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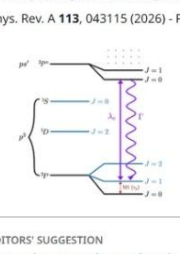
HIGHLIGHTED ARTICLES

EDITORS' SUGGESTION

Simulated laser cooling and magneto-optical trapping of group-IV atoms

Geoffrey Zheng, Jianwei Wang, Mohit Verma, Qian Wang, Thomas K. Langin, and David DeMille

Phys. Rev. A **113**, 043115 (2026) - Published 13 April, 2026



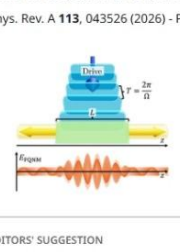
The authors introduce a scheme for laser cooling and magneto-optical trapping of the group-IV atoms, including silicon, germanium, tin, and lead, with a much more challenging structure than the usual alkali-metal and alkaline-earth-metal atoms. They propose an experimental setup for realizing a magneto-optical trap for tin and discuss a wide variety of potential applications.

EDITORS' SUGGESTION

Quasinormal modes in dispersive photonic time crystals

Calvin M. Hooper, Ian R. Hooper, and Simon A. R. Horsley

Phys. Rev. A **113**, 043526 (2026) - Published 29 April, 2026



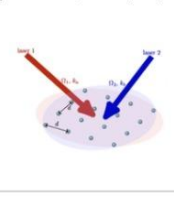
The authors introduce a Floquet quasinormal mode formalism for describing the transient response of time crystals. They analyze the emergence of exceptional points and non-perturbative phenomena relevant to recent experiments.

EDITORS' SUGGESTION

Directional quantum scattering transducer in cooperative Rydberg metasurfaces

Jonas von Milczewski, Kelly Werker Smith, and Susanne F. Yelin

Phys. Rev. A **113**, 043716 (2026) - Published 8 April, 2026



The authors introduce a single-photon transduction scheme based on two-dimensional arrays of Rydberg atoms using four-wave mixing and quantum scattering. It may allow for efficient and mode-selective terahertz-to-optical transduction.

LETTERS

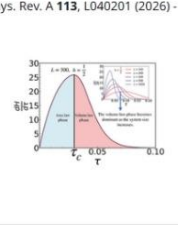
Fundamental concepts

LETTER

Disappearance of measurement-induced phase transition in a quantum spin system for large sizes

Paranjoy Chaki, Protyush Nandi, Ujjwal Sen, and Subinay Dasgupta

Phys. Rev. A **113**, L040201 (2026) - Published 10 April, 2026



Classically, it seems counterintuitive that measurements can drastically alter the overall character of a quantum system, and yet it happens. The authors report that for a quantum spin chain, the measurement-induced entanglement transition is captured in the behavior of the survival probability of the initial state, and moreover, this probability can be calculated analytically for large sizes. The result reveals that as the system size increases, the transition, so prominent at small size, simply disappears, leaving a single ("volume-law") phase.

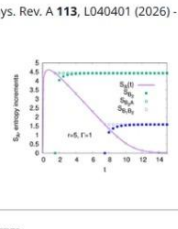
Quantum information science

LETTER

Entanglement production in the decay of a metastable state

Sergei Khlebnikov

Phys. Rev. A **113**, L040401 (2026) - Published 1 April, 2026



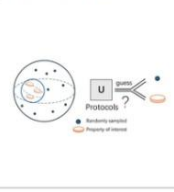
The author studies theoretically the entanglement entropy increments associated with radiation fragments produced at different times during the decay of a metastable system. It is argued that these entropy increments are useful entanglement measures, especially in cases, such as Hawking radiation, where one wishes to separate the radiation into "old" and "new."

LETTER

Optimal sample complexity for testing unitary properties

Masahito Hayashi, Yu-Ao Chen, Chenghong Zhu, and Xin Wang

Phys. Rev. A **113**, L040402 (2026) - Published 10 April, 2026



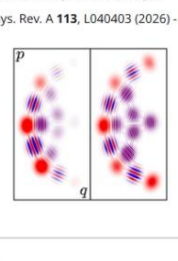
This work explores how to predict whether an unknown quantum process has a specific symmetry, such as identity or time-reversal symmetry. Combining group representation theory with quantum hypothesis testing, it determines the minimum number of tests required for reliable detection and shows that parallel strategies perform as well as more complex adaptive or indefinite-causal-order protocols.

LETTER

Creating multicomponent Schrödinger cat states in a coupled qubit-oscillator system

Pavel Stránský and Pavel Cejnar

Phys. Rev. A **113**, L040403 (2026) - Published 17 April, 2026



The authors demonstrate theoretically that coupling a semiclassical oscillator to a quantum spin (or a set of qubits) and performing a quantum quench followed by a spin measurement produces exotic Schrödinger cat states composed of an arbitrary number of superposed wavepackets with tunable weights and dynamics in the oscillator phase space. The method is implementable with current experimental platforms, including trapped ions and superconducting circuits.

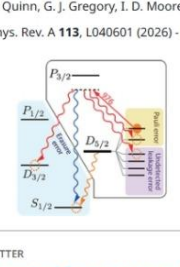
Quantum technologies

LETTER

High-fidelity entanglement of metastable trapped-ion qubits with integrated erasure conversion

A. Quinn, G. J. Gregory, I. D. Moore, S. Brudney, J. Metzner, E. R. Ritchie, J. O'Reilly, D. J. Wineland, and D. T. C. Allcock

Phys. Rev. A **113**, L040601 (2026) - Published 2 April, 2026



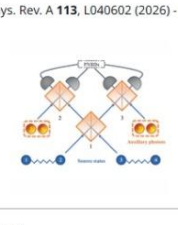
The authors experimentally demonstrate an entangling gate for qubits encoded in metastable levels of trapped ions and provide a detailed error budget. They show that this encoding enables the detection of most of the fundamental errors associated with laser-based quantum logic gates.

LETTER

Boosted fusion gates above the percolation threshold for scalable graph-state generation

Yong-Peng Guo, Geng-Yan Zou, Xing Ding, Qi-Hang Zhang, Mo-Chi Xu, Run-Ze Liu, Jun-Yi Zhao, Zhen-Xuan Ge, Li-Chao Peng, Ke-Mi Xu, Yi-Yang Lou, Zhen Ning, Lin-Jun Wang, Hui Wang, Yong-Heng Huo, Yu-Ming He, Chao-Yang Lu, and Jian-Wei Pan

Phys. Rev. A **113**, L040602 (2026) - Published 9 April, 2026



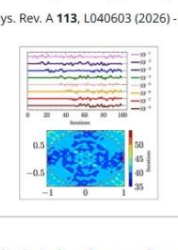
The authors demonstrate a boosted fusion gate for scalable graph-state generation using deterministically generated auxiliary photon states. The improved success probability surpasses the percolation threshold, and direct entanglement measurements are performed to verify the effectiveness of the fusion operation.

LETTER

Chaos-mediated quantum state discrimination near unit fidelity

Sourav Paul, Anant Vijay Varma, Yogesh N. Joglekar, and Sourin Das

Phys. Rev. A **113**, L040603 (2026) - Published 9 April, 2026



By harnessing the sensitivity of chaotic evolution, this study demonstrates how initially similar qubits can develop measurable differences in their temporal correlations, enabling high-fidelity discrimination.

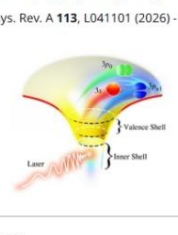
Light-induced processes in atomic-scale systems

LETTER

Orbital orientation resolving real-time attosecond ionization and rescattering dynamics

Lin Han, Jing-Jing Zhang, Hong-Gang Luo, and Peng-Cheng Li

Phys. Rev. A **113**, L041101 (2026) - Published 7 April, 2026



Real-time attosecond dynamics of ionization and rescattering from individual atomic orbitals are tracked using a theoretical framework that combines time-dependent density functional theory with Bohmian mechanics.

LETTER

Coulomb crystallization of xenon highly charged ions in a laser-cooled matrix

Leonid Prokhorov, Aaron A. Smith, Mingyao Xu, Kostas Georgiou, Vera Guarrera, Lakshmi P. Kozhiparambil Sajith, Elwin A. Dijck, Christian Warnecke, Malte Wehrheim, Alexander Wilzewski, Laura Blackburn, Matthias Keller, Vincent Boyer, Thomas Pfeifer, Ulrich Schwanke, Cigdem Issever, Steven Worm, Piet O. Schmidt, José R. Crespo López-Urrutia, and Giovanni Barontini

Phys. Rev. A **113**, L041102 (2026) - Published 15 April, 2026

The authors demonstrate sympathetic cooling and Coulomb crystallization of highly charged xenon ions, which are promising systems for optical clocks and searches for new physics. They show that the resulting mixed crystals can be prepared with controlled ion number and ordering, and with well-characterized collective motion, enabling high-resolution spectroscopy of these highly charged ions.

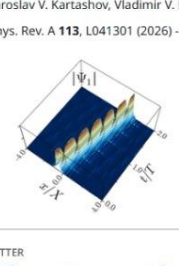
Ultracold systems and matter waves

LETTER

Quantized transport of solitons in Bose-Einstein condensates driven by spin-orbit coupling

Yaroslav V. Kartashov, Vladimir V. Konotop, and Dmitry A. Zezyulin

Phys. Rev. A **113**, L041301 (2026) - Published 3 April, 2026



Moving spin-orbit coupling enables topological pumping of linear wave packets and matter-wave solitons in Bose-Einstein condensates.

LETTER

Coherent transport in two-dimensional disordered potentials under spatially uniform gauge fields

Masataka Kakoi, Christian Miniatura, and Keith Slevin

Phys. Rev. A **113**, L041302 (2026) - Published 10 April, 2026

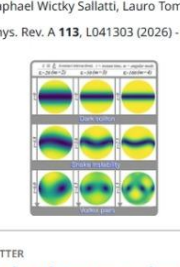
The authors investigate the real-time dynamics of a spin-1/2 particle undergoing coherent multiple scattering in a disordered potential under a uniform non-Abelian gauge field realizable with cold atoms. They show how the gauge field induces a transient coherent backscattering effect in addition to the usual interference dip in the momentum distribution.

LETTER

Stability of dark solitons in a bubble Bose-Einstein condensate

Raphael Wictky Sallatti, Lauro Tomio, Dmitry E. Pelinovsky, and Arnaldo Gammal

Phys. Rev. A **113**, L041303 (2026) - Published 13 April, 2026



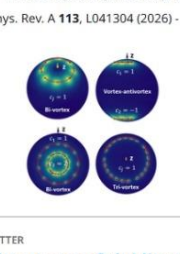
The authors demonstrate theoretically that dark solitons in a Bose-Einstein condensed bubble exhibit an instability threshold in the nonlinear interaction parameter, beyond which they decay into vortex dipoles via snake instability.

LETTER

Index theorem and vortex kinetics in Bose-Einstein condensates on a Haldane sphere with a magnetic monopole

Xi-Yu Chen, Lijia Jiang, Tao Yang, and Jun-Hui Zheng

Phys. Rev. A **113**, L041304 (2026) - Published 13 April, 2026



The authors reveal an index theorem linking vortex configurations to the topology of a gauge field in Bose–Einstein condensates on a Haldane sphere with a magnetic monopole, enabling the construction of vortex–monopole composites. They further develop a kinetic theory where vortex motion reduces to spin precession under the monopole's topological constraint.

LETTER

Signatures of rigidity and second sound in dipolar supersolids

G. A. Bougas, T. Bland, H. R. Sadeghpour, and S. I. Mistakidis

Phys. Rev. A **113**, L041305 (2026) - Published 20 April, 2026

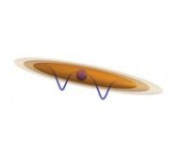
The authors employ a double-well potential and a phase imprinting technique to unveil both the rigidity and phase coherence of one-dimensional supersolids in dipolar quantum gases. A damped coupled oscillators model adequately captures the rigid dynamics, while the out-of-phase collective motion between the crystal and the superfluid background is controllably excited by means of phase imprinting.

LETTER

Unified theory of attractive and repulsive polarons in a one-dimensional Bose gas

Nikolay Yegovtsev, T. Alper Yoğurt, Matthew T. Eiles, and Victor Gurarie

Phys. Rev. A **113**, L041306 (2026) - Published 21 April, 2026



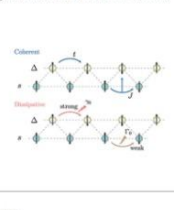
The authors present a unified description of attractive and repulsive polarons formed in a one-dimensional Bose gas hosting an impurity particle by semi-analytically obtaining all solutions to the Gross-Pitaevskii equation. This analysis shows how, as the impurity-bath coupling increases, the excited states of this system evolve from pair-soliton configurations to hybridized soliton-polaron states, eventually crossing over from repulsive to attractive polarons at unitarity.

LETTER

Emergent universality class in dissipative quantum systems with dipole symmetry

Wenbo Zhou, Yuke Zhang, and Pengfei Zhang

Phys. Rev. A **113**, L041307 (2026) - Published 29 April, 2026



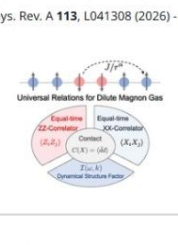
The authors develop an effective field theory for dissipative quantum systems with dipole symmetry, identifying an interacting non-equilibrium fixed point that governs universal phase fluctuations.

LETTER

Universal relations in long-range quantum spin chains

Ning Sun, Lei Feng, and Pengfei Zhang

Phys. Rev. A **113**, L041308 (2026) - Published 30 April, 2026



The authors establish universal relations in long-range quantum spin chains that connect equal-time spin correlations and dynamical response functions to a single quantity, termed the contact. Their results reveal how few-body correlations manifest in many-body systems with long-range couplings.

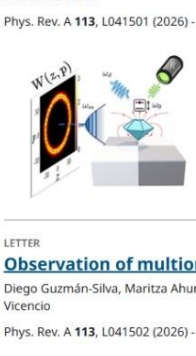
Photonics, nonlinear optics, and optomechanics

LETTER

Autonomous phonon maser in levitated spin mechanics

Mohamed Hatifi

Phys. Rev. A **113**, L041501 (2026) - Published 10 April, 2026



The author shows that a single microwave-dressed, optically pumped nitrogen-vacancy center in a levitated nanodiamond can act as a gain medium for the particle's center-of-mass motion. The work derives the onset of an autonomous phonon-maser regime, its saturation behavior, and the conditions under which its coherent signal can emerge above thermal motion.

LETTER

Observation of multiorbital Fano resonances in photonic lattices

Diego Guzmán-Silva, Maritza Ahumada, Polette Parra-Palavecino, Alexis R. Legón, Pedro A. Orellana, and Rodrigo A. Vicencio

Phys. Rev. A **113**, L041502 (2026) - Published 10 April, 2026

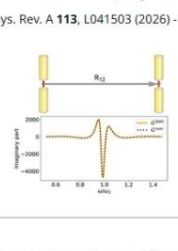
The authors study, theoretically and experimentally, the multiorbital Fano resonance phenomenon in the context of photonic lattices. Using the femtosecond laser writing technique, they observe Fano resonances for fundamental and excited states, characterized by the absence of light transmission through a one-dimensional lattice.

LETTER

Green's-function expansion for multiple coupled optical resonators with finite retardation using quasinormal modes

Robert Meiners Fuchs, Juanjuan Ren, Stephen Hughes, and Marten Richter

Phys. Rev. A **113**, L041503 (2026) - Published 13 April, 2026



For multiple coupled and lossy optical resonators with significant spatial separation, the authors develop a scheme for the scattered Green's function using only the quasinormal modes (QNMs) of the individual resonators as input. Retardation delays are fully included, and complex multi-resonator scattering naturally decomposes into products of simple two-resonator scattering processes.

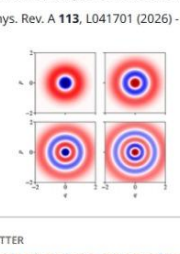
Quantum optics

LETTER

Nonclassicality of multiphoton-added cat states

Jhordan Santiago and Petr Steindl

Phys. Rev. A **113**, L041701 (2026) - Published 6 April, 2026



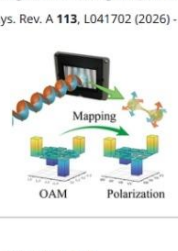
The authors show that adding photons to optical Schrödinger cat states significantly reshapes their quantum structure, inducing a phase shift in the photon-number distribution and in the Wigner function when the number of added photons is odd. The resulting states are universally sub-Poissonian, losing quadrature squeezing while exhibiting amplitude-squared squeezing.

LETTER

Polarization entanglement in atomic biphotons via orbital-angular-momentum-to-spin mapping

Chang-Wei Lin, Yi-Ting Ma, Jiun-Shiuan Shiu, and Yong-Fan Chen

Phys. Rev. A **113**, L041702 (2026) - Published 9 April, 2026



Polarization-entangled photon pairs are generated in a cold-atom system by coherently mapping orbital-angular-momentum correlations into the polarization basis. The scheme produces polarization entanglement without modifying the underlying atomic interaction or level structure.

ARTICLES

Fundamental concepts

Mereological quantum phase transitions
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Paolo Luppi, Claudia Benedetti, and Andrea Smirne
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Topological enhancement of a -symmetric Su-Schrieffer-Heeger quantum battery
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Tunneling in double-well potentials within Nelson's stochastic mechanics: Application to ammonia inversion
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Contextual Heisenberg microscope
Jan-Åke Larsson
Phys. Rev. A **113**, 042215 (2026) - Published 16 April, 2026

Environment-assisted discrete time crystals in noninteracting quantum systems
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Anisotropy-induced dynamics in coupled quantum oscillators
B. Vigneshwar, V. K. Chandrasekar, and D. V. Senthilkumar
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Quantum speed limits for open system dynamics based on a representation-basis-dependent -seminorm
H. F. Chau and Jinjie Li
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Reentrant topological phase transition in a periodically modulated Su-Schrieffer-Heeger model
Xin-Yue Zhang, Xiao-Feng Nie, Jie Zhang, Li-Nan Zhong, Ji Cao, and Hong-Fu Wang
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Juyeon Yi and Yong Woon Kim
Phys. Rev. A **113**, 042220 (2026) - Published 21 April, 2026

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Spectral analysis of the Koopman operator as a framework for recovering Hamiltonian parameters in open quantum systems
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Ahmed A. Barakat, Avishek Chowdhury, Anh Tuan Le, and Eva M. Weig
Phys. Rev. A **113**, 042223 (2026) - Published 24 April, 2026

Radiation of breathing vortex electron packets in magnetic field
G. V. Zmaga, G. K. Sizykh, D. V. Grosman, Qi Meng, Liping Zou, Pengming Zhang, and D. V. Karlovets
Phys. Rev. A **113**, 042224 (2026) - Published 28 April, 2026

Quantum filtering formulation of the Diósi-Penrose model
John E. Gough and Dylon Rees
Phys. Rev. A **113**, 042225 (2026) - Published 28 April, 2026

Quantum-foundational implications of information erasure upon measurement
Alberto Montina and Stefan Wolf
Phys. Rev. A **113**, 042226 (2026) - Published 30 April, 2026

Quantum information science

Practical quantum reservoir computing in Rydberg atom arrays
Dong-Sheng Liu, Qing-Xuan Jie, Chang-Ling Zou, Xi-Feng Ren, and Guang-Can Guo
Phys. Rev. A **113**, 042401 (2026) - Published 1 April, 2026

Quantum key distribution by quantum energy teleportation
Shlomi Dolev, Kazuki Ikeda, and Yaron Oz
Phys. Rev. A **113**, 042402 (2026) - Published 1 April, 2026

Noise-canceling quantum feedback: Non-Hermitian dynamics with applications to state preparation and magic state distillation
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Sublogarithmic distillation in all prime dimensions using punctured Reed-Muller codes
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Phys. Rev. A **113**, 042405 (2026) - Published 1 April, 2026

Quantum limits of exoplanet detection and localization
Nico Deshler, Sebastiaan Haffert, and Amit Ashok
Phys. Rev. A **113**, 042406 (2026) - Published 1 April, 2026

Constrained free energy minimization for the design of thermal states and stabilizer thermodynamic systems
Michele Minervini, Madison Chin, Jacob Kupperman, Nana Liu, Ivy Luo, Meghan Ly, Soorya Rethinasamy, Kathie Wang, and Mark M. Wilde
Phys. Rev. A **113**, 042407 (2026) - Published 2 April, 2026

Supervised learning of optimal pulse design for the adiabatic speedup under time-dependent noise
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Engineering precise and robust effective Hamiltonians
Jiahui Chen and David Cory
Phys. Rev. A **113**, 042409 (2026) - Published 2 April, 2026

Physics and computation: An insight from non-Hermitian quantum computing
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Sensing decoherence by using edge states
Andrey R. Kolovsky
Phys. Rev. A **113**, 042411 (2026) - Published 2 April, 2026

Dense packing of the surface code: Code deformation procedures and hook-error-avoiding gate scheduling
Kohei Fujiu, Shota Nagayama, Shin Nishio, Hideaki Kawaguchi, and Takahiko Satoh
Phys. Rev. A **113**, 042412 (2026) - Published 3 April, 2026

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