ECOLOGICAL NETWORKS

Happy together

Nat. Ecol. Evol. **2**, 1237–1242 (2018)

Credit: Robert Adrian Hillman/Alamy Stock Vector

Creating a stable ecosystem from scratch doesn't sound like an easy task: populations of interdependent species have to be carefully balanced to ensure coexistence and avoid extinctions. And the more species to juggle, the harder it gets —increasing the complexity of ecosystems makes them inherently less stable. But then why are ecosystems in nature so wonderfully diverse? Network models are seemingly unhelpful on this front, as large food webs are stable only when parameters are fine-tuned — an unrealistic expectation for real ecosystems.

With a change of perspective, Carlos A. Serván and colleagues have now provided a solution to this problem. They demonstrated that a stable equilibrium comprising many coexisting species can be easily achieved by letting population dynamics prune a much larger pool of species. Interaction parameters influence the share of species that survive, whereas the underlying structure of the interaction network was found to have very little effect. It looks like the key to populating a desert island may just be to bring enough species along. *FL*

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BIOLOGICAL CLOCKS

That ticking noise

Phys. Rev. Lett. (in the press); preprint at https://arxiv.org/abs/1710.02098

Various organisms that live in environments subjected to a diurnal rhythm have developed timekeeping capabilities. In many cases such biological clocks are based on limit-cycle oscillators, which can run autonomously. Some chronometric mechanisms, however, seem to rely on sustained oscillatory input and relax to a stable fixed point once driving stops. Among cyanobacteria both types of timepiece are found, and the question is why. Michele Monti and colleagues argue that it could have to do with noise resilience.

Monti et al. studied several network designs for timekeeping and looked at how noise in the external input — such as variations in light intensity during daytime — affects the precision with which different types of oscillators estimate time. For low input noise, they found no significant differences between limit-cycle oscillators and their damped counterparts. But when they cranked up the noise, the former emerged as the victor. *AHT*

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SOLID-STATE SWITCHES

Single-photon gatekeepers

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The building blocks of quantum circuits, such as single-photon transistors and switches, are key elements for next-generation information technology. However, realizing such structures for compact solid-state devices is challenging, because they require highly efficient photon–memory interaction and broad bandwidths at optical frequencies, along with high switching rates. Only some of these criteria have been achieved so far with alternative approaches such as atomic traps. Now, Shuo Sun and colleagues have successfully demonstrated a fully functional device experimentally.

Sun et al. took a nanophotonic cavity and embedded a charged quantum dot in it, loaded with a single electron. When subjected to a magnetic field, the system performed as a semiconductor qubit, in which two spin configurations represent a stable quantum memory. They demonstrated that the quantum memory could be activated by a single gate photon, and then transmitted a signal field of a specific number of photons in only a few tens of picoseconds. *JPK*

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STRUCTURAL MECHANICS

Elastic bits

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The discrete nature of memory storage typically lends itself to lattice-like structures. But doing away with the lattice may confer flexibility without sacrificing memory density. Jun Young Chung and colleagues have taken this approach to build a programmable device from a thin elastic shell — a read–write memory that is akin to a kind of lattice-free Braille.

Inspiration for the device came from the idea that a rubber hemisphere can find stability when it's turned inside out. By forcing a long thin elastic sheet to arch between parallel rails and then applying an axial compressive strain, Chung et al. found that they could use a stylus to form localized dimples that persisted when the force was removed. The team succeeded in programming multiple non-interacting dimples that could be simply erased by relaxing the axial compression. And for higher strains, they found that they could even programme dimple doublets. *AK*

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THEORETICAL PHYSICS

Ballistic versus diffusive

Phys. Rev. X (in the press); preprint at https://arxiv.org/abs/1710.09835
Phys. Rev. X (in the press); preprint at https://arxiv.org/abs/1710.09827

A drop of ink gets diluted in water. The movement of the ink particles — from regions of high to low concentration — is governed by diffusion, in which mass conservation plays a crucial role. In the quantum world, the evolution of a system is constrained by unitarity in addition to conservation laws. So how does quantum information propagate under the combination of these constraints? Vedika Khemani and co-workers have addressed this problem, revealing an interplay between the conservation of an actual observable and unitarity.

Previous studies indicated that with the unitary constraint alone, quantum information propagates ballistically, leading to a light-cone structure in spacetime. Khemani et al. considered an additional charge-conservation constraint, and found that the information-spreading front still travelled ballistically. However, coupling between the unitary evolution and the diffusion induced more complicated relaxation dynamics behind the ballistic front. In a related work, Tibor Rakovszky and co-workers reached similar conclusions with a slightly different approach. *YL*

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