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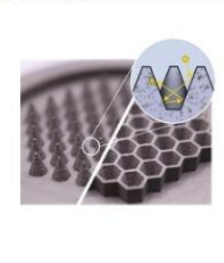
HIGHLIGHTED ARTICLES

FEATURED IN PHYSICS EDITORS' SUGGESTION

Exploiting complex 3D-printed surface structures for portable quantum technologies

N. Cooper, D. Johnson, B. Hopton, M. Overton, D. Stupple, A. Bratu, E. Wilson, J. Robinson, L. Coles, M. Papastavrou, and L. Hackermueller

Phys. Rev. Applied **25**, 014047 (2026) - Published 21 January, 2026



Controlling high-vacuum gas dynamics is critical to many technologies, especially for portable quantum sensors. This article shows how purpose-designed surface textures can influence high-vacuum particle propagation in controlled ways to improve device performance. Using 3D printing to experimentally realize such textures in ultrahigh-vacuum-compatible materials, the authors show an example application in which textured surfaces are able to triple the pumping rate of a nonevaporable getter pump. This approach offers significant technical advantage in numerous high-vacuum settings, and will be of particular benefit to portable quantum technologies.

EDITORS' SUGGESTION

Dense associative memory in a nonlinear-optical Hopfield neural network

Khalid Musa, Santosh Kumar, Michael Katidis, and Yu-Ping Huang

Phys. Rev. Applied **25**, 014011 (2026) - Published 6 January, 2026

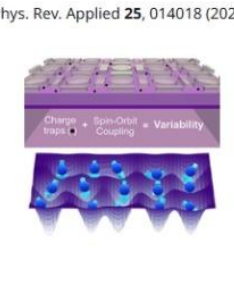
This work demonstrates a photonic dense associative memory, which is important for high-capacity associative memory, combinatorial optimization, and computer vision. Here scalable, higher-order interactions beyond pairwise couplings would be key to progress. The authors use a spatial light modulator and second-harmonic generated light to implement both two- and four-body interactions. Four-body interactions are shown to increase storage capacity by a factor of 10 for uncorrelated patterns and a factor of up to 50 for correlated patterns, and to yield further benefits as well. These results point to a scalable route for energy-efficient, high-capacity optical neural networks.

EDITORS' SUGGESTION

Variability of hole-spin qubits in planar germanium

Biel Martinez and Yann-Michel Niquet

Phys. Rev. Applied **25**, 014018 (2026) - Published 8 January, 2026



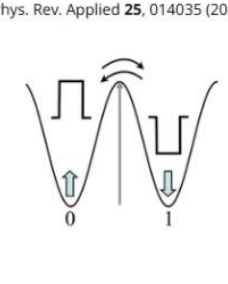
Qubits based on hole spins in germanium have seen remarkable progress over the last few years, and are currently one of the most promising spin-qubit platforms for quantum computing. Nevertheless, disorder scatters the charge and spin properties of the qubits within a quantum chip, which poses a challenge for scaling up. The accurate assessment of variability is crucial for establishing reliable roadmaps toward large-scale spin-qubit quantum computers. This study uses numerical simulations to quantify the expected variability of hole-spin qubits in realistic Ge devices, focusing on charge traps at interfaces. It turns out that charge properties don't vary so much, but spin properties do.

EDITORS' SUGGESTION

Tunable random telegraph noise in stable perpendicular magnetic tunnel junctions for unconventional computing

Ahmed Sidi El Valli, Michael Tsao, Dairong Chen, and Andrew D. Kent

Phys. Rev. Applied **25**, 014035 (2026) - Published 14 January, 2026



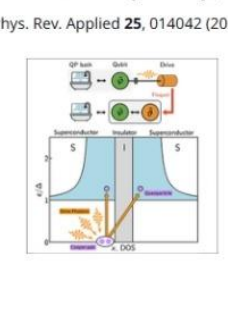
Stochastic magnetic tunnel junctions (MTJs) are promising building blocks for neuromorphic and probabilistic computing, but conventional approaches rely on thermally unstable superparamagnetic devices with limited reliability and tunability. In this work, thermally stable perpendicular MTJs are electrically driven to produce random telegraph noise using nanosecond spin-torque pulses, the response being well described by a simple Poisson process. This approach enables broad, continuous tuning of both fluctuation rate and probability bias in a single device, pointing to a practical route for combining memory elements with programmable stochastic functionality on a single hardware platform.

EDITORS' SUGGESTION

Theory of quasiparticle generation by microwave drives in superconducting qubits

Shoumik Chowdhury, Max Hays, Shantanu R. Jha, Kyle Serniak, Terry P. Orlando, Jeffrey A. Grover, and William D. Oliver

Phys. Rev. Applied **25**, 014042 (2026) - Published 16 January, 2026



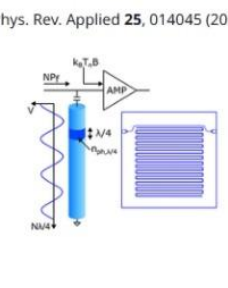
Superconducting circuits for quantum computation are controlled via microwave signals, which are typically assumed to be too weak to disturb the superconducting material itself. When these microwave drives become sufficiently strong, though, multiple photons can combine to break Cooper pairs of electrons in the device, leading to qubit errors. The authors develop a theoretical framework to predict when this effect occurs, and demonstrate its relevance for emerging qubit designs and readout schemes that rely on strong driving. These results reveal a previously overlooked error mechanism for superconducting qubits, and provide guidance on how to mitigate the effects.

EDITORS' SUGGESTION

Broadband high-precision measurement of two-level-system loss using multiwavelength superconducting resonators

Cliff Chen, Shahriar Aghaeimeibodi, Yuki Sato, Matthew H. Matheny, Oskar Painter, and Jiansong Gao

Phys. Rev. Applied **25**, 014045 (2026) - Published 20 January, 2026



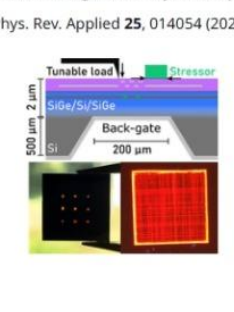
Superconducting resonators are a popular way to study dissipation in superconducting quantum circuits induced by two-level systems (TLS) due to their ease of fabrication, but measuring unsaturated TLS loss in quarter-wave resonators remains difficult due to the intrinsic frequency fluctuations of the TLS and low signal-to-noise ratio of the measurement. This study demonstrates that spatially extending the quarter-wave resonator to be many wavelengths long mitigates these difficulties and significantly reduces measurement uncertainty. This new resonator design provides a tool for researchers to examine the effects of material and fabrication processes on superconducting circuit performance.

EDITORS' SUGGESTION

Fabrication, characterization, and mechanical loading of Si/Si-Ge membranes for spin-qubit devices

Lucas Marcogliese, Ouviyan Sabapathy, Rudolf Richter, Jhih-Sian Tu, Dominique Bougeard, and Lars R. Schreiber

Phys. Rev. Applied **25**, 014054 (2026) - Published 22 January, 2026



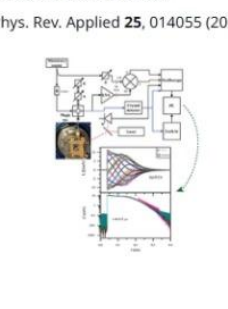
Strain engineering and electric field control are key to optimizing the properties of electron-spin qubits hosted in electrostatically defined Si/Si-Ge quantum dots, and compared to thick Si-Ge heterostructures, thin Si/Si-Ge membranes offer more control. This article reports the fabrication of micrometer-thick Si/Si-Ge heterostructures suspended by a silicon substrate over an area of a few hundred micrometers. The authors characterize the elastic properties of these membranes and identify two mechanical modes useful for strain-field engineering, which helps to increase the valley splitting and thus the coherence time and shuttling fidelity of electron spins.

EDITORS' SUGGESTION

Versatile system for photoconductance decay measurement across a wide range of semiconductor materials

András Bojtor, Dávid Krisztián, Gábor Paráda, Ferenc Korsós, Sándor Kollarics, Gábor Csősz, Bence G. Márkus, László Forró, and Ferenc Simon

Phys. Rev. Applied **25**, 014055 (2026) - Published 23 January, 2026



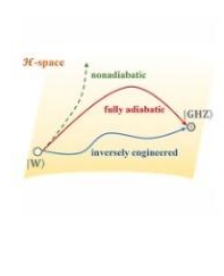
Time-resolved photoconductivity (PCD) sits at the heart of semiconductor characterization, yet many implementations probe only a narrow slice of the system's properties—typically using a single microwave frequency paired with a single excitation wavelength. This work presents a versatile, contactless microwave PCD instrument that combines a broadband coplanar-waveguide sensor with flexible readout electronics, enabling an extensive detection range, temperature-dependent studies, and multiphoton excitation. This platform is equally relevant for industrial silicon wafers and emerging quantum materials, from perovskites to wide-band-gap power semiconductors and topological systems.

EDITORS' SUGGESTION

Fast conversion from *W* to Greenberger-Horne-Zeilinger states via inverse engineering

Hui Zhou, Qilong Hu, Yuquan Chen, Tianyun Wang, Fangzhou Jin, Yunlan Ji, Jianpei Geng, and Xinhua Peng

Phys. Rev. Applied **25**, 014056 (2026) - Published 23 January, 2026



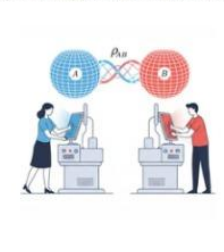
Controlled conversion between distinct classes of multipartite entangled states is crucial for quantum technologies, but direct interconversion is impossible, due to the states' inequivalence under local operations. More sophisticated dynamical protocols are required; unfortunately, conventional adiabatic methods face a trade-off between fidelity and speed. This study employs inverse engineering to design accelerated adiabatic passages in a spin-chain system, enabling rapid *W*-to-GHZ conversion, as experimentally verified on an NMR quantum processor. The work highlights the potential of inverse engineering for efficient quantum state manipulation in many-body systems.

EDITORS' SUGGESTION

From top quarks to enhanced quantum key distribution: A framework for optimal predictability of quantum observables

Dennis I. Martínez-Moreno, Miguel Castillo-Celeita, and Diego G. Bussandri

Phys. Rev. Applied **25**, 014063 (2026) - Published 27 January, 2026



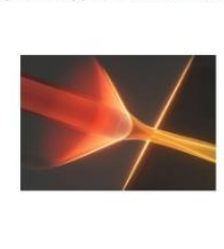
The predictability of quantum measurement outcomes is relevant for developing applications in quantum information, and potential sources of useful quantum correlations now extend even to top-antitop quark pairs produced in high-energy colliders. This study presents a comprehensive framework for assessing predictability, using error measures inherited from statistical learning theory. Building on an existing foundation, the authors propose a modified entanglement-based protocol for quantum key distribution, demonstrating enhanced resilience to noise compared to the standard BB84 protocol, and leveraging the strength and capabilities of quark-pair states as resources for quantum cryptography.

EDITORS' SUGGESTION

Light coupling to photonic integrated circuits using optimized lensed fibers

Dengke Chen, Zeying Zhong, Sanli Huang, Jiahao Sun, Sicheng Zeng, Baoqi Shi, Yi-Han Luo, and Junqiu Liu

Phys. Rev. Applied **25**, 014078 (2026) - Published 30 January, 2026



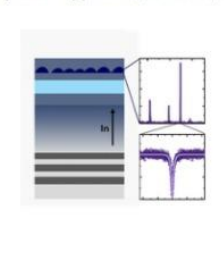
Devising efficient light coupling between optical fibers and silicon nitride photonic integrated circuits is critical in a wide range of applications, but common Gaussian-beam approximations fail to capture the complex physics of lensed fibers. This study employs a comprehensive co-optimization strategy that integrates high-resolution scanning electron microscopy with rigorous three-dimensional simulations to model and experimentally validate the coupling process. The actual emission profile of lensed fibers deviates significantly from the widely assumed paraxial Gaussian beam, a crucial insight that allows the authors to predict and achieve coupling efficiencies exceeding 80% per facet.

EDITORS' SUGGESTION LETTER

Quantum dots on GaAs substrates as integration-ready high-performance single-photon sources at telecommunication wavelengths

Beatrice Costa, Bianca Scaparra, Xiao Wei, Hubert Riedl, Gregor Koblmüller, Eugenio Zallo, Jonathan J. Finley, Lukas Hanschke, and Kai Müller

Phys. Rev. Applied **25**, L011002 (2026) - Published 6 January, 2026



Quantum dots emitting in the telecommunication bands are an excellent candidate for deterministic single-photon sources for fiber-based quantum technologies. However, challenges remain in optimizing their optical properties. This Letter presents a detailed study of the optical properties of InAs quantum dots with optimized growth via molecular beam epitaxy. The authors realize high-quality single-photon emitters operating in the telecom O and C bands, and their growth technique is promising for further photonic technologies as well.

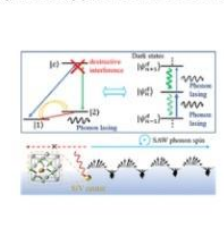
LETTERS

LETTER

Dark-state-induced surface-acoustic-wave lasing and phonon-spin-selected unidirectionality

Changyong Lei and Jie Ren

Phys. Rev. Applied **25**, L011001 (2026) - Published 2 January, 2026



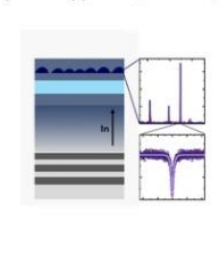
The authors propose the concept of a surface-acoustic-wave (SAW) phonon laser that also lases phonon spin. Such a device would be challenging to create, due to the impact of environmental noise on the excited state. By utilizing a dark-state scheme for a silicon-vacancy (Si-*V*) center in diamond, however, destructive interference of excitation amplitudes from two ground states to the excited state leaves the excited state decoupled from the laser system, affording a dissipation-robust phonon laser. Moreover, due to the interplay between phonon and Si-*V* spins plus the spin-momentum locking of the SAW, phonon-spin-selected unidirectional lasing of coherent SAW phonons is expected.

EDITORS' SUGGESTION LETTER

Quantum dots on GaAs substrates as integration-ready high-performance single-photon sources at telecommunication wavelengths

Beatrice Costa, Bianca Scaparra, Xiao Wei, Hubert Riedl, Gregor Koblmüller, Eugenio Zallo, Jonathan J. Finley, Lukas Hanschke, and Kai Müller

Phys. Rev. Applied **25**, L011002 (2026) - Published 6 January, 2026



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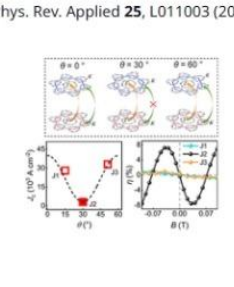
LETTER

Modulation of Josephson coupling and superconducting diode effect in twisted $\mathrm{NbSe_2/NbSe_2}$ van der Waals junctions

Zhi-Hui Ren, Si-Li Wu, Hao-Chen Zhang, Xue-Tao Di, Wen-Yuan Jia, Yi-Xuan Li, Chong Wang, Mao-Yuan Wang, Chuan Li, Cai-Zhen Li, and Zhi-Min Liao

Phys. Rev. Applied **25**, L011003 (2026) - Published 7 January, 2026



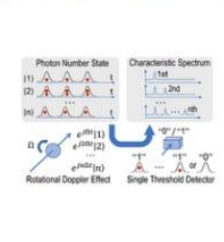
The *superconducting diode effect* is attractive for superconducting logic and quantum information technologies, yet key control “knobs” remain limited. This work demonstrates a way to control the efficiency of superconducting diodes by varying the twist angle in $\mathrm{NbSe_2/NbSe_2}$ van der Waals junctions. Twist angles near 30° induce weak coupling and greatly enhance the diode efficiency, whereas angles near 15° or 51° recover strong coupling but suppress nonreciprocity. These results provide an effective and practical means to create superconducting devices with customizable nonreciprocal functionalities.

LETTER

Characterization of photon statistics by single threshold detection channel without multiplexing via rotational Doppler effect

Shu-Tian Xue (薛舒天), He Jiang (姜贺), Jing Wang (王晶), Zhi-Cheng Ren (任志成), Xi-Lin Wang (王喜林), and Hui-Tian Wang (王慧田)

Phys. Rev. Applied **25**, L011004 (2026) - Published 9 January, 2026



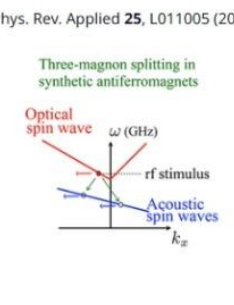
Determining photon statistics is crucial in quantum technology and optics, and doing so with a single threshold detector is both highly desirable and a persistent challenge. The authors utilize the rotational Doppler effect to induce an *n*-fold frequency shift on an *n*-photon Fock state, exploiting the particle nature of light to allow the photon-number distribution to be resolved using only one threshold detector, without any spatial or temporal multiplexing. This resource-efficient approach to characterizing photon statistics opens possibilities for photon-number detection, with promising applications across quantum optics and quantum information processing.

LETTER

Spin waves involved in three-magnon splitting in synthetic antiferromagnets

Asma Mouhoub, Nathalie Bardou, Jean-Paul Adam, Aurélie Solignac, and Thibaut Devolder

Phys. Rev. Applied **25**, L011005 (2026) - Published 29 January, 2026



An important nonlinear effect in magnonics is *three-magnon splitting*, where a high-frequency magnon splits into two magnons of lower frequencies, but the technical difficulty of efficiently generating and measuring spin waves has stymied widespread use of their nonlinear properties. Using inductive spectroscopy and Brillouin light scattering, the authors show that nanostructures patterned from a synthetic antiferromagnet film are suitable for hosting three-magnon splitting, and collecting the resulting split waves. This enables the use of spin waves in nonlinear microwave signal processing, including frequency conversion without the need for a microwave mixer and local oscillator.

ARTICLES

Quantum physics-informed neural networks for multivariable partial differential equations

Giorgio Panichi, Sebastiano Corli, and Enrico Prati

Phys. Rev. Applied **25**, 014001 (2026) - Published 2 January, 2026

Excitation of surface plasmon-polaritons through optically induced ultrafast transient gratings

Olesia Pashina, Albert Seredin, Giulia Crotti, Giuseppe Della Valle, Andrey Bogdanov, Mihail Petrov, and Costantino De Angelis

Phys. Rev. Applied **25**, 014002 (2026) - Published 2 January, 2026

Photogalvanic-effect-induced generation of simultaneous charge and spin currents in a four-probe monolayer $\mathrm{MoS_2}$ device

Bo Bian, Zhanran Wang, Lei Zhang, and Zhizhou Yu

Phys. Rev. Applied **25**, 014003 (2026) - Published 2 January, 2026

Compact 780-nm Rb optical clock

Zhendong Chen, Tianyu Liu, Ruoao Yang, Qiaohui Yang, Ya Wang, Jie Miao, Jingming Chen, Duo Pan, Shiying Cao, Zhigang Zhang, Jianjun Wu, and Jingbiao Chen

Phys. Rev. Applied **25**, 014004 (2026) - Published 2 January, 2026

Extended parameter-shift rules with minimal derivative variance for parameterized quantum circuits

Zhijian Lai, Jiang Hu, Dong An, and Zaiwen Wen

Phys. Rev. Applied **25**, 014005 (2026) - Published 5 January, 2026

High-efficiency, high-fidelity charge initialization of shallow nitrogen-vacancy centers in diamond

Marjana Mahdia, Artur Lozovoi, Jared Rovny, Zhiyang Yuan, Carlos A. Meriles, and Nathalie P. de Leon

Phys. Rev. Applied **25**, 014006 (2026) - Published 5 January, 2026

Polarization loss in low-power $\mathrm{Hf_{0.5}Zr_{0.5}O_2}$ ferroelectric memory: A polydomain-aware predictive framework

Elizaveta Kalika, Ilya Margolin, and Anastasia Chouprik

Phys. Rev. Applied **25**, 014007 (2026) - Published 5 January, 2026

Generation and transformation of topological textures via spin-orbit interaction in bulk crystals

Qiang Wang, Xi Xie, Jiafeng Zeng, Shuilong Chen, Yijie Shen, Chenghou Tu, and Xiangsheng Xie

Phys. Rev. Applied **25**, 014008 (2026) - Published 5 January, 2026

Ultrasensitive transverse deflection measurement with two-photon interference

Chaojie Wang, Yuning Zhang, Yuanyuan Chen, and Lixiang Chen

Phys. Rev. Applied **25**, 014009 (2026) - Published 6 January, 2026

Intraband entanglement–assisted cavity electro-optic quantum transducer

Yu-Bo Hou, Rui-Zhe You, Di-Jia Zhang, Pengbo Li, and Changchun Zhong

Phys. Rev. Applied **25**, 014010 (2026) - Published 6 January, 2026

EDITORS' SUGGESTION

Dense associative memory in a nonlinear-optical Hopfield neural network

Khalid Musa, Santosh Kumar, Michael Katidis, and Yu-Ping Huang

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Reliable magnetometry for antiferromagnets and thin films: Correcting substrate artifacts in $\mathrm{Mn_3Sn / MgO}$ systems

Katarzyna Gas and Maciej Sawicki

Phys. Rev. Applied **25**, 014012 (2026) - Published 6 January, 2026

Design of a dual-layer concentric-ring metalens with switchable unidirectional fluorescence emission based on deep reinforcement learning

Deyi Guo, Ruixin Luo, Weijin Chen, Lingqiao Li, Zhiyuan Wang, Yang Wang, and Zhihui Chen

Phys. Rev. Applied **25**, 014013 (2026) - Published 7 January, 2026

High-speed quantum random-number generation based on frequency-division multiplexing

Jialiang Li, Xiaodong Fan, Ye Chen, Tonglin Mu, Junran Guo, Jinquan Huang, Minjie Liu, Zitao Huang, Bo Liu, and Shihai Sun

Phys. Rev. Applied **25**, 014014 (2026) - Published 7 January, 2026

Spatiotemporal differentiation and vortex based on an acoustic metagrating

Xi-Ying Chen, Xing-Feng Zhu, Jie Yao, Qi Wei, and Da-Jian Wu

Phys. Rev. Applied **25**, 014015 (2026) - Published 7 January, 2026

Tunable hybrid-mode coupler enabling strong interactions between transmons at centimeter-scale distance

Jianwen Xu, Xiang Deng, Wen Zheng, Wenchang Yan, Tao Zhang, Zhenchuan Zhang, Wanli Huang, Xiaoyu Xia, Xudong Liao, Yu Zhang, Jie Zhao, Shaoxiong Li, Xinsheng Tan, Dong Lan, and Yang Yu

Phys. Rev. Applied **25**, 014016 (2026) - Published 7 January, 2026

Highly efficient deterministic voltage control of the perpendicular Néel vector in a magnetoelectric antiferromagnet

Hiroki Sameshima, Kakeru Ujimoto, Nozomi Murayama, Kentaro Toyoki, Kohji Nakamura, Takahiro Moriyama, Ryoichi Nakatani, and Yu Shiratsuchi

Phys. Rev. Applied **25**, 014017 (2026) - Published 8 January, 2026

EDITORS' SUGGESTION

Variability of hole-spin qubits in planar germanium

Biel Martinez and Yann-Michel Niquet

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Image matching based on third-order correlation ghost imaging

Zilin Chen, Jiatong Yu, Fei Lin, and Lixiang Chen

Phys. Rev. Applied **25**, 014019 (2026) - Published 8 January, 2026

Generation of multicycle terahertz waves from single-crystal quartz

Chengyue Wang, Weiwei Li, Zheng Liu, Yangkai Wang, Yiqian Zhang, Qiang Deng, Chengzhi Yu, Qiuping Huang, Hao Cheng, and Yalin Lu

Phys. Rev. Applied **25**, 014020 (2026) - Published 8 January, 2026

Leveraging biased noise for more efficient quantum error correction at the circuit level with two-level qubits

Josu Etxezarreta Martinez, Paul Schnabl, Javier Oliva del Moral, Reza Dastbasteh, Pedro M. Crespo, and Ruben M. Otxoa

Phys. Rev. Applied **25**, 014021 (2026) - Published 9 January, 2026

Localized Josephson hot spots due to two-level systems

Joshuah T. Heath, Alexander C. Tyner, Thue Christian Thann, Vincent P. Michal, Peter Krogstrup, Mark Kamper Svendsen, and Alexander V. Balatsky

Phys. Rev. Applied **25**, 014022 (2026) - Published 9 January, 2026

Revealing the acoustic rotational Doppler effect from rotating objects without incoming waves

Rui Li, Chunxia Liu, Linbo Wang, Xingxing Shi, Yulong Sun, Jiu Hui Wu, and Fuyin Ma

Phys. Rev. Applied **25**, 014023 (2026) - Published 9 January, 2026

Noise-tolerant tomography of multimode linear optical interferometers with single photons

Yu.A. Biriukov, R.D. Morozov, A.A. Korneev, S.P. Kulik, B.V. Kondratyev, I.V. Dyakonov, S.S. Straupe, M.V. Rakhlin, A.I. Galimov, G.V. Klimko, S.V. Sorokin, I.V. Sedova, M.M. Kulagina, Yu.M. Zadiranov, and A.A. Toropov

Phys. Rev. Applied **25**, 014024 (2026) - Published 9 January, 2026

Thin-film lithium niobate on diamond as a platform for efficient spin-phonon coupling

Zhujing Xu, Sophie Weiyi Ding, Eliza Cornell, Salma Mohideen, Matthew Yeh, Kazuhiro Kuruma, Leticia Magalhaes, Amirhassan Shams-Ansari, Benjamin Pingault, and Marko Lončar

Phys. Rev. Applied **25**, 014025 (2026) - Published 12 January, 2026

In situ tunable photon blockade assisted by a Floquet coupler

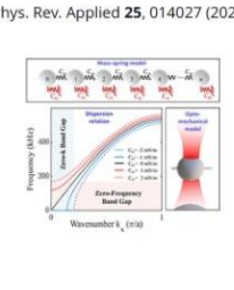
Shiyan Li, Nan Wang, Jian-Jun Han, Ai-Dong Zhu, and Lin Yu

Phys. Rev. Applied **25**, 014026 (2026) - Published 12 January, 2026

Active elastic metamaterials for zero-frequency and zero-wave-number band gaps

Brahim Lemkalli, Alaa M. Ali, Qingxiang Ji, Julio Andrés Iglesias Martínez, Younes Achaoui, Sebastien Guenneau, Richard Craster, and Muamer Kadic

Phys. Rev. Applied **25**, 014027 (2026) - Published 12 January, 2026



Zero-frequency and zero-wave-number band gaps are highly desirable for controlling low-frequency elastic waves, but are fundamentally forbidden in conventional passive elastic systems. The authors show that optomechanical trapping with optical tweezers based on a metasurface introduces tunable, contactless stiffness in a mass-spring chain, enabling the realization of both types of band gaps. This approach overcomes long-standing physical constraints and opens possibilities for active and reconfigurable elastic metamaterials.

Thermal conductivity suppression by extreme stress gradients in bent cracked silicon nanowires

Yuxi Xiao, Jun Lyu, Shuo Qiao, Qiye Zheng, Guihua Tang, and Lin Yang

Phys. Rev. Applied **25**, 014028 (2026) - Published 13 January, 2026

Beyond von Mises truss models: Emergent bistability in mechanical metamaterials

Md Nahid Hasan, Taylor E. Greenwood, Sharat Paul, Bolei Deng, Qihan Liu, Yong Lin Kong, and Pai Wang

Phys. Rev. Applied **25**, 014029 (2026) - Published 13 January, 2026

High-performance nanodevices based on $\mathrm{WGe_2N_4}$ monolayer

Jiajun Li, Xiaozheng Fan, Mehrdad Shiri, Kun Wang, Chunlan Ma, Shijing Gong, Chuanxi Zhao, Junshuai Wang, Xiao Dong, Tianxing Wang, Guoliang Xu, and Yipeng An

Phys. Rev. Applied **25**, 014030 (2026) - Published 13 January, 2026

Manipulation of first- and second-order quantum coherence with undetected photons through path identity

Zi-Mo Cheng (程子默), Bo-Wen Dong (董博文), Pei Wan (万佩), Wen-Zheng Zhu (朱文正), Zhi-Cheng Ren (任志成), Xi-Lin Wang (王喜林), and Hui-Tian Wang (王慧田)

Phys. Rev. Applied **25**, 014031 (2026) - Published 13 January, 2026

Subsystem many-hypercube codes: High-rate concatenated codes with low-weight syndrome measurements

Ryota Nakai and Hayato Goto

Phys. Rev. Applied **25**, 014032 (2026) - Published 13 January, 2026

Excitation frequency dependence of noise and minimum detectable force in amplitude-modulation atomic force microscopy

Kenichi Umeda and Noriyuki Kodera

Phys. Rev. Applied **25**, 014033 (2026) - Published 14 January, 2026

Growth and investigations of the two-dimensional van der Waals $\mathrm{CrTe_2}$ films by the sputtering route: Influence of crystallinity and film thickness on their magnetization and transport behavior

Nakul Kumar, Nikita Sharma, Lalit Pandey, Soumyarup Hait, Nanhe Kumar Gupta, Shubhashish Pati, Abhay Pandey, and Sujeet Chaudhary

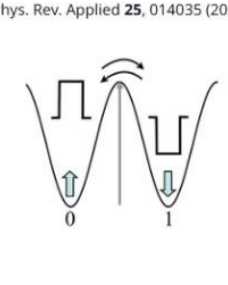
Phys. Rev. Applied **25**, 014034 (2026) - Published 14 January, 2026

EDITORS' SUGGESTION

Tunable random telegraph noise in stable perpendicular magnetic tunnel junctions for unconventional computing

Ahmed Sidi El Valli, Michael Tsao, Dairong Chen, and Andrew D. Kent

Phys. Rev. Applied **25**, 014035 (2026) - Published 14 January, 2026



Stochastic magnetic tunnel junctions (MTJs) are promising building blocks for neuromorphic and probabilistic computing, but conventional approaches rely on thermally unstable superparamagnetic devices with limited reliability and tunability. In this work, thermally stable perpendicular MTJs are electrically driven to produce random telegraph noise using nanosecond spin-torque pulses, the response being well described by a simple Poisson process. This approach enables broad, continuous tuning of both fluctuation rate and probability bias in a single device, pointing to a practical route for combining memory elements with programmable stochastic functionality on a single hardware platform.

Ultrabroadband sound absorption enabled by a hybridized soft boundary

Yuanzhou Zhu, Ziqi Tao, Ji Zhang, Houyou Long, Taimin Wang, Jixing Qin, Ying Cheng, and Xiaojun Liu

Phys. Rev. Applied **25**, 014036 (2026) - Published 14 January, 2026

Electronic and magnetic properties of $\mathrm{Fe}X_4$ $(X = \mathrm{N}, \mathrm{P})$ monolayer and bilayer structures under strain

Fuat Bilican, Fatih Ersan, Zeynep Demir Vatansever, Sevgi Ozdemir Kart, and Erol Vatansever

Phys. Rev. Applied **25**, 014037 (2026) - Published 15 January, 2026

Robustness of bound states in the continuum in bilayer structures against symmetry breaking

Kliment V. Semushev, Zilong Zhao, Alexey Proskurin, Mingzhao Song, Xinrui Liu, Mikhail V. Rybin, Ekaterina E. Maslova, and Andrey A. Bogdanov

Phys. Rev. Applied **25**, 014038 (2026) - Published 15 January, 2026

Femtosecond-laser-based true-random-number generator: Entropy as a service

Prasanna Paithankar, Amritash Sharma, Sauradeep Kar, and Shailendra Varshney

Phys. Rev. Applied **25**, 014039 (2026) - Published 16 January, 2026

Interplay between morphology and thickness of a SiN interlayer for enhanced thermal transport across the GaN/diamond interface

Nian Xiao, Hao Chen, Shuang Tian, Yan Zhou, Lina Yang, Lifa Zhang, and Dengke Ma

Phys. Rev. Applied **25**, 014040 (2026) - Published 16 January, 2026

Modulation-transfer-function analysis for optical fiber bundle–based superresolution imaging systems

G.M. Katyba, A.V. Radivon, D.V. Lavrukhin, D.S. Ponomarev, I.N. Dolganova, A.-E.P. Protopopova, S.V. Garnov, V.N. Kurlov, M. Skorobogatiy, and K.I. Zaytsev

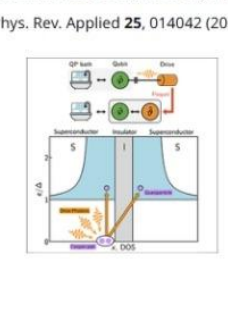
Phys. Rev. Applied **25**, 014041 (2026) - Published 16 January, 2026

EDITORS' SUGGESTION

Theory of quasiparticle generation by microwave drives in superconducting qubits

Shoumik Chowdhury, Max Hays, Shantanu R. Jha, Kyle Serniak, Terry P. Orlando, Jeffrey A. Grover, and William D. Oliver

Phys. Rev. Applied **25**, 014042 (2026) - Published 16 January, 2026



Superconducting circuits for quantum computation are controlled via microwave signals, which are typically assumed to be too weak to disturb the superconducting material itself. When these microwave drives become sufficiently strong, though, multiple photons can combine to break Cooper pairs of electrons in the device, leading to qubit errors. The authors develop a theoretical framework to predict when this effect occurs, and demonstrate its relevance for emerging qubit designs and readout schemes that rely on strong driving. These results reveal a previously overlooked error mechanism for superconducting qubits, and provide guidance on how to mitigate the effects.

Bootstrapping, autonomous testing, and initialization system for $\mathrm{Si/Si}_x\mathrm{Ge}_{1-x}$ multi-quantum-dot devices

Tyler J. Kovach, Daniel Schug, M.A. Wolfe, E.R. MacQuarrie, Patrick J. Walsh, Owen M. Eskandari, Jared Benson, Mark Friesen, M.A. Eriksson, and Justyna P. Zwolak

Phys. Rev. Applied **25**, 014043 (2026) - Published 20 January, 2026

Full-spectrum modeling of mobile gamma-ray spectrometry systems in scattering media

David Breitenmoser, Alberto Stabilini, Malgorzata Magdalena Kasprzak, and Sabine Mayer

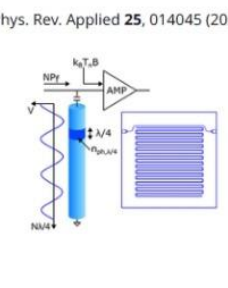
Phys. Rev. Applied **25**, 014044 (2026) - Published 20 January, 2026

EDITORS' SUGGESTION

Broadband high-precision measurement of two-level-system loss using multiwavelength superconducting resonators

Cliff Chen, Shahriar Aghaeimeibodi, Yuki Sato, Matthew H. Matheny, Oskar Painter, and Jiansong Gao

Phys. Rev. Applied **25**, 014045 (2026) - Published 20 January, 2026



Superconducting resonators are a popular way to study dissipation in superconducting quantum circuits induced by two-level systems (TLS) due to their ease of fabrication, but measuring unsaturated TLS loss in quarter-wave resonators remains difficult due to the intrinsic frequency fluctuations of the TLS and low signal-to-noise ratio of the measurement. This study demonstrates that spatially extending the quarter-wave resonator to be many wavelengths long mitigates these difficulties and significantly reduces measurement uncertainty. This new resonator design provides a tool for researchers to examine the effects of material and fabrication processes on superconducting circuit performance.

Practical hybrid decoding scheme for parity-encoded spin systems

Yoshihiro Nambu

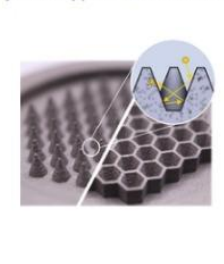
Phys. Rev. Applied **25**, 014046 (2026) - Published 20 January, 2026

FEATURED IN PHYSICS EDITORS' SUGGESTION

Exploiting complex 3D-printed surface structures for portable quantum technologies

N. Cooper, D. Johnson, B. Hopton, M. Overton, D. Stupple, A. Bratu, E. Wilson, J. Robinson, L. Coles, M. Papastavrou, and L. Hackermueller

Phys. Rev. Applied **25**, 014047 (2026) - Published 21 January, 2026

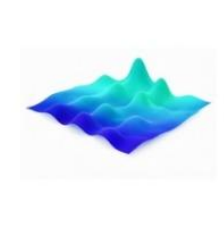


Controlling high-vacuum gas dynamics is critical to many technologies, especially for portable quantum sensors. This article shows how purpose-designed surface textures can influence high-vacuum particle propagation in controlled ways to improve device performance. Using 3D printing to experimentally realize such textures in ultrahigh-vacuum-compatible materials, the authors show an example application in which textured surfaces are able to triple the pumping rate of a nonevaporable getter pump. This approach offers significant technical advantage in numerous high-vacuum settings, and will be of particular benefit to portable quantum technologies.

Phase-space engineering and collective dynamics in memcomputing

Chesson Sipling, Yuan-Hang Zhang, and Massimiliano Di Ventra

Phys. Rev. Applied **25**, 014048 (2026) - Published 21 January, 2026



Physics-based memcomputing is of interest for solving hard combinatorial-optimization problems in computer science, engineering, and physics by embedding a problem directly into the dynamics of a nonlinear system with memory. Few studies, however, have addressed how the phase-space structure controls performance and scalability. This work uses systematic phase-space engineering and simulations of memcomputing machines to identify the dynamical mechanisms that enable efficient solution-finding. Its insights into how memory-driven collective behavior influences phase-space geometry could help in designing more reliable and scalable physics-inspired devices for hard computational problems.

Witnessing nonstationary and non-Markovian environments with a quantum sensor

John W. Rosenberg, Martín Kuffer, Inbar Zohar, Rainer Stöhr, Andrej Denisenko, Analia Zwick, Gonzalo A. Álvarez, and Amit Finkler

Phys. Rev. Applied **25**, 014049 (2026) - Published 21 January, 2026

Practical implementation of Toffoli-based qubit rotation

Christoffer Hindlycke, Jakov Krnic, and Jan-Åke Larsson

Phys. Rev. Applied **25**, 014050 (2026) - Published 21 January, 2026

Activating Cu high-index facets for nitrogen reduction via nonprecious metal doping

Xin Wang, Xiongxiong Xue, Nannan Luo, Li-Ming Tang, Yexin Feng, Ke-Qiu Chen, and Jiang Zeng

Phys. Rev. Applied **25**, 014051 (2026) - Published 22 January, 2026

Unified physical model for negative capacitance and resistive switching in halide perovskite devices

Junhui Wu, Cheng Yang, Sheng Qiang, Zhenwang Luo, Xiang Chen, Xu Wang, Fei Zheng, Zhenfu Zhao, Fei Zhuge, and Ziyang Hu

Phys. Rev. Applied **25**, 014052 (2026) - Published 22 January, 2026

Turquoise magic wavelength of the $^{87}\mathrm{Sr}$ clock transition

G. Kestler, R.J. Sedlik, E.C. Trapp, M.S. Safronova, and J.T. Barreiro

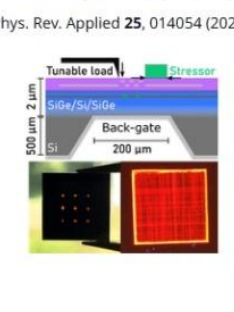
Phys. Rev. Applied **25**, 014053 (2026) - Published 22 January, 2026

EDITORS' SUGGESTION

Fabrication, characterization, and mechanical loading of Si/Si-Ge membranes for spin-qubit devices

Lucas Marcogliese, Ouviyan Sabapathy, Rudolf Richter, Jhih-Sian Tu, Dominique Bougeard, and Lars R. Schreiber

Phys. Rev. Applied **25**, 014054 (2026) - Published 22 January, 2026



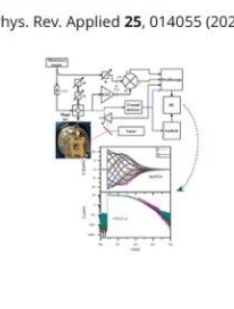
Strain engineering and electric field control are key to optimizing the properties of electron-spin qubits hosted in electrostatically defined Si/Si-Ge quantum dots, and compared to thick Si-Ge heterostructures, thin Si/Si-Ge membranes offer more control. This article reports the fabrication of micrometer-thick Si/Si-Ge heterostructures suspended by a silicon substrate over an area of a few hundred micrometers. The authors characterize the elastic properties of these membranes and identify two mechanical modes useful for strain-field engineering, which helps to increase the valley splitting and thus the coherence time and shuttling fidelity of electron spins.

EDITORS' SUGGESTION

Versatile system for photoconductance decay measurement across a wide range of semiconductor materials

András Bojtor, Dávid Krisztián, Gábor Paráda, Ferenc Korsós, Sándor Kollarics, Gábor Csősz, Bence G. Márkus, László Forró, and Ferenc Simon

Phys. Rev. Applied **25**, 014055 (2026) - Published 23 January, 2026



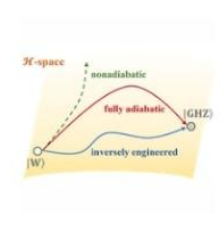
Time-resolved photoconductivity (PCD) sits at the heart of semiconductor characterization, yet many implementations probe only a narrow slice of the system's properties—typically using a single microwave frequency paired with a single excitation wavelength. This work presents a versatile, contactless microwave PCD instrument that combines a broadband coplanar-waveguide sensor with flexible readout electronics, enabling an extensive detection range, temperature-dependent studies, and multiphoton excitation. This platform is equally relevant for industrial silicon wafers and emerging quantum materials, from perovskites to wide-band-gap power semiconductors and topological systems.

EDITORS' SUGGESTION

Fast conversion from *W* to Greenberger-Horne-Zeilinger states via inverse engineering

Hui Zhou, Qilong Hu, Yuquan Chen, Tianyun Wang, Fangzhou Jin, Yunlan Ji, Jianpei Geng, and Xinhua Peng

Phys. Rev. Applied **25**, 014056 (2026) - Published 23 January, 2026



Controlled conversion between distinct classes of multipartite entangled states is crucial for quantum technologies, but direct interconversion is impossible, due to the states' inequivalence under local operations. More sophisticated dynamical protocols are required; unfortunately, conventional adiabatic methods face a trade-off between fidelity and speed. This study employs inverse engineering to design accelerated adiabatic passages in a spin-chain system, enabling rapid *W*-to-GHZ conversion, as experimentally verified on an NMR quantum processor. The work highlights the potential of inverse engineering for efficient quantum state manipulation in many-body systems.

Amplifying decoherence-free many-body interactions with giant atoms coupled to a parametric waveguide

Xin Wang and Zhao-Min Gao

Phys. Rev. Applied **25**, 014057 (2026) - Published 23 January, 2026

Monolayer $MN\mathrm{H}_2$ $(M, N = \mathrm{C}, \mathrm{Si}, \mathrm{Ge})$: Enabling sub-5-nm MOSFETs compatible with silicon-based manufacturing

Hao-Ran Hu, Yan-Dong Guo, Shao-Jin Xia, Yue Jiang, Ye-Wei Chen, Lin-Dong Zhang, Li-Yan Lin, Hong-Li Zeng, and Xiao-Hong Yan

Phys. Rev. Applied **25**, 014058 (2026) - Published 23 January, 2026

Power laws for the thermal slip length of a liquid/solid interface from the structure and frequency response of the contact zone

Hiroki Kaifu and Sandra M. Troian

Phys. Rev. Applied **25**, 014059 (2026) - Published 26 January, 2026

Achromatic ultrasound metalens for enhanced multiplexing underwater communications

Ming Ma, He Gao, Wanglinhan Zhang, Qingqing Wang, Di Wang, Jie Zhu, and Zhongqing Su

Phys. Rev. Applied **25**, 014060 (2026) - Published 26 January, 2026

Enhanced thermoelectric response driven by lone-pair electrons and multivalley band structures in intercalation compounds $X\mathrm{Nb}Y_2$ $(X = \mathrm{Li}, \mathrm{Na};\ Y = \mathrm{S}, \mathrm{Se})$

Zhenguo Wang, Yinchang Zhao, Jun Ni, and Zhenhong Dai

Phys. Rev. Applied **25**, 014061 (2026) - Published 27 January, 2026

Enhanced sensitivity in microscale high-field NMR via nuclear-spin locking with N-*V* centers

Oliver T. Whaites, Jaime García Oliván, and Jorge Casanova

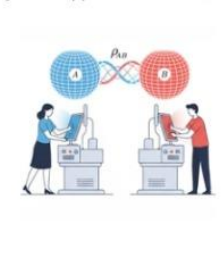
Phys. Rev. Applied **25**, 014062 (2026) - Published 27 January, 2026

EDITORS' SUGGESTION

From top quarks to enhanced quantum key distribution: A framework for optimal predictability of quantum observables

Dennis I. Martínez-Moreno, Miguel Castillo-Celeita, and Diego G. Bussandri

Phys. Rev. Applied **25**, 014063 (2026) - Published 27 January, 2026



The predictability of quantum measurement outcomes is relevant for developing applications in quantum information, and potential sources of useful quantum correlations now extend even to top-antitop quark pairs produced in high-energy colliders. This study presents a comprehensive framework for assessing predictability, using error measures inherited from statistical learning theory. Building on an existing foundation, the authors propose a modified entanglement-based protocol for quantum key distribution, demonstrating enhanced resilience to noise compared to the standard BB84 protocol, and leveraging the strength and capabilities of quark-pair states as resources for quantum cryptography.

Transition waves in a beam coupled to a foundation of symmetric bistable elements

Dengge Jin, Samuele Ferracin, Vincent Tournat, Saheli Patel, Prashant K. Purohit, and Jordan R. Raney

Phys. Rev. Applied **25**, 014064 (2026) - Published 27 January, 2026

Anomalous inverse spin and orbital Hall effects in Fe films with strong uniaxial anisotropy

E. Santos, U. Borges, J.L. Costa, E.L.T. França, J.B.S. Mendes, and A. Azevedo

Phys. Rev. Applied **25**, 014065 (2026) - Published 28 January, 2026

Phototunable adaptive colloidal microrobots in a nematic liquid crystal

Saikat Das, Devika Venkuzhy Sudhakaran, Suvendu Kumar Panda, Dhruv Pratap Singh, Osamu Haba, and Surajit Dhara

Phys. Rev. Applied **25**, 014066 (2026) - Published 28 January, 2026

Transmission loss of a labyrinthine acoustic metamaterial augmented with multichannel feedforward active noise control

Gregory M. Hernandez, Jordan Cheer, and Gianluca Memoli

Phys. Rev. Applied **25**, 014067 (2026) - Published 28 January, 2026

Multiscale model to enhance near-infrared absorptivity in patterned *MX*enes

Niloufar Pirouzfam, Zafer Kandemir, Claudia Cardoso, Cem Sevik, and Kursat Sendur

Phys. Rev. Applied **25**, 014068 (2026) - Published 28 January, 2026

Magnetic-field-resilient high-impedance high-kinetic-inductance superconducting resonators

C. Roy, S. Frasca, and P. Scarlino

Phys. Rev. Applied **25**, 014069 (2026) - Published 28 January, 2026

Purcell-enhanced solid-state laser cooling

Mohammed Benzaouia and Shanhui Fan

Phys. Rev. Applied **25**, 014070 (2026) - Published 29 January, 2026

Machine-learning-assisted density functional theory for predicting transparent conducting materials

Yang Huang, Gui Wang, Shaogang Xu, Yiguo Xu, Da Li, Menglin Huang, Lars Samuelson, and Xiao Wei Sun

Phys. Rev. Applied **25**, 014071 (2026) - Published 29 January, 2026

Exact homogenization method for heat conduction

Gal Shmuel and John R. Willis

Phys. Rev. Applied **25**, 014072 (2026) - Published 29 January, 2026

Thermal analog computing: Application to matrix-vector multiplication with inverse-designed metastructures

Caio Silva and Giuseppe Romano

Phys. Rev. Applied **25**, 014073 (2026) - Published 29 January, 2026

Enhancement of magnetoacoustic coupling by surface acoustic wave–driven spin current

Shuting Cui, Fa Chen, Liyang Liao, Jiacheng Lu, Rui Xiong, Xiaofei Yang, Shiheng Liang, Yue Zhang, Wei Luo, and Yoshichika Otani

Phys. Rev. Applied **25**, 014074 (2026) - Published 30 January, 2026

Josephson traveling-wave parametric amplifier with inverse Kerr phase matching

M.T. Bell

Phys. Rev. Applied **25**, 014075 (2026) - Published 30 January, 2026

Dynamical sweet and sour regions in bichromatically driven Floquet qubits

D. Dominic Briseño-Colunga, Bibek Bhandari, Debmalya Das, Long B. Nguyen, Yosep Kim, David I. Santiago, Irfan Siddiqi, Andrew N. Jordan, and Justin Dressel

Phys. Rev. Applied **25**, 014076 (2026) - Published 30 January, 2026

Scattering and chirping at accelerated interfaces

Klaas De Kinder, Amir Bahrami, and Christophe Caloz

Phys. Rev. Applied **25**, 014077 (2026) - Published 30 January, 2026

EDITORS' SUGGESTION

Light coupling to photonic integrated circuits using optimized lensed fibers

Dengke Chen, Zeying Zhong, Sanli Huang, Jiahao Sun, Sicheng Zeng, Baoqi Shi, Yi-Han Luo, and Junqiu Liu

Phys. Rev. Applied **25**, 014078 (2026) - Published 30 January, 2026

Devising efficient light coupling between optical fibers and silicon nitride photonic integrated circuits is critical in a wide range of applications, but common Gaussian-beam approximations fail to capture the complex physics of lensed fibers. This study employs a comprehensive co-optimization strategy that integrates high-resolution scanning electron microscopy with rigorous three-dimensional simulations to model and experimentally validate the coupling process. The actual emission profile of lensed fibers deviates significantly from the widely assumed paraxial Gaussian beam, a crucial insight that allows the authors to predict and achieve coupling efficiencies exceeding 80% per facet.

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