



**Fungi in flow**

The means by which filamentous fungi can control fluid flows in porous media remain poorly understood. Sang Hyun Lee and co-workers show that the fungi can create multiphase flows by locally clogging pores, thereby redistributing fluid phases. The image shows hydrophilic fungi *Penicillium* sp. displacing oil trapped in a porous medium. The fungi grow from the aqueous phase into the oil phase in a microfluidic chip, advancing the oil-water interface and displacing the oil.

See [Lee et al.](#)

Image: Peter K. Kang, University of Minnesota and Sang Hyun Lee, University of Massachusetts Amherst. Cover design: Laoise Mac Gabhann

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Editorial

Editorial  
11 Nov 2025

The prize at the end of the quantum tunnel

The 2025 Nobel Prize in Physics has been awarded to John Clarke, Michel Devoret and John Martinis “for the discovery of macroscopic quantum mechanical tunnelling and energy quantisation in an electric circuit”.



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World View

World View  
29 Oct 2025

An initiative towards better representation in high-pressure research

Women in High Pressure, a community tackling gender imbalance in high-pressure research, is driving inclusion, visibility and systemic change — so every scientist can thrive, even under pressure.

Miriam Peña-Alvarez & Julia Contreras-García

Advertisement Feature

Entangled photons travel from chip to satellite in quantum tests

From silicon defects to satellite beams, Canada’s researchers are shaping quantum computing with networks of light.

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Thesis

Thesis  
11 Nov 2025

The beat of digital twins

Mark Buchanan

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Books & Arts

Books & Arts  
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On knowledge and spectacle

Urmila Chadayammuri

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News & Views

News & Views  
31 Oct 2025

A magnetic knob for strangeness

High-field transport and ultrasound experiments in cuprates tie strange metallic T-linear resistivity to spin dynamics.

Edwin W. Huang

News & Views  
06 Nov 2025

A tale of two domes in twisted trilayer graphene

A careful investigation of superconductivity in twisted trilayer graphene reveals a two-dome structure, which may be connected to intricate patterns of symmetry breaking in the underlying metallic state.

Étienne Lantagne-Hurtubise

News & Views  
14 Oct 2025

Ultrafast topological control

Exciton-polariton superlattices allow sub-picosecond switching of topological phases, paving the way for ultrafast and reconfigurable topological photonic devices.

Hyun Gyu Song & Su-Hyun Gong

News & Views  
23 Oct 2025

Vortices revealed by synchronization

A study shows that the nucleation of vortices in dipolar supersolids can be revealed by the onset of rotational synchronization.

Yu-Kun Lu

News & Views  
22 Oct 2025

Practical limits on entanglement manipulation

Entanglement is a powerful resource for quantum technologies but real-world computation limits can drastically change what is achievable. Now research reveals that computational constraints reshape our understanding of entanglement manipulation.

Kun Fang

News & Views  
03 Nov 2025

Free electrons as a source of nonclassical light

Photon sources used in quantum optics are limited in ways that free electron sources may not be. Now, accelerated electrons have been shown to generate non-classical light — this opens up possibilities for quantum experiments at the nanoscale.

Sophie Meuret & Hugo Lourenço-Martins

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Research Briefings

Research Briefing  
03 Nov 2025

Short-range propagation of plasma membrane tension in neurons facilitated by periodic barriers

In two types of roundworm neurons that can sense mechanical stimuli, the tension in the plasma membrane propagates rapidly, but it is spatially confined by periodic barriers formed by cytoskeletal and membrane proteins. This spatial restriction enables localized mechanical signalling, enhancing a neuron’s capacity to process multiple stimuli independently.

Research Briefing  
03 Oct 2025

Imaging isospin order in rhombohedral graphene reveals anisotropy in correlated states

The microscopic magnetic textures of isospin symmetry-broken phases in rhombohedral tetralayer graphene have been directly imaged. By probing spin orientation and magnetic anisotropy at ultra-low fields, key energy scales — the spin-orbit coupling and intervalley Hund’s exchange — have been extracted, shedding new light on the phase hierarchy in strongly correlated electron systems.

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Review Articles

Review Article  
07 Nov 2025

Fractional quantization in insulators from Hall to Chern

This Review describes the concepts behind generalized quantum Hall effects that can take place without a magnetic field, and summarizes recent experimental manifestations of these phenomena in twisted two-dimensional materials and few-layer graphene.

B. A. Bernevig, L. Fu ... J. Shan

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Matters Arising

Matters Arising  
21 Oct 2025

Inadequacy of the Casimir force for explaining a strong attractive force in a micrometre-sized narrow-gap re-entrant cavity

Giuseppe Bimonte

Matters Arising  
21 Oct 2025

Reply to: Inadequacy of the Casimir force for explaining a strong attractive force in a micrometre-sized narrow-gap re-entrant cavity

J. M. Pate, M. Goryachev ... M. E. Tobar

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Articles

Article  
01 Sept 2025

Filamentous fungi control multiphase flow and fluid distribution in porous media

Filamentous fungi often grow in porous environments with multiphase flow. Now it is shown that these fungi can actively induce multiphase flow and mobilize trapped fluid phases in porous media.

Sang Hyun Lee, Marcel Moura ... Peter K. Kang

Article  
Open Access  
15 Sept 2025

Decoding frequency-modulated signals increases information entropy in bacterial second messenger networks

Cells decode temporal patterns into gene expression states through amplitude and frequency modulation. Now it is shown that frequency modulation increases information entropy compared with amplitude modulation alone.

Rongrong Zhang, Shengjie Wan ... Fan Jin

Article  
Open Access  
29 Oct 2025

Obstacles regulate membrane tension propagation to enable localized mechanotransduction

Propagation of membrane tension mediates communication on the membrane surface. It is now shown that membrane-bound obstacles can obstruct tension propagation, which helps to localize signalling.

Frederic Català-Castro, Mayte Bonilla-Quintana ... Michael Krieg

Article  
16 Sept 2025

Observation of the Yamaji effect in a cuprate superconductor

The Yamaji effect is a modulation of the electronic transport as the angle of an applied magnetic field is changed. This has been observed in a model cuprate and sheds light on the geometry of the Fermi surface and the nature of the pseudogap.

Mun K. Chan, Katherine A. Schreiber ... Neil Harrison

Article  
30 Sept 2025

Impact of low-energy spin fluctuations on the strange metal in a cuprate superconductor

The underlying physics of the strange metal phase observed in many strongly correlated materials is not well understood. Now, evidence emerges that antiferromagnetic spin fluctuations play an important role.

D. J. Campbell, M. Frachet ... D. LeBoeuf

Article  
Open Access  
02 Oct 2025

Isospin magnetic texture and intervalley exchange interaction in rhombohedral tetralayer graphene

Hund’s exchange interaction energy in two-dimensional materials is challenging to extract from experiments. Now, this is achieved in rhombohedral graphene, which allows an estimate of the interactions that drive the variety of correlated states in this material.

Nadav Auerbach, Surajit Dutta ... Eli Zeldov

Article  
30 Sept 2025

Gate-tunable double-dome superconductivity in twisted trilayer graphene

Two regions of superconductivity are observed in the phase diagram of magic-angle twisted trilayer graphene. This may yield insight into the superconducting mechanism in moiré materials.

Zekang Zhou, Jin Jiang ... Mitāl Banerjee

Article  
05 Sept 2025

Pressure induced superconductivity in hybrid Ruddlesden–Popper La<sub>3</sub>Ni<sub>2</sub>O<sub>7</sub> single crystals

La<sub>3</sub>Ni<sub>2</sub>O<sub>7</sub>, a hybrid Ruddlesden–Popper nickelate, exhibits pressure-induced superconductivity with a high superconducting volume fraction; offers insights into the interplay of structure and electronic order in nickelate superconductors.

Mengzhu Shi, Di Peng ... Xianhui Chen

Article  
23 Sept 2025

Universal anyone tunnelling in a chiral Luttinger liquid

Measurements of anyone moving through a quantum point contact allow the extraction of their tunnelling exponent. This fully characterizes their topological order and confirms that they are well described by the Luttinger liquid theory.

Ramon Guerrero-Suarez, Adithya Suresh ... Michael Manfra

Article  
22 Oct 2025

Individual solid-state nuclear spin qubits with coherence exceeding seconds

Nuclear spins in solid-state systems can have very long coherence times, which makes them attractive for use as qubits. Now a nuclear spin qubit device has been developed with all-microwave two-qubit control that has important performance benefits.

James O’Sullivan, Jaime Travesedo ... Emmanuel Flurin

Article  
18 Sept 2025

Acoustic phonon phase gates with number-resolving phonon detection

It has been proposed that phonons propagating through a material can be used for quantum computing, in a similar manner to photons. Now, several of the quantum gates and measurements needed for this approach have been demonstrated.

Hong Qiao, Zhaoyou Wang ... Andrew N. Cleland

Article  
26 Sept 2025

Sub-picosecond topological phase transition in nonlinear exciton–polariton superlattices

Achieving in a microcavity, real-time topological photonic system is challenging. Now this is accomplished by designing superlattices of WS<sub>2</sub> and a polymer embedded in a microcavity.

Hefei Zhao, Zheng Guan ... Wenjing Liu

Article  
Open Access  
14 Oct 2025

Experimental observation of a time rondoau crystal

Previous work on periodically driven many-body systems has demonstrated the formation of time crystals that break time-translation symmetry. Now, more general phases with partial temporal ordering have been realized.

Leo Joon Il Moon, Paul M. Schindler ... Ashok Jayoy

Article  
Open Access  
23 Oct 2025

Synchronization in rotating supersolids

Supersolids combine superfluid and crystal order and their response to external driving remains unclear. Now it is shown that, in a dipolar supersolid, rotation induces synchronization of the crystal motion via vortex nucleation.

Elena Poli, Andrea Litvinov ... Francesca Ferlaino

Article  
12 Sept 2025

Parallelized telecom quantum networking with an ytterbium-171 atom array

Most atom-based quantum networks emit photons at non-telecom wavelengths, requiring lossy conversion for long-distance links. A scalable approach for generating direct entanglement between atoms and telecom-band photons has now been demonstrated.

Lintao Li, Xiye Hu ... Jacob P. Covey

Article  
08 Sept 2025

Certifying universal quantum state with few single-qubit measurements

The certification protocol presented here is an efficient way to verify that a many-qubit quantum state is close to a desired target state. As well as enabling the verification of near-term quantum devices, it has applications to quantum learning.

Hsin-Yuan Huang, John Preskill & Mehdi Soleimanifar

Article  
16 Sept 2025

Constant-overhead magic state distillation

The creation and purification of magic states can be a limiting step in quantum computing. Now an error correcting code has been found where the overhead of this process is the lowest value possible, showing that optimal performance can be achieved.

Adam Willis, Min-Hsi Hsieh & Hayata Yamasaki

Article  
Open Access  
22 Oct 2025

Entanglement theory with limited computational resources

Previous work on the limits of quantum information processing has often assumed access to unlimited computational resources. Imposing a requirement for computational efficiency on entanglement theory substantially changes what is possible.

Lorenzo Leone, Jacopo Rizzo ... Sofiene Jerbi

Article  
Open Access  
16 Oct 2025

Electrons herald non-classical light

When free electrons emit light, an entangled electron-photon state is created. Here measurements of the correlated multiparticle system have been used to produce non-classical photonic states.

Germaine Arend, Guanhao Huang ... Claus Ropers

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