FORENSICS

Fake, out!

Proc. Natl Acad. Sci. USA https://doi.org/c67x (2019)

Credit: © James Hamm

Spotting forged artwork can be tough, in part because getting enough material to do radiocarbon dating is invasive, and in part because old frames and canvases can be acquired by forgers relatively easily. Laura Hendriks and co-workers have now demonstrated a carbon dating technique that targets a microsample of the paint itself, and tested it on a known fraud.

Using recent developments in mass spectrometry, the team sampled both a strand from the canvas and a 58 μg fleck of the paint. They confirmed that the canvas was old, but discovered that the oil from which the paint was made was harvested either between 1958 and 1961, or 1983 and 1989. The forger had previously confessed to creating the fake in 1985. Forgers will now have to get their hands on antique paint to stay ahead of the authorities. *DA*

https://doi.org/10.1038/s41567-019-0587-4

BOSE–EINSTEIN CONDENSATES

Atomic rollercoaster

Nature **570**, 205–209 (2019)

Hurl an atomic cloud from a tower into an interferometer and you get an exquisite sensor of gravity and rotation. More compact alternatives that allow for long interrogation times without the skyscrapers are atom chips — miniature devices for trapping and controlling Bose–Einstein condensates. Some interferometer designs need to be able to shuttle atoms around, but moving quantum objects isn't easy. Any perturbation may heat up the cloud and disrupt its coherence and potential for precision measurements.

Saurabh Pandey and co-workers have now managed to create a smooth enough ring-shaped trap to send their condensate on a hypersonic ride, reaching speeds of up to Mach 16 over distances of 15 cm, all while preserving the cloud's coherent properties. Such an engineering feat required a combination of magnetic fields applied at three different timescales, as well as control techniques that compensated the tug felt by the atoms as the trap began to move around the ring — a feeling familiar to anyone who has been on a rollercoaster. *FL*

https://doi.org/10.1038/s41567-019-0588-3

RANDOM WALKS

Obstacle course

Nat. Commun. **10**, 2442 (2019)

How fast can you feasibly make it out of a confined space littered with obstacles? The average path length of a random walk inside an arbitrary closed domain is given by the volume-to-surface-area ratio of the space, a relationship that has been exploited in studies of light propagation in turbid media. Giacomo Frangipane and colleagues have now shown that they can use this proportionality to predict the average path length of bacteria swimming inside microstructures.

The team tracked bacteria as they moved through different microchambers containing randomly distributed pillars. The pillars provided a degree of tunable complexity that allowed the researchers to sample a range of volume-to-surface-area ratios, and ultimately confirm the general invariance property predicted for confined random walks. In doing so, they succeeded in showing that introducing more obstacles doesn't actually increase the average residence time. Instead, it shortens it by decreasing the volume in which the bacteria can swim. *AK*

https://doi.org/10.1038/s41567-019-0586-5

OPTICAL CHIRALITY

Something from nothing

Phys. Rev. B **99**, 241101(R) (2019)

Chiral structures interact differently with left- and right-circularly polarized light — absorbing or scattering either one or the other. Chiral molecules possess an inherent structural handedness and chiral antennas are deliberately designed without mirror symmetry. Sergey Nechayev and Peter Banzer have now shown that chiral states of light can be created from the interaction of achiral light with an achiral nanoparticle.

Although the vector beam in their experiment is not circularly polarized and therefore has no optical chirality, its lack of reflection symmetry makes it geometrically chiral. Similarly, the spherical gold nanoparticle has no geometrical chirality, but it only scatters the electric — not the magnetic — component of the light field, thus breaking electromagnetic duality. The resulting circularly polarized scattered field is evidence that optical chirality is not limited to chiral fields and structures, but can result from more general symmetry breaking. *NM*

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NUCLEAR FUSION

Triton burn-up

Nucl. Fusion **59**, 076017 (2019)

In the fusion reaction of deuteron and triton, alpha particles are more than a mere by-product. Their kinetic energy of 3.5 MeV is actually transferred to the plasma, which has the effect of heating it up. One challenge in realizing a fusion reactor involves determining how the alpha particles can be better confined and the self-heating sustained.

Kunihiro Ogawa and colleagues studied the confinement of triton produced in deuterium plasma operations in the Large Helical Device because it exhibits behaviour similar to the alpha particles created in deuteron–triton reactions. With newly installed neutron diagnostics, the ratio between the neutron emission rates from a deuteron–triton and deuteron–deuteron reaction was measured for different magnetic-field configurations. When the magnetic-field axis was shifted inwards, this burn-up ratio increased significantly and revealed better ion confinement. The maximum value of the burn-up ratio was comparable to those obtained in middle-sized tokamaks such as KSTAR and promises good confinement of alpha particles in helical devices. *SR*

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