MICROFLUIDICS

A trap for two

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Single-particle trapping methods typically rely on one or more forces holding a specific type of particle in place. Confinement via hydrodynamic forces, however, has the advantage of not posing any restrictions on a particle's physicochemical properties.

Anish Shenoy and colleagues have now developed a microfluidic hydrodynamic trap capable of simultaneously confining two micrometre-sized polystyrene beads. A six-branched cross, consisting of three ingoing and three outgoing microfluidic channels, was the 'catchment area'; by clever control of the inlet and outlet flows using pressure regulators, the authors created a flow-field featuring two stagnation points (pictured).

The experimental set-up was dubbed a Stokes trap by Shenoy *et al.*, as the use of a high-viscosity glycerol–water solution justified a Stokes-regime description. The device uses a model-predictive control algorithm, which enables the streamline topology to be adjusted and the two particles steered. Admittedly, it requires active feedback control because the trapping loci correspond to unstable equilibrium positions, which is a slight disadvantage compared with passive trapping methods. On the other hand, expanding the Stokes trap with more branches may add even more controllability. *BV*

MILKY WAY

We want to break free

Astrophys. J. **821,** L1–L19 (2016)

Hypervelocity stars can reach speeds of 770 km s^{-1} (with respect to our galactic rest frame), exceeding the escape velocity from the Milky Way. How stars reach those speeds is a matter of debate. One theory involves a binary star system that gets too close to the supermassive black hole at the centre of the Galaxy, which tears apart the binary, keeps (or swallows) one star and accelerates the other star outwards with a high velocity. But Péter Németh and co-workers have shown that the binary star system, PB 3877, moving just below escape velocity, challenges such models.

The authors used the Keck II telescope in Hawaii and the Very Large Telescope in Chile to discover that a known hypervelocity star is actually in a wide binary system with a much cooler star. A reconstruction of their orbit suggests that the stars were never near the galactic centre. All other acceleration mechanisms, such as supernova explosions, would disrupt the binary stars. Thus Németh *et al.* speculated that dark matter may be holding the stars together, or that they have come from another galaxy. *MC*

COSMIC-RAY MUONS

Pictures from the sky

EPL **113,** 58001 (2016)

Following in the wake of pioneering experiments carried out with photosensitive films on mountaintops, we have now a good understanding of the subatomic particles falling on the Earth. Muons, specifically, reach the Earth's surface with a fairly high and uniform flux, a feature that has now been exploited for imaging purposes.

Nuclear reactors and pyramid interiors have been inspected via muon absorption or scattering, but so far these techniques have mostly been employed for the detection of heavy elements. Now, Istvan Bikit and colleagues have demonstrated an approach for using cosmic-ray muons to image small structures made of light elements.

Their idea was to combine a gamma spectrometer with a muon tracker, and consider only particle trajectories that would lead to coincident detections. A low cutoff on the gamma spectrometer rendered it unable to detect muons directly interacting with it, meaning that it only detected secondary particles generated by interactions with the object to be imaged. A plane-by-plane reconstruction technique then enabled the team to create a tomographic image of a small copper tube — the first using particles from the sky. *FL*

ACTIVE MATTER

Guided by the light

Sci. Adv. **2,** e1501850 (2016)

Imagine being able to herd self-propelled particles through a maze built from the particles themselves. Joakim Stenhammar and colleagues have undertaken simulations designed to do just that — showing that light-controlled motile particles can be manipulated into active rectification devices.

By exploiting the fact that motile particles accumulate in regions where they move more slowly, the authors simulated patterns of high and low particle density using illumination to influence the particles' speed. Chevron-shaped light patterns coaxed the particles to form funnel-like obstructions, taking inspiration from a rectifier that uses micropatterned obstacles to manipulate self-propelled particles. The efficiency of the device was around 1.6, compared with 2.8 in its microfabricated analogue. An alternative sawtooth-shaped design bumped this efficiency up to 2.

The beauty of the proposed device rests with its simplicity: the light imparts only scalar information on the microswimmers, and dispenses with the need for micropatterning — sculpting programmable dynamics out of an otherwise unstructured particle soup. *AK*

BLACK HOLES

Complexity growth

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In quantum computation, the notion of complexity refers to the minimum number of gates needed to prepare a certain state from a reference state. This pragmatic notion has now been related to something more exotic: black hole horizons. More precisely, it has been conjectured that the growth of the volume of a black hole interior is dual to the growth in computational complexity. Adam Brown and colleagues revisited this conjecture and restated it, this time relating complexity to the action of a particular type of spacetime region called a Wheeler–DeWitt patch. In other words, the computational complexity of a boundary relates to the geometry of a bulk region.

There are reasons to believe that the original conjecture, and hence the new one, is likely to be correct. Interestingly, the new conjecture may have deeper implications connecting quantum information and quantum gravity. And it also suggests that black holes could reach the physical limits of computation determined by the fundamental constants. In this sense, black holes are the fastest computers in the known universe. *IG*

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