

Sciencewatch

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Endless recycling possibilities

Easily recyclable polymers, which could be broken down into their constituent monomers and then repolymerised, would potentially help to solve the global plastic-waste problem. Jian-Bo Zhu and colleagues of Colorado State University have developed a polymer system based on γ -butyrolactone (GBL) that renders the usually nonpolymerisable GBL ring easily polymerisable at room temperature and under solvent-free conditions. The polymer has high molecular weight, thermal stability



The easily recyclable polymer system developed by Zhu and colleagues could help to fix the global plastic-waste problem.

and crystallinity, and can be repeatedly converted back into its monomers by thermolysis or chemolysis, ready to be used again as a raw material.

● Further reading

J-B Zhu *et al.* 2018 *Science* **360** 398.

20-qubit entanglement

For quantum computing to reach its full potential, the critical benchmark to push is the number of quantum-entangled qubits. Nicolai Friis of the Austrian Academy of Sciences and colleagues now report entangled states in a fully controlled 20-qubit system using trapped atomic ions as the qubits. The previous largest number of entangled qubits was 14, but even modest improvements in how many qubits can be entangled can lead to vast increases in computational power. The team observed genuine multipartite entanglement in all neighbouring qubit pairs and triplets, in most quadruplets, and in some quintuplets. Genuine multipartite entanglement in larger qubit groups in their system remains to be demonstrated.

● Further reading

N Friis *et al.* 2018 *Phys. Rev. X* **8** 021012.

Two new time crystals

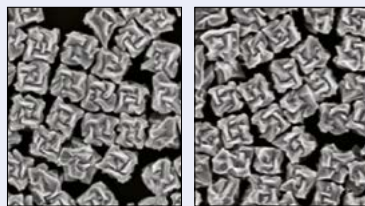
Time crystals – structures whose lowest-energy configurations are periodic in time rather than space – were first experimentally demonstrated in 2017 in (spatially) disordered systems. Two independent teams have now added spin systems periodically driven by NMR pulses to the list of systems that can host time crystals. Jared Rovny and colleagues of Yale University used radio-frequency (RF) pulses to periodically rotate the spins of phosphorus-31 nuclei inside a crystal of ammonium dihydrogen phosphate, finding that the spins displayed time-crystal behaviour, oscillating at twice the period of the pulse sequence. In a distinct NMR experiment, Soham Pal and colleagues at the Indian Institute of Science Education and Research found time-crystal behaviour in a liquid, using

From amino acids to gold

Chiral nanoparticles have several potential applications, such as in optical devices and sensors. But it can be tricky to prepare them, particularly from crystalline metals. A novel idea uses the chirality of amino acids to make chiral plasmonic gold nanoparticles. Hye-Eun Lee of Seoul National University and colleagues used chiral (L or D) amino acids on “seed” nanoparticles to favour one chirality over the other as the seeds grew. The resulting nanoparticles have a twisted morphology that gives them a strong chiral plasmonic optical activity with a so-called dissymmetry factor of 0.2, even when the particles are dispersed randomly in solution.

● Further reading

H-E Lee *et al.* 2018 *Nature* **556** 360.



Scanning electron microscope images of chiral gold nanoparticles grown in the presence of L (left) or D (right) amino acids.

molecules with a central spin surrounded by several satellite spins and subjecting the molecules to an RF pulse sequence.

● Further reading

J Rovny *et al.* 2018 *Phys. Rev. Lett.* **120** 180603;

Phys. Rev. B **97** 184301.

S Pal *et al.* 2018 *Phys. Rev. Lett.* **120** 180602.

Randomness from starlight

John von Neumann once said “Anyone who attempts to generate random numbers by deterministic means is, of course, living in a state of sin.” Enter Calvin Leung from Harvey Mudd College in California and colleagues. In earlier work, Leung and co-workers used light coming from stars in the Milky Way to develop a random-number generator to assign detector settings for a so-called Bell experiment, which tests the quantum nature of a system. This allowed them to rule out any local correlations between the particles and detectors used in the experiment going back 600 years into the past. The team has now used (distant) quasars to push this time frame back to near the beginning of the universe.

● Further reading

C Leung *et al.* 2018 *Phys. Rev. A* **97** 042120.

New Bose–Einstein condensate

Tommi Hakala and colleagues of the Aalto University School of Science have made a new type of Bose–Einstein condensate, in which the condensate particles are surface plasmon polaritons – a mixture of light and electrons. The researchers produced the condensate using a periodic array of gold nanoparticles overlaid with dye molecules and optically pumped from one edge. The condensate emerges in less than a picosecond, which is far shorter than typical condensation times, and unlike most other condensates it forms at room temperature. These features might make this new form of condensate a promising system for future light-based technologies.

● Further reading

T K Hakala *et al.* 2018 *Nat. Phys.* doi:10.1038/s41567-018-0109-9.