Volume 22 Issue 4, April 2026

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Coarsening in an active fluid

Coarsening is a process where larger structures form within multiphase systems, and it can take place in complex fluids. Jeremy Laprade and colleagues show that this process is not self-similar in a self-stirring active fluid. The cover image shows a DNA-based condensate (yellow) coarsening within a fluid composed of reconstituted microtubule bundles (cyan).

See Jeremy Laprade et al.

Image: Jeremy Laprade, Guillaume Duclos (Brandeis University). Cover design: Laoise Mac Gabhann

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Laser-focused on precision

The advent of the laser-transformed spectroscopy into a tool for precision measurements across scales, from nuclei to stars. In this Editorial we reflect on its far-reaching influence.

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The core question

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A crystal of neutral excitons

Interlayer excitons are neutral particles, which are prevalent in transition metal dichalcogenide heterostructures. Now, long-range repulsive interactions between these neutral particles leads to the formation of a crystal.

Atac Imamoglu

News & Views
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When excitons lose their mass

Excitons are commonly regarded as massive composite quasiparticles. Now, experiments show that, in two-dimensional materials, light–matter interactions can turn excitons into massless collective modes with linear, photon-like dispersions.

Jin Zhao

News & Views
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A tunable topological photonic interferometer

Robust interference between photonic topological edge states, without compromising unidirectional transmission, is achieved. Optical gain enables fast, reconfigurable control of mode coupling, thus realizing a tunable on-chip topological interferometer.

Yandong Li

News & Views
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A molecular probe for quantum metrology

Cavity-enhanced spectroscopy has now reached temperatures as low as 4 K — colder than most of space. This removes long-standing barriers in measuring hydrogen, which is a benchmark system for testing quantum theory and relevant for metrology.

Cun-Feng Cheng & Shui-Ming Hu

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Frozen sound

Leonardo Banchi

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Universally ouchy

Richard Brierley

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Research Briefings

Research Briefing
23 Mar 2026

MagnetoARPES reveals time-reversal symmetry breaking in a kagome superconductor

The electronic structure of a kagome metal has been investigated using magnetoARPES — the newly developed capability to perform angle-resolved photoemission spectroscopy in the presence of a tunable magnetic field. The momentum-resolved spectral response to a magnetic field was seen to develop in the charge density wave order, revealing electronic evidence of time-reversal symmetry breaking.

Research Briefing
07 Apr 2026

Self-organized elastic membranes with life-like oscillatory dynamics

Chaotic flows generated by a microtubule-based active fluid are shown to enhance the motion of passive actin fibres and assemble them into a hierarchical elastic membrane. Active flows also actuate the multiscale dynamics of the emerging membrane, and non-reciprocal feedback between the active and elastic stresses yields macroscopic oscillations.

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Articles

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18 Feb 2026

An exciton crystal in a moiré excitonic insulator

The formation of exciton crystals is challenging because excitons possess short lifetimes and exhibit weaker interactions than electrons. Now, an exciton Wigner crystal is observed in a moiré electron–hole bilayer.

Ruishi Qi, Qize Li ... Feng Wang

Article
16 Mar 2026

Direct observation of massless excitons and linear exciton dispersion

The linear dispersion and massless behaviour of excitons have been predicted for two-dimensional materials but have not been experimentally demonstrated. Now this behaviour is observed using momentum-resolved electron energy-loss spectroscopy.

Luna Y. Liu, Steffi Y. Woo ... Diana Y. Qiu

Article
16 Mar 2026

Angular interplay of nematicity, superconductivity and strange metallicity in magic-angle twisted trilayer graphene

Nematicity, superconductivity and strange metallicity have been observed in correlated systems, but how their interplay relates to the pairing mechanism is unclear. Now this is revealed in twisted trilayer graphene using angle-resolved transport.

Naiyuan J. Zhang, Pavel A. Nosov ... J.I.A. Li

Article
31 Mar 2026

Observation of giant nonlinear valley Hall effect

Previous observations of the valley Hall effect have been limited to the linear regime. Now a nonlinear version is demonstrated with a larger magnitude than in the linear case.

Pan He, Min Zhang ... Jian Shen

Article
Open Access
17 Mar 2026

Origin of strange metallicity in a d orbital kagome metal

The mechanism of strange metallicity remains difficult to understand. Now it is shown that in a strongly correlated d-orbital kagome metal, compact orbitals created by destructive interference can produce the unusual electronic behaviour.

Jean C. Souza, Moshe Haim ... Haim Beidenkopf

Article
11 Mar 2026

Magnetic field-induced momentum-dependent symmetry breaking in a kagome superconductor

Disentangling intertwined orders in quantum materials is challenging. Now, photoemission spectroscopy experiments show that magnetic fields can be used to disentangle such orders in a kagome superconductor.

Jianwei Huang, Zheng Ren ... Ming Yi

Article
02 Feb 2026

Co-propagating photonic topological interface states with hybridized pseudo-spins

Topological interface states typically support the propagation of a single state in each direction, which limits their applicability. Now, co-propagating states are achieved in a photonic topological insulator system.

Xilin Feng, Tianwei Wu ... Liang Feng

Article
17 Mar 2026

Bose–Hubbard simulator with long-range hopping

Simulating the Bose–Hubbard model with physical systems is an important fundamental task. Now it is shown that dipolar excitons emulate a version of this model in which bosons can hop beyond their nearest neighbours.

Camille Lagoin, Corentin Morice ... François Dubin

Article
25 Feb 2026

Quantum-limited metrology of macroscopic spin ensembles

Quantum fluctuations have been detected in a macroscopic, millimole-scale solid-state spin ensemble without the use of external excitations, enabling non-invasive quantum sensing techniques.

Stephen E. Kuenstner, Declan W. Smith ... Alexander O. Sushkov

Article
20 Mar 2026

Exceptional sensitivity near the bistable transition point of a hybrid quantum system

Operating devices close to a phase transition can improve performance due to the singular behaviour at critical points. An enhancement in sensitivity has now been achieved using the bistable transition point in a hybrid quantum system.

Haofeng Wang, Kurt Jacobs ... Matthew E. Trusheim

Article
Open Access
06 Apr 2026

Quantum ground-state cooling of two librational modes of a nanorotor

Controlling the rotational motion of nanoscale objects by trapping and cooling is a prerequisite for exploring quantum rotational phenomena. Now, two orthogonal librational modes of a levitated nanorotor are cooled into their quantum ground state.

Stephan Troyer, Florian Fechtel ... Markus Arndt

Article
06 Mar 2026

Logical multi-qubit entanglement with dual-rail superconducting qubits

Quantum computers often exhibit a bias in the type of error that is the most common or severe. Entanglement has now been demonstrated for qubits encoded with an error correction code that is designed to efficiently handle biased errors.

Wenhui Huang, Xuandong Sun ... Dapeng Yu

Article
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Low-overhead fault-tolerant quantum computation by gauging logical operators

Combining quantum error correction with gauge theory concepts from many-body physics enables the design of codes with improved resource requirements for fault-tolerant quantum computation.

Dominic J. Williamson & Theodore J. Yoder

Article
02 Apr 2026

Active assembly and non-reciprocal dynamics of elastic membranes

The microtubule–kinesin system is a well-known active matter system. Now it is shown that a microtubule-based active fluid can assemble adhesive non-thermal fibres into a membrane-like structure.

John Berezney, Sathvi Ray ... Zvonimir Dogic

Article
06 Mar 2026

The coarsening of biomimetic condensates in an active fluid is non-self-similar

A study of condensates that mimic biological ones within a reconstituted cytoskeleton reveals the mechanisms underlying the coarsening of the condensate.

Jeremy Laprade, Layne B. Frechette ... Guillaume Duclos

Article
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The hydrodynamic torque dipole from rotary bacterial flagella powers symmetric discs

It is known that placing asymmetric objects in a bacterial bath results in the net rotation of those objects. Now it is shown that the torque dipole of confined *E.coli* can rotate symmetric objects hydrodynamically.

Daniel Grober, Tanumoy Dhar ... Jérémie Palacci

Article
12 Mar 2026

Universal dynamics and microwave control of programmable resonant electro-optic frequency combs

The physics of resonant electro-optic microcomb generation is underexplored, limiting their potential applications. Now several technological advances are realized by studying the state space of a thin-film lithium niobate photonic frequency comb.

Yunxiang Song, Tianqi Lei ... Marko Lončar

Article
Open Access
06 Mar 2026

Cavity-enhanced spectroscopy in the deep cryogenic regime for quantum sensing and metrology

Operating cavity-based spectrometers at low temperature has several advantages, such as improved sensitivity. Now, a cavity-enhanced spectrometer is demonstrated down to 4 K.

K. Stankiewicz, M. Makowski ... P. Wcisło

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Amendments & Corrections

Publisher Correction
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Publisher Correction: Driving Floquet physics with excitonic fields

Vivek Pareek, David R. Bacon ... Keshav M. Dani

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Measure for Measure

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In pursuit of metrological diplomacy

International metrological decision-making processes are exceedingly complex. Shanay Rab and Richard Brown explain how it works.

Shanay Rab & Richard J. C. Brown

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