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## HIGHLIGHTED ARTICLES

FEATURED IN PHYSICS
**Information, movement, and adaptation in human vision**
Alexander J. H. Houston, David H. Brainard, Ramesh K. Sridharan, and David J. Heeger
Phys. Rev. Research 8, 023081 (2026) - Published 29 April, 2026

A model captures how the retina avoids tuning out during a fixed gaze.



EDITORS' SUGGESTION
**Error detection without postselection in adaptive quantum circuits**
Eli Chertkov, Andrew J. Potter, David Huse, and Michael Foss-Feig
Phys. Rev. Research 8, 023077 (2026) - Published 16 April, 2026




Current quantum computers are noisy and require either scalable and costly error correction or error mitigation. We propose error detection in analog quantum circuits as an intermediate approach and present a practical and cheap error detection framework that avoids postselection, which they use to simulate a nonequilibrium phase transition in an open quantum system on a trapped-ion quantum computer.

EDITORS' SUGGESTION
**Trapping and cooling mechanisms in blue-detuned magneto-optical traps of molecules**
Dimitis Lycarelli & Ni Yahuai
Phys. Rev. Research 8, 023079 (2026) - Published 8 June, 2026



This work identifies the mechanisms responsible for trapping and cooling in a blue-detuned magneto-optical trap driven by a pair of closely spaced frequency components of opposite circular polarization. When the thermal-spitting matches the frequency difference between the two components, there is a state that's dark to the trap-cooling transition and experiences a net force in one of the opposite direction, generating a radiation pressure force toward the field zero.

EDITORS' SUGGESTION
**Dynamical phase transitions across slow and fast regimes in a two-tone driven Duffing resonator**
Soumya S. Kumar, Jacob Ilan Ma, Letizia Catalini, Alexander Eisner, and Eldad Bibchenko
Phys. Rev. Research 8, 023084 (2026) - Published 15 June, 2026



The dynamical phase transitions of a Duffing resonator subjected to a bichromatic drive across the slow- and fast-beating regimes are mapped. An analytical threshold to observe these transitions based on an effective nonlinear response theory is provided, explaining the mechanisms behind these processes. Complementary analytical treatments for the slow and fast regimes are supplied.

EDITORS' SUGGESTION
**Experimental measurement and a physical interpretation of quantum shadow enumerators**
Daniel Gottesman, Lukas Pondor, Alex Steiner, Lennart Bittel, Gregory A.L. White, Yifan Tang, Eric L. Kaufman, Antonio Z. Mele, Sumeet Shah, Lorenzo Leone, Jens Carrasco, Christian D. Marciniak, Sven Pogorelov, Milena Guevara-Bertsch, Robert Prevedel, Rainer Blatt, Philipp Schindler, Thomas Monz, Martin Kliesmann, Andreas Buchleitner
Phys. Rev. Research 8, 023078 (2026) - Published 10 June, 2026



This article shows that Kalai-Gottesman shadow enumerators, a powerful tool in quantum error correction, admit a direct physical interpretation in terms of outcome statistics of two-copy Bell measurements. This connection enables efficient learning protocols for these quantities and is demonstrated experimentally on a trapped-ion quantum device.

## LETTERS

LETTER
**First electron acceleration in a tunable-velocity laser wakefield**
Karen Cakmakyan, Anton Golovanov, Oleg Smorenburg, Anna-Maria Talpai, Sheng Tang, and Victor Malka
Phys. Rev. Research 8, L022007 (2026) - Published 7 April, 2026




Flying-focus wakefields promise to overcome the dephasing limit in laser-wakefield acceleration, enabling the acceleration of higher-energy electrons. This work shows that tunable-velocity flying-focus wakefields can maintain the coherent structure necessary for accelerating ultrarelativistic electrons. It also shows that tuning the propagation velocity of the wakefield imparts the maximum electron energy, suggesting the partial mitigation of dephasing.

LETTER
**Long nuclear spin coherence times for molecules trapped in high-purity solid parahydrogen**
Alexander P. Mishkevich and Jonathan D. Weinstein
Phys. Rev. Research 8, L022002 (2026) - Published 7 April, 2026



The nuclear spin coherence of HD molecules trapped in solid hydrogen is measured. The proton coherence time increases as the magnetic impurities in the solid are reduced, until a limit from the solid itself is reached. Because of the unusual nature of solid hydrogen, long coherence times can be obtained in the solid phase without magic angle spinning.

LETTER
**Direct observation of three-neutron emission from $^{7}$He$^{*}$ and the search for the trineutron**
S. M. Wang et al.
Phys. Rev. Research 8, L022003 (2026) - Published 7 April, 2026



Three-neutron emission from the neutron-rich unbound nucleus $^{7}$He was observed for the first time. The kinematics of the measured three-neutron resonance means spectrum and correlations constrain the decay mechanism and the possible contribution of a trineutron component.

LETTER
**Sub-kHz mechanical resonator passively cooled to 6 mK**
Jacob van Dijsseldonk, Jonny Plugge, Tim M. Hu, Ale Bu, Kustin, Jan de Dingo, Gerd Hensel, Thijmen de Jong, Jasper Bijl, Wim A. Bosch, and Sjoerd H. Hooikoolong
Phys. Rev. Research 8, L022004 (2026) - Published 7 April, 2026



Passive cooling of a 700 Hz massive 0.5 mg mechanical oscillator down to 6 mK is demonstrated. The oscillator is thermally decoupled, as could need by detecting its thermal motion via a sub-Kelvin detection scheme. At this temperature, the thermal motion of the resonator is still clearly distinguishable from the background noise and the origin of its thermal saturation are discussed.

LETTER
**Radiation-tolerant polarized solid target**
Y. Ichikawa, T. Ishikawa, T. Kaneko, S. Kawai, T. Komatsu, Y. Maeda, Y. Miyachi, H. Nagata, H. Nishibata, S. Okada, K. Sakai, K. Sugahara, R. Suzuki, T. Suzuki, T. Takaya, and K. Watanabe
Phys. Rev. Research 8, L022005 (2026) - Published 7 April, 2026




Radiation damage caused by radicals generated during high-intensity beam irradiation can be repaired through annealing. On the basis of this concept, researchers have developed a polarized proton solid target that maintains high polarization and dynamic nuclear polarization with photoconductive light emission.

LETTER
**Realizing a topological staggered Su-Schrieffer-Heeger ladder with atomic momentum lattice**
Yi-Fi Zhao, Chao Zeng, Fei-Fei Ma, Yan-Jun Liu, Tian Xue, Yu-Ao Chen, Han-Xing Dai, and Jian-Wei Pan
Phys. Rev. Research 8, L022006 (2026) - Published 8 April, 2026



A staggered Su-Schrieffer-Heeger ladder is realized in an atomic momentum chain by introducing fully controlled next-nearest neighbor couplings. By tracking the bulk dynamics of wave packets, the experiment maps the two-dimensional topological phase diagram of the ladder model and identifies three phases characterized by winding numbers.

LETTER
**Neural wave functions for high-pressure atomic hydrogen**
David Ernesto, Sandro Morresi, Giuseppe Carleo, and Markus Holzmann
Phys. Rev. Research 8, L022007 (2026) - Published 7 April, 2026



A neural quantum state wave function for high-pressure atomic hydrogen is optimized using the variational Monte Carlo method in the same variational framework, both under the Born-Oppenheimer approximation and beyond it. Using this approach, the calculated ground-state energies match or improve on established projector Monte Carlo benchmarks, and the simulations capture the change from crystalline order to a liquid-like phase under extreme compression.

LETTER
**Hilbert space geometry and quantum chaos**
Rudolph Sharlow, Anastasia Tiukalova, Alexander Gorsky, Vladimir Schaveet, and Andrei Pokhorotov
Phys. Rev. Research 8, L022008 (2026) - Published 9 April, 2026



Hilbert space geometry defined by the quantum geometric tensor is analyzed for quantum-dependent random matrix nonintegrable. The quantum metric forms a smooth manifold in the ergodic regime but develops a conical defect near integrable points.

LETTER
**Coherent attosecond x-ray pulses from laser-driven relativistic plasma mirrors**
M. Lamut, P. Valenza, C. Chenaux, J. Nejdl, T. M. Jeong, and S. V. Bulanov
Phys. Rev. Research 8, L022009 (2026) - Published 9 April, 2026




A nonlinear plasma wave driven by a proton or electron particle beam can form a relativistic mirror that compresses and amplifies an optical laser into a coherent attosecond x-ray pulse. By comparing the principles theory with multidimensional particle-in-cell simulations, this work identifies laser-driven relativistic plasma mirrors as a promising route for bright coherent x-ray generation.

LETTER
**Bipartite entanglement measures for anyonic systems**
Zhenhao Ye, Li Yao, and Cheng-Qian Ma
Phys. Rev. Research 8, L022010 (2026) - Published 10 April, 2026



Bipartite entanglement in anyonic systems, whose state spaces are shaped by fusion rules and superselection constraints, is investigated. We show that conventional entanglement measures can be generalized to theoretic framework and establish an additive decomposition of total entanglement into conventional entanglement and anyonic charge entanglement.

LETTER
**Temperature of an active nematic**
Jay M Pitt, Alvil Lam, and Rudolf Oldt
Phys. Rev. Research 8, L022011 (2026) - Published 13 April, 2026



A thermal hydrodynamic framework is developed for active nematics coupled to an environment and is used to analyze temperature dynamics near steady states. While linear temperature fluctuations remain insensitive to activity, nonlinear fluctuations lead to consumption, spontaneous flow in confined geometries generates dissipative inhomogeneous temperature profiles that provide a thermal signature of activity.

LETTER
**Phase separation in a mixture of proliferating and motile active matter**
Lukas Hupe, Jonathan W. Bleiberg, David Zwicker, Martin Gebauer, Bartlomiej Mazlow, and Philip Bittihn
Phys. Rev. Research 8, L022012 (2026) - Published 13 April, 2026



In a mixture of growing and motile particles, the proliferating component drives the formation of dense clusters, while motility suppresses into dense clusters. By constructing an effective model, researchers trace this behavior to growth-induced fluctuations and emergent attractive interactions, revealing a distinct mechanism of phase separation in mixed active matter, with potential relevance for tissues, turbers, and biofilms.

LETTER
**Continuous matrix-product operators for quantum fields**
Francesc Tarazona-Vera, Ignacio Cirac
Phys. Rev. Research 8, L022013 (2026) - Published 14 April, 2026



By exploiting a tick-like representation of matrix-product operators, this work provides an ansatz for matrix-product operators for quantum fields. The ansatz allows for explicit constructions of many nontrivial families of continuous matrix-product operators and contains the class of matrix-product operators that have well-defined continuous limits.

LETTER
**Interface fragmentation via horizontal vibration: A pathway to scalable monodisperse emulsification**
Linfeng Pan and Anna Lee
Phys. Rev. Research 8, L022014 (2026) - Published 14 April, 2026



This work presents a method for producing size-tunable monodisperse emulsions utilizing the interfacial instability that arises near the wed walls of a horizontally vibrated vessel containing two immiscible liquid layers. This approach allows for the upscaled production of monodisperse emulsions.

LETTER
**Static impurity in a mesoscopic system of $SU(N)$ fermionic matter waves**
Jean Polo, Nayana J. Chetcuti, Anna Minguzzi, Andreas Osterloh, and Luigi Amico
Phys. Rev. Research 8, L022015 (2026) - Published 15 April, 2026



A static impurity in a mesoscopic ring of SU(N) fermions is an artificial gauge field provides a controlled setting to study flow interactions. Exact diagonalization and mean-field calculations are used to determine the eraser-wave flow induced by the applied effective flux. The resulting competition between single-particle screening and specific collective dynamics produces distinct signatures in the density and persistent currents, including flux fractionalization and symmetry-selective gap openings.

LETTER
**Hamiltonian model for energy condensation in classical systems: Relevance to protons**
Jordana Pinto, Nachi Gaedelli, Elena Kharlan, Sergey Kalmo, and Alexei Petrov
Phys. Rev. Research 8, L022016 (2026) - Published 15 April, 2026



This work explores energy condensation in a classical Hamiltonian system of coupled vibrational modes interacting with a thermal bath and an energy source. It shows how low-frequency modes become dynamically isolated under specific oscillation conditions and examines the robustness of this behavior against Fermi-Pasta-Ulam-type nonlinearities. It also discusses possible implications for vibrational energy redistribution in the ultrafast dissociation paradigm.

LETTER
**Delayed active swimmer in a velocity landscape**
Oleksii Malakhov, Alexander Pechko, Giovanni Volpe, and Hartmut Löwen
Phys. Rev. Research 8, L022017 (2026) - Published 22 April, 2026



Theory, simulations, and experiments on thermophoretic Janus particles in a velocity landscape show that the nonequilibrium response of active particles to a spatially varying velocity landscape produces a tunable density accumulation and a polarization inversion controlled by the competition between the response delay and the diffusion length.

LETTER
**Vortex refraction and enhanced vortex velocities at tilted superconductor-normal metal interfaces**
Sander E. L. Bakker, Cristian Cuppens, Chenney, and Erik Scheeder
Phys. Rev. Research 8, L022018 (2026) - Published 27 April, 2026



Using a modified time-dependent Ginzburg-Landau formulation, this work explores vortices bent across differently tilted superconductor/normal metal interfaces and identifies a refraction effect that enhances vortex velocities. In a complement, a refracted vortex core is found to develop a relative displacement in neighboring materials owing to unequal vortex viscosities.

LETTER
**Tailoring interaction ranges in atom arrays**
T. Bintsung, G. Chandler, T. Sayrin, and S. Scholzenberger
Phys. Rev. Research 8, L022019 (2026) - Published 30 April, 2026



The range of dipolar interactions in optical tweezer atom arrays is made tunable by strategically positioning for detuned relay atoms that act as controllable mediators of excitation exchange.

LETTER
**Numerical case for identifying paired quantum Hall phases by their daughter states**
Mohit Vasishtar, Arjun Dey, and David F. Mross
Phys. Rev. Research 8, L022020 (2026) - Published 30 April, 2026




Many candidate non-Abelian quantum Hall states are accompanied by nearby "daughter" states that have been proposed as experimental fingerprints of the parent topological order. Using exact diagonalization and density matrix renormalization group, we provide a numerical test of this parent-daughter relationship by demonstrating that the same interactions favor both states.

LETTER
**Nonequilibrium thermodynamics in driven macromolecular self-assembly**
S. J. Thomson, J. M. Rorrison, and G. M. Harris
Phys. Rev. Research 8, L022021 (2026) - Published 1 May, 2026



Supercritical Faraday waves are used to drive structural rearrangements of small clusters of spherical particles bound by capillary attractions. Direct measurement of transition statistics between metastable cluster configurations reveals a nonzero entropy production rate reflecting broken detailed balance, in quantitative agreement with a theoretical active-matter model.

LETTER
**Phase structure of below-threshold harmonics in aligned molecules: A few-level model system**
Samuel Eckart, Lisa Bellke, Falko Ehrt-Wachmann, Franziska Ferrel, and Dieter Bauer
Phys. Rev. Research 8, L022022 (2026) - Published 4 May, 2026



This work analyzes the phase and polarization structure of below-threshold harmonics from aligned molecules in a few-level model system. It shows that in a driven two-level system, harmonics below and above the transition frequency exhibit a qualitatively different phase behavior, a feature that directly imprints on the polarization of harmonics emitted from systems with orthogonal transitions.

LETTER
**Phase separation with nonlocal interactions**
Filippo E. Finnegan, Yunhong Jiang, Oliver M. Pavlov, and David Chandler
Phys. Rev. Research 8, L022023 (2026) - Published 4 May, 2026



The interplay between phase separation and nonlocal interactions is identified as a unifying mechanism underlying the morphologies of liquid droplets across systems ranging from living cells to elastic materials and charged liquids. Identifying short- and long-range contributions to the interfacial free energy, this work predicts generic phase transitions that produce distinct droplet morphologies and their coexistence, bridging conventional phase separation and pattern formation.

LETTER
**Topological homogenesis**
Jiwen Wang
Phys. Rev. Research 8, L022024 (2026) - Published 5 May, 2026




Dark matter may consist of long-range entangled topological order, so gapped anyonic excitations may decay to generate the standard model's lepton asymmetry.

LETTER
**Experimental measurement of quantum first-passage time distributions**
Joseph M. Ryan, Simon Gerber, Thomas J. Hosea, Mirshad C. Pulas, Stephen R. Tetsworth, and Crystal Noel
Phys. Rev. Research 8, L022025 (2026) - Published 7 May, 2026



First-passage time distributions for classical stochastic processes have been extensively studied both theoretically and experimentally. By contrast, the quantum case has been theoretically explored only in conceptual and very deep implications for both fundamental physics and the development of emerging quantum technologies. This work reports single-shot projective measurements of the quantum motion of a trapped ion subject to electric field noise using composite phase laser sequences. Such experiments set an an effective quantum filter for correlating quantum first-passage time distributions of the ion energy.

LETTER
**Topology and edge modes surviving criticality in non-Hermitian Floquet systems**
Longyan Zhou
Phys. Rev. Research 8, L022026 (2026) - Published 11 May, 2026



A theoretical framework based on Cauchy's argument principle on the generalized Brillouin zone is developed for non-Hermitian quasi-periodic systems. This framework predicts the emergence of non-Hermitian systems, providing unified winding numbers, bulk-edge correspondence, and entanglement characteristics at criticality. Applying this theory to a periodically quenched non-Hermitian Su-Schrieffer-Heeger chain reveals gapless symmetry-protected topological phases, where critical edge modes—including a modes localized in the non-Hermitian Floquet settings—survive at phase transitions.

LETTER
**Separation of the Kibble-Zurek mechanism from quantum criticality**
R. Jafari and Alireza Akbari
Phys. Rev. Research 8, L022027 (2026) - Published 11 May, 2026



The emergence of Kibble-Zurek scaling is shown to be controlled by the nonspecific modes participating in the dynamics rather than by quantum criticality alone. As a result, quenches across critical points may remain effectively adiabatic, while nonchiral quenches can still exhibit conventional Kibble-Zurek scaling.

LETTER
**Stochastic resetting versus thermal equilibration: Faster relaxation, different destination**
Ma Chen Fabio Cecconi, Bacek Wersberg, and Yael Roichman
Phys. Rev. Research 8, L022028 (2026) - Published 11 May, 2026



Stochastic resetting of Brownian motion in a harmonic potential always relaxes faster than thermal equilibration, with both the relaxation speed and the resulting nonequilibrium steady state governed by a single dimensionless parameter combining the resetting rate, viscosity, and potential stiffness.

LETTER
**Influence of quantum fluctuations on the spin-flop transition in hematite**
Tobias Dornweger, Dirk Hagenmüller, Levente Rózsa, and Ulrich Nowak
Phys. Rev. Research 8, L022029 (2026) - Published 11 May, 2026



An investigation of the spin-flop transition of a quantum spin model for hematite using different theoretical methods shows that, despite the presence of long-range order and large quantum numbers, correctly accounting for quantum fluctuations is essential to describe this phase transition accurately at low temperatures.

LETTER
**Winding-control mechanism of non-Hermitian systems**
Yongqi Hu and Yi Zheng
Phys. Rev. Research 8, L022030 (2026) - Published 11 May, 2026



By introducing conditional boundary conditions, a winding-control mechanism is established in non-Hermitian systems that links the spectral winding to metric the residual imaginary velocity, and the resulting spectral flow. This work shows that the spectral flow collapse of specific boundary-condition boundary condition quenches into their open-boundary condition counterparts, accompanied by a composite reconstruction of the bulk zone and the generalized Brillouin zone, thereby resolving a topological transition between distinct spectral-winding configurations.

LETTER
**Automated discovery of nonlocal photonic gates**
Dexter Ott, Mario Krenn, and Hannes Hu
Phys. Rev. Research 8, L022031 (2026) - Published 11 May, 2026



This work presents experimental proposals for nonlocal photonic quantum gates that act on spatially separated photons by exploiting quantum indistinguishability on path identity rather than pre-shared entanglement or Bell-state measurements. The underlying ideas were discovered by a machine learning algorithm and subsequently translated into concrete experimental blueprints by the automated quantum-optics design tool PyTheus, and subsequently interpreted and generalized into broader design principles.

LETTER
**Leveraging chaotic transients in the training of artificial neural networks**
Pedro Jiménez-Gonzáles, Miguel C. Soriano, and Lucas Lacasa
Phys. Rev. Research 8, L022032 (2026) - Published 11 May, 2026



Alternately large learning rates in the optimization of neural networks induce a transition to chaos of the training dynamics, where the network eventually loses its ability to learn the correct representation. However, close to the onset of chaotic network trajectories, the network still learns and can do so at an accelerated place.

LETTER
**Coherent vibrational dynamics in molecular bond breaking: Methyl radical umbrella mode probed by femtosecond x-ray spectroscopy**
Christian S. Schmidt, John B. Hack, Johnson J. Edwards, Zhuo Cheng, Tyler Kenyon, Ziyan Wang, Ken Wang, Daniel M. Neumark, and Stephen R. Leone
Phys. Rev. Research 8, L022033 (2026) - Published 12 May, 2026



This work discloses methyl radicals with a short pulse of ultraviolet light and tracks the temporal evolution of the emerging methyl radicals via their soft x-ray absorption. The "umbrella" vibrational mode of the radicals is excited coherently to a high degree, and by using a quantum-mechanical model of the x-ray transition energy shifts, the vibrational motion of the radicals is reconstructed from the ultrafast molecular dynamics of the radicals is reconstructed from the experiment.

LETTER
**Electric current control of helimagnetic chirality from a multidomain state in the helimagnet $Mn_3Ag_2$**
Yuta Kikuchi, Nobukiyo Ohkawa, Jun-Ichiro Ohe, Tatsuya Sakamoto, Takashi Tate, and Yoshinori Onuse
Phys. Rev. Research 8, L022034 (2026) - Published 20 May, 2026




Helimagnetic structures - magnetic textures with chirality or handedness—hold a domain wall as the interface between domains with opposite chirality. This helimagnetic domain wall is revealed to be highly mobile under electric current, leading to efficient chirality control with lower current density.

LETTER
**Tight bound for the total time in digital-analog quantum computation**
Mikel Garcia de Andoin and Mikel Sanz
Phys. Rev. Research 8, L022035 (2026) - Published 20 May, 2026



Digital-analog quantum computing combines the flexibility of the gate-based paradigm with the robustness of analog quantum simulation. Its performance has been characterized in terms of gate or hard problems. This work derives a tight upper bound on the optimal circuit time that scales linearly with the number of couplings. This result enables accurate resource estimation and allow fair comparisons with alternative paradigms.

LETTER
**Impossibility of quantum private queries**
Esther Hänggi and Severin Winkler
Phys. Rev. Research 8, L022036 (2026) - Published 20 May, 2026



This work investigates whether quantum communication protocols allow confidential access to a remote database. It shows that any protocol that does not reveal which client is retrieved allows the user to reconstruct the entire database.

LETTER
**Spinor pairing order enforced by Berry phase**
P.V. Lodi Grigoryan & Pavlos
Phys. Rev. Research 8, L022037 (2026) - Published 20 May, 2026



Pairing between Kerr surfaces with unequal Chern number pairs is shown to be enforced by a topological obstruction characterized by half-integer monopole harmonics and a spinor-valued order parameter. Consequences include a single degeneracy Weyl node that "relates" the Nielsen-Ninomiya theorem, protected gapless surface states, and a fractional Meissner-like relation for the superfluid velocity.

LETTER
**Large deviations in non-Markovian stochastic epidemics**
Malte Schmitz and Michael Kühl
Phys. Rev. Research 8, L022038 (2026) - Published 1 June, 2026



Researchers study non-Markovian epidemic models in a well-mixed setting and reveal that the nonexponential waiting-time distributions between successive infective (and/or recovery) events can significantly alter the final outbreak size distribution and disease lifetime compared with the Markovian case.

LETTER
**Compact cavity-dressed Hamiltonian framework at arbitrarily strong light-matter coupling**
Jakub Czerniak and Dario Poletti
Phys. Rev. Research 8, L022039 (2026) - Published 2 June, 2026



Researchers derive a compact bare-mapping method for open quantum light-matter systems that remains accurate and tractable apply to the open Dicke model and the Dicke-Heisenberg lattice model. They demonstrate advantage over conventional approaches in terms of error scaling with Hilbert space dimension and reveal cavity-mediated spin correlations analytically and numerically, achieving computational savings over brute-force simulations.

LETTER
**Correlational transformer neve functions**
Ha Chen, Pightesh Ostrovsky-Tarlé, and Mahesh Vijay
Phys. Rev. Research 8, L022040 (2026) - Published 2 June, 2026



A new study introduces the correlational transformer wave function, an architecture that, unlike earlier transformer-based approaches, properly harnesses the attention mechanism while respecting the symmetries of quantum systems, setting new accuracy benchmarks for frustrated magnets and quantum dynamics.

LETTER
**Experimentally realized local-global trade-off in quantum resources**
Yue Dai, Zhiyu Wang, Xinzhi Zhao, Jingbei Ye, and Chengjie Zhang
Phys. Rev. Research 8, L022041 (2026) - Published 3 June, 2026




The trade-off between local maximum coherence and quantum mutual information is experimentally investigated. It is found that their sum is bounded by a definitive upper limit. This result reveals a complementarity between crucial and global quantum resources.

LETTER
**Imaginary time spectral transforms for excited-state preparation**
D. A. Miller, S. M. Anderson, F. Alzamora, D. Wolfe, R. C. Farias, J. Y. Cui, and S. J. Thomas
Phys. Rev. Research 8, L022042 (2026) - Published 3 June, 2026




A variational method is presented for preparing excited eigenstates of many-body quantum systems, combining a shift-invert spectral transformation with imaginary time evolution to avoid explicit matrix inversion. The method is benchmarked on transverse-field Ising tensor-network simulations within a framework compatible with hybrid quantum-classical implementations.

LETTER
**Reproducible nucleation and control of stable quantum vortex rings in Bose-Einstein condensates**
Dongze Sun, Mingfei Xiao, Wen Jin Kwon, Davide Emilio Galli, and Luca Galbiati
Phys. Rev. Research 8, L022043 (2026) - Published 3 June, 2026



Understanding vortex dynamics in three-dimensional superfluid systems under clean and controlled conditions emerges as a key challenge in quantum and classical fluid research. This work introduces an experimentally feasible protocol for the on-demand nucleation and manipulation of stable quantum vortex rings in Bose-Einstein condensates. Numerical simulations explore systematically investigating how the protocol setup influences the ring dynamics and proposing a method to generate vortex excitations such as Kelvin waves.

LETTER
**Distinct reentrant transitions in a quasiperiodic Raman lattice**
Xingjie Wei, Zhenhua Yao, Tong Liu, Gao Xianlong, and Panjie Zhang
Phys. Rev. Research 8, L022044 (2026) - Published 4 June, 2026



Reentrant transitions are investigated in a one-dimensional Raman lattice with spin-orbit coupling and a Zeeman potential containing both uniform and quasiperiodic components. A reentrant criticality transition with multiple entries into the critical phase is identified, extending reentrant phenomena in quasiperiodic systems to include critical states. In addition to extended and localized states.

LETTER
**Effects of Berry curvature on ideal fractional Chern insulator many-body gaps**
Jingxian Shi, Jennifer Cano, and Nicolás Morales-Durán
Phys. Rev. Research 8, L022045 (2026) - Published 5 June, 2026



This work studies ideal and nearly ideal Chern bands relevant to semiconductor moiré materials. It shows how Berry curvature inhomogeneity destabilizes fractional Chern insulators in favor of charge density waves and explains this mechanism using the single-mode approximation.

LETTER
**Extending the dynamic range in quantum frequency estimation with sequential weak measurements**
Yu Dmitriev, Manuel Krämer, and Tuna Gefen
Phys. Rev. Research 8, L022046 (2026) - Published 5 June, 2026



A sequential-weak-measurement protocol is developed for Ramsey quantum frequency estimation with coherent spin states in which weakly entangled ancilla qubits track the sensing qubits during free evolution to suppress phase slips errors and extend the dynamic range. The protocol allows Heisenberg scaling with time and saturates the Cramér-Rao precision bound asymptotically across a large frequency bandwidth.

LETTER
**Testing the problem of time with cold atoms**
Giovanni Barontini
Phys. Rev. Research 8, L022047 (2026) - Published 11 June, 2026



An ultracold atomic gas is used as a self-contained minicosmos to show that time can be defined without an external clock. Its internal dynamics, governed by the Wheeler-DeWitt equation, and clocks of the system provides an internal time that robustly orders the dynamics and yields a Schrödinger description of the observed evolution.

LETTER
**Nonstabilizerness in molecular bonding**
Matthew Sarsa and Alexandre Reichenbach
Phys. Rev. Research 8, L022048 (2026) - Published 11 June, 2026



Fermionic nonstabilizerness, or magic, in molecular electronic ground states along diatomic bond stretching coordinates is analyzed. For $H_2$ and several other dimers, magic measures form an intermediate-separation peak near rapid changes of the binding energy curve, providing new quantum-information-theoretic insight on molecular bonding beyond entanglement.

LETTER
**Visualizing phonon edge states on molybdenum disulfide**
Patrick Knese, Mathias Scheinhardt Nguyen, Stig Hennig, and Jonas Gutiérrez
Phys. Rev. Research 8, L022049 (2026) - Published 12 June, 2026



Enhanced atomic vibrations have previously been observed near the edge of molybdenum disulfide nanoribbons using scanning transmission electron microscopy (HAADF). Here this phenomenon is accounted for by localized phonon edge modes by including correlated atom vibrations in ab initio DFT-based simulations.

LETTER
**Current-induced successive structural phase transitions beyond thermal equilibrium in single-crystal $VO_2$**
Masayuki Ishida, Akihiko Ishizaka, Takashi Tsuchiya, Kazuyuki Kuroki, Yoshinori Haga, Hiromori Takai, Yoshifumi Tokiwa, Shinsuke Kunitai, and Tai Takasuga
Phys. Rev. Research 8, L022050 (2026) - Published 12 June, 2026



Using synchrotron x-ray diffraction, optical microscopy, and Raman spectroscopy, current-induced structural phase transitions in single-crystal $VO_2$ are mapped beyond thermal equilibrium. Successive and two distinct metallic nonequilibrium phases are observed, including a nanequilibrium structure with isotropic lattice expansion inaccessible under thermal equilibrium.

LETTER
**Confinement and finite-range effects in a quasi-two-dimensional gas of fermionic dimers**
Giovanni Pellitteri, Jakob Bonnemann, and Grigory E. Astrakharchik
Phys. Rev. Research 8, L022051 (2026) - Published 12 June, 2026



A study of a gas of fermionic dimers in a quasi-two-dimensional geometry induced by strong harmonic confinement in one direction is presented. Fixed-node diffusion Monte Carlo calculations are used to quantify the effects of confinement and finite interaction range on the equation of state and dimer energy profiles, with the results benchmarked against analytical theories.

LETTER
**Ladderfrost hydrogels: Elastic surface-wave instability and sustained bouncing**
Nathan C. J. Coombs, Peter Lewin-Jones, Mykyta V. Chubynsky, and James E. Spinelos
Phys. Rev. Research 8, L022052 (2026) - Published 17 June, 2026