FLUID DYNAMICS

Salty legs

Phys. Rev. Fluids (in the press)

Credit: Samantha McBride and Kripa K. Varanasi (MIT)

Spray some sea water and it will leave a salty deposit that might corrode the surface it has landed on. The salty crystals left behind as a result of evaporation can be damaging to ships, and strategies for their removal are needed. Samantha McBride and co-workers have captured a curious behaviour of evaporating salty drops that could be exploited for antifouling applications in a video shown in the Gallery of Fluid Motion (https://doi.org/dgvt).

The team placed a saline droplet on a hot superhydrophobic surface. As it evaporated, the droplet left behind a salty round casing, which in turn started growing salty 'legs' that lifted it off the surface. This peculiar — almost life-like — structure was created because once the salt globe formed, the evaporation continued at a few points where the globe was in contact with the very hot surface. Once evaporation was complete, the salt crystals had minimal contact with the surface and could be easily removed. *ED*

https://doi.org/10.1038/s41567-019-0776-1

QUANTUM OPTICS

Mix and match

Nat. Photon. https://doi.org/dgvp (2019)

Linear quantum networks consist of an array of beam splitters and waveguides, either on an optical bench or on a chip. Of course, table-top networks are too unwieldy for applications but integrated networks are just as fixed in their configuration, often only able to perform one task. Saroch Leedumrongwatthanakun and colleagues have now exploited the spatial and polarization mode mixing in a multimode fibre to realize an optical network that is programmable on the fly.

First, the team measured the transmission matrix, which connects the output of the 400-mode fibre they used to the optical input. With this in hand, they turned the fibre into a specific network by injecting the wavefront to match the desired operation. In this way, the team was able to first certify the indistinguishability of photons, then demonstrate controlled coherent absorption. The experiments were limited to two-output × two-input networks by the detection architecture but this can, in principle, be scaled up. *NM*

https://doi.org/10.1038/s41567-019-0777-0

ASTRONOMY

Quest for a neutrino source

Astrophys. J. Lett. **887**, L6 (2019)

The Sun and the supernova 1987A produce astrophysical neutrinos, but with much lower energies than the highest-energy neutrino observed to date. Of the many candidate sources of neutrinos in the giga- to tera-electronvolt range, blazars — active galactic nuclei with relativistic jets — are the most promising. Although the direction of the 290-TeV neutrino event reported by the IceCube Collaboration in 2017 coincided with a flaring blazar, the neutrino's origin is not yet fully understood — motivating further searches.

Kaito Hagiwara and colleagues have searched for neutrinos from the direction of that very same blazar. With data collected over two decades by the Super-Kamiokande detector — a water Cerenkov detector located a thousand metres underground in Japan — the team looked for an excess of neutrinos over the atmospheric background. They found no excess of neutrinos in the direction of the blazar over the whole period as well as localized over shorter time spans. The quest continues. *SR*

https://doi.org/10.1038/s41567-019-0778-z

HYDRODYNAMICS

In pursuit of Poiseuille

Nature **576**, 75–79 (2019)

Hydrodynamic flow of electrons in solids has been observed many times, but an image of the Poiseuille flow — the spatial structure of the dynamics — has not been seen yet. Using a scanning single-electron transistor, Joseph Sulpizio and co-workers have now done just that in a graphene device.

The team mounted a carbon nanotube on the end of a scanning probe tip and, by monitoring the flow of electrons through it, they were able to detect the potential generated by the currents in the graphene sample. As the temperature increased, the spatial profile of the potential changed from flat to quadratic, indicating that the Poiseuille regime had been reached. They also calculated the probable phase diagram of the electron flow regimes and found qualitative agreement with their experiments. *DA*

https://doi.org/10.1038/s41567-019-0775-2

NANOPARTICLES

From classical to quantum

Phys. Rev. Lett. (in the press); preprint at https://arxiv.org/abs/1908.05079

In quantum mechanics textbooks, particles trapped in a harmonic potential often serves as a paradigmatic system to study. They possess eigenstates labelled by sets of quantum numbers and their corresponding equally spaced eigenenergies have a non-zero minimum value — the zero-point energy. Although this textbook example has long been realized in the lab, transitioning a mesoscopic system from the classical realm to this quantum regime is still challenging. Now Felix Tebbenjohanns and co-workers have demonstrated this with a very simple setup.

The system consisted of a 136-nm-diameter silica particle trapped in a single-beam optical dipole trap. A measurement-based linear-feedback cooling scheme brought the system — which initially behaved entirely classically — directly to the quantum regime. As the particle approached its lowest energy state, light–particle scattering, which involves a further reduction of the energy, was supressed. The particle's quantum ground-state motion could then be inferred by measuring the asymmetry of the spectrum of the scattered light. *YL*

https://doi.org/10.1038/s41567-019-0779-y

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