


A study predicts that soft magnon modes arising from spin-canting order can give rise to Cooper pairing in spin-orbit-proximitized rhombohedral graphene, naturally accounting for various experimentally observed trends.

Stabilization of Cat-State Manifolds Using Nonlinear Reservoir Engineering

Ivan Rojkov, Matteo Simoni, Elias Zapusek, Florentin Reiter, and Jonathan Home

Phys. Rev. X **16**, 011056 (2026) - Published 13 March, 2026



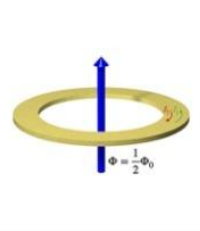
A nonlinear reservoir engineering approach is proposed, enabling the stabilization and error correction of multicomponent Schrödinger cat manifolds through the destructive interference of nonlinear gain and loss processes.

FEATURED IN PHYSICS

Persistent Spin Currents in Superconducting Altermagnets

Kyle Monkman, Joan Weng, Niclas Heinsdorf, Alberto Nocera, Yafis Barlas, and Marcel Franz

Phys. Rev. X **16**, 011057 (2026) - Published 16 March, 2026



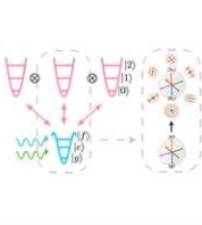
Persistent spin currents in superconducting altermagnets offer a dissipationless mechanism for spin transport that could enable the development of high-efficiency spintronic computer chips.

FEATURED IN PHYSICS

Fast Sideband Control of a Multimode Cavity Memory with Weak Dispersive Coupling to a Transmon

Jordan Huang, Thomas J. DiNapoli, Gavin Rockwood, Ming Yuan, Prathyankara Narasimhan, Eesh Gupta, Mustafa Bal, Francesco Crisa, Sabrina Garattoni, Yao Lu, Liang Jiang, and Srivatsan Chakram

Phys. Rev. X **16**, 011058 (2026) - Published 17 March, 2026

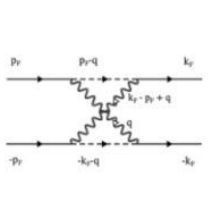


Researchers use fast "sideband control" to swap quantum information between a processor and a superconducting-cavity memory far faster than traditional dispersive methods, even when the two are only weakly coupled. This enables robust encoding gates and reliable quantum storage in high-quality superconducting cavities.

Superconductivity via Paramagnon and Magnon Exchange in a 2D Near-Ferromagnetic Full Metal and Ferromagnetic Half-Metal

Zachary M. Raines and Andrey V. Chubukov

Phys. Rev. X **16**, 011059 (2026) - Published 18 March, 2026

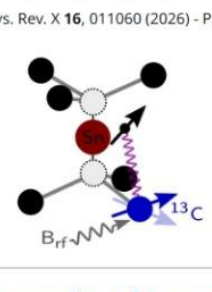


Theoretical analysis of two-dimensional electron systems shows that magnon-mediated interactions drive robust p-wave superconductivity within a ferromagnetically order state at a temperature significantly higher than in a paramagnetic state.

High-Fidelity Control of a ^{13}C Nuclear Spin Coupled to a Tin-Vacancy Center in Diamond

Jeremias Resch, Ioannis Karapatzakis, Mohamed Elshorbagy, Marcel Schrodin, Philipp Fuchs, Philipp Graßhoff, Luis Kussi, Christoph Sürgers, Cyril Popov, Christoph Becher, Wolfgang Wernsdorfer, and David Hunger

Phys. Rev. X **16**, 011060 (2026) - Published 19 March, 2026

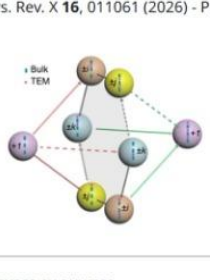


High-fidelity control of a ^{13}C nuclear spin coupled to a tin-vacancy center yields coherence times exceeding 1.35 s using a superconducting waveguide, highlighting the potential of the tin-vacancy center as a coherent spin-photon interface for future quantum network applications.

Observation of Anomalous Floquet Non-Abelian Topological Insulators

Huahui Qiu, Shuaishuai Tong, Qicheng Zhang, Kun Zhang, and Chunyin Qiu

Phys. Rev. X **16**, 011061 (2026) - Published 20 March, 2026



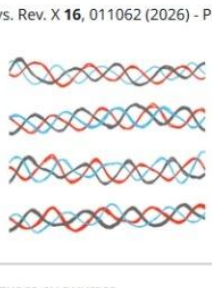
An anomalous Floquet non-Abelian topological insulator is realized in an acoustic system, exhibiting robust edge states across all band gaps, despite a trivial bulk charge, and unique topological interface modes arising from noncommutative dynamics.

FEATURED IN PHYSICS

Slow Quasiparticle Dynamics and Anyonic Statistics in a Fractional Quantum Hall Fabry-Pérot Interferometer

Noah L. Samuelson, Liam A. Cohen, Will Wang, Simon Blanch, Takashi Taniguchi, Kenji Watanabe, Michael P. Zaletel, and Andrea F. Young

Phys. Rev. X **16**, 011062 (2026) - Published 23 March, 2026



Anyons, collective excitations of fractional quantum Hall systems, are shown to exhibit unprecedented stability in graphene heterostructures, enabling their practical manipulation for use in fault-tolerant quantum computing.

FEATURED IN PHYSICS

Scalable Photonic Quantum Interconnect Platform

Daniel Riedel, Teodoro Graziosi, Zhuoxian Wang, Chawina De-Eknamkul, Alex Abulnaga, Jonathan Dietz, Andrea Mucchietto, Michael Haas, Madison Sutula, Pierre Barral, Matteo Pompili, Mouktik Raha, Carsten Robens, Jeonghoon Ha, Denis Sukachev, David Levonian, Mihir Bhaskar, Matthew Markham, and Bartholomeus Machielse

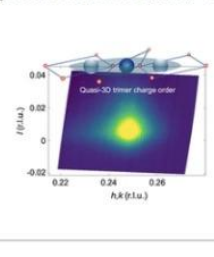
Phys. Rev. X **16**, 011063 (2026) - Published 24 March, 2026

A wafer-scale platform integrating high-quality diamond membranes with functionalized silicon substrates enables the parallel fabrication of quantum memory arrays with near-unity yield, paving the way for the mass production of modular quantum interconnects.

Cooperative Charge Ordering Signature of Trimer Molecules in Infinite-Layer CaCoO$_2$

J.-S. Lee, W. J. Kim, A. Khandelwal, K.-T. Ko, H. Lee, C.-T. Kuo, S. Song, C. Song, D. Jang, H. Choi, G. Park, S.-Y. Park, G. Kang, H. Jang, P. Abdollahi, A. Seo, C.-C. Kao, and H. Y. Hwang

Phys. Rev. X **16**, 011064 (2026) - Published 24 March, 2026

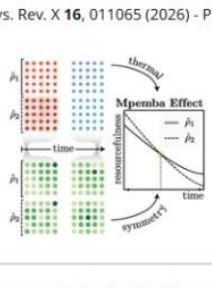


Resonant x-ray scattering in CaCoO$_2$ reveals a quasi-three-dimensional trimer charge order linked to interlayer orbital hybridization, establishing molecular units as key organizers for macroscopic electronic states.

Resource-Theoretical Unification of Mpemba Effects: Classical and Quantum

Alessandro Summer, Mattia Moroder, Laetitia P. Bettmann, Xhek Turkeshi, Iman Marvian, and John Goold

Phys. Rev. X **16**, 011065 (2026) - Published 25 March, 2026

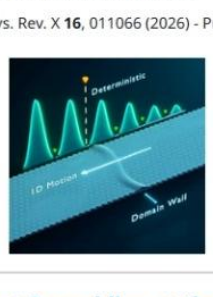


A unified theory of Mpemba effects across a variety of contexts is provided using resource theories. Faster relaxation occurs when states with a larger amount of resources have a smaller overlap with the slowest resourceful relaxation channel.

Deterministic 1D Domain Wall Motion with Nucleation-Free Nature in Sliding Ferroelectric Switching

Jiangang Chen, Changming Ke, Renji Bian, Er Pan, Peter Kun, Zefen Li, Biao Dong, Fan Yang, Qing Liu, Levente Tapaszto, Xiao Luo, Shi Liu, and Fucai Liu

Phys. Rev. X **16**, 011066 (2026) - Published 26 March, 2026

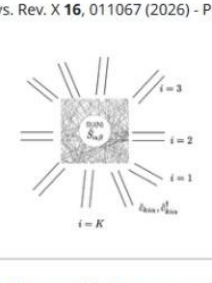


Sliding ferroelectrics possess a nucleation-free nature, where collective and constrained domain wall motion enables deterministic polarization control far beyond conventional ferroelectrics.

Fast Scrambling at the Boundary

Ancel Larzul, Anirvan M. Sengupta, Antoine Georges, and Marco Schirò

Phys. Rev. X **16**, 011067 (2026) - Published 26 March, 2026

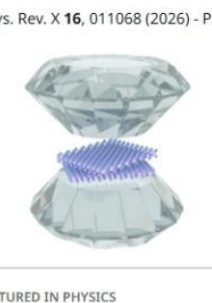


Researchers find that a simple boundary quantum spin in the multichannel Kondo model can scramble information as fast as the most complex random systems, revealing a link between impurity physics and fast scramblers.

Hydrostatic Pressure-Enhanced Correlated Magnetism and Chern Insulator in Moiré WSe$_2$

Pengfei Jiao *et al.*

Phys. Rev. X **16**, 011068 (2026) - Published 27 March, 2026



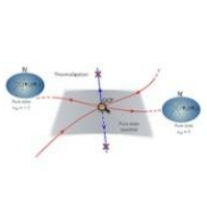
Hydrostatic pressure acts as a reversible control knob in twisted WSe$_2$ to enhance ferromagnetism and drive topological phase transitions between Chern and Mott insulating states.

FEATURED IN PHYSICS

Fermion Quantum Criticality far from Equilibrium

Rohan Mittal, Tom Zander, Johannes Lang, and Sebastian Diehl

Phys. Rev. X **16**, 011069 (2026) - Published 30 March, 2026

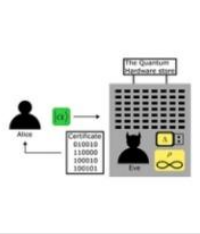


A new nonequilibrium universality class for fermions is identified. It displays an emergent "dark state symmetry" that protects quantum criticality, requiring only a single tuning parameter.

Continuous Variable Measurement-Device-Independent Quantum Certification

B. L. Larsen, A. A. E. Hajomer, P. Abiuso, S. Izumi, T. Gehring, J. S. Neergaard-Nielsen, A. Acín, and U. L. Andersen

Phys. Rev. X **16**, 011070 (2026) - Published 30 March, 2026

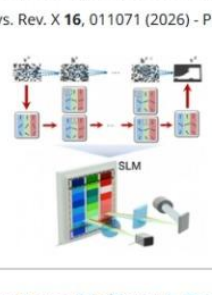


Researchers demonstrate a measurement-device-independent certification for continuous-variable systems. By using coherent states, they show that entanglement and memory can be verified even with untrusted hardware.

Photonic Restricted Boltzmann Machine for Content Generation Tasks

Li Luo, Yisheng Fang, Wanyi Zhang, and Zhichao Ruan

Phys. Rev. X **16**, 011071 (2026) - Published 31 March, 2026



A newly developed photonic restricted Boltzmann machine accelerates generative artificial intelligence by executing complex Gibbs sampling optically, overcoming traditional electronic computing bottlenecks.

Erratum: Unitary k-Designs from Random Number-Conserving Quantum Circuits [Phys. Rev. X **15**, 021022 (2025)]

Sumner N. Hearth, Michael O. Flynn, Anushya Chandran, and Chris R. Laumann

Phys. Rev. X **16**, 019901 (2026) - Published 20 January, 2026

Erratum: Strongly Interacting, Two-Dimensional, Dipolar Spin Ensembles in (111)-Oriented Diamond [Phys. Rev. X **15**, 021035 (2025)]

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