

Sciencewatch

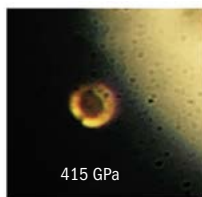
COMPILED BY JOHN SWAIN, NORTHEASTERN UNIVERSITY

Metallic hydrogen claimed

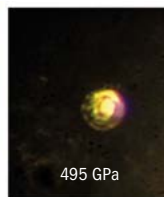
It has long been expected that hydrogen becomes metallic under sufficient pressure, and researchers have been edging closer to its production. Now, Ranga Dias and Isaac Silvera of Harvard University in the US report that they have finally observed the bizarre quantum state. Squeezed in a diamond-anvil cell to a pressure of 495 GPa, hydrogen becomes a shiny metal with a plasma frequency of 32.5 ± 2.1 eV at a temperature of 5.5 K – a transition predicted more than 80 years ago by Wigner and Huntington. The metal may be metastable, remaining metallic when the pressure is removed, similarly to



205 GPa



415 GPa



495 GPa

Photos of a microscopic sample of hydrogen within a circular gasket at increasing pressures, showing the transition from a transparent (left) to opaque (centre) and reflective (right) state.

how diamond is formed at high pressures and retains its form under normal conditions. If metastable, it could have applications as a rocket fuel far more powerful than liquid hydrogen and oxygen, and may even be

superconducting at room temperature.

● Further reading

R Dias and I Silvera 2017 *Science* DOI: 10.1126/science.aal1579.

Time crystals

Time crystals are a new form of non-equilibrium matter that has periodic motion even in its ground state. Norman Yao of the University of California, Berkeley, and colleagues have published detailed instructions for how to make them and measure their properties, leading two groups to report experimental realisations: J Zhang of the University of Maryland and colleagues via a chain of trapped ions, and Soonwon Choi of Harvard University and colleagues, via an ensemble of dipolar-spin impurities in diamond. These are the first materials to break time-translation symmetry in a way that is analogous to the breaking of space-translation symmetry in crystals, opening a new chapter in experimental condensed-matter physics.

● Further reading

S Choi *et al.* 2016 arXiv:1610.08057v1.

N Yao *et al.* 2017 *Phys. Rev. Lett.* **118** 030401.

J Zhang *et al.* 2016 arXiv:1609.08684v1.

Cosmic Bell test

Bell's inequality, which provides a test of whether a system is quantum or classical, is usually derived on the assumption that there are no correlations between the experimenter's choice of measurement settings or anything else that could causally affect the outcomes. This leaves open the possibility that an unknown cause affects both the choice of settings and measurements before each trial – typically as little as microseconds before in experimental tests. A new “cosmic Bell test” by Johannes

Human–pig genetics

The first successful human–animal hybrid has been created: a mixture of human and pig. Jun Wu of the Salk Institute in the US and colleagues built on previous work making chimeras from mice and rats, and managed to put human cells into developing pig embryos. The embryos were then inserted into adult pigs, which carried them for three to four weeks, after which they were removed and studied. Although considered controversial, the work demonstrates that human cells can be made to survive and grow inside of a host animal, bolstering hopes for better ways to make organs without the need for human donors.



The observations raise the possibility of generating transplantable human tissue.

● Further reading

Jun Wu *et al.* 2017 *Cell* **168** 473.

Handsteiner of the Institute for Quantum Optics and Quantum information in Vienna and colleagues uses light from distant astronomical sources to produce the settings. The work pushes back the most recent time that any local-realistic influences could have produced the observed Bell inequality violation by about 16 orders of magnitude, or approximately 600 years.

● Further reading

J Handsteiner *et al.* 2017 *Phys. Rev. Lett.* **118** 060401.

Giant quantum computer

An ambitious proposal suggests that a giant quantum computer able to solve currently computationally unsolvable problems such as factoring large numbers could be built based on existing technology. Winfried Hensinger of the University of Sussex in the UK and colleagues propose a football-field-sized microwave-coupled trapped-ion quantum computer using thousands of hand-sized modules, each containing 2500 trapped-ion qubits, which could be joined to make an arbitrarily large computer. To factor a 2048 bit (617 digit)-long number (a task impossible on classical computers today) would need, including error correction, some two billion qubit ions, and the calculation would take around 110 days. Quantum computing might start to develop along lines similar to experimental high-energy physics with large facilities funded by international collaborations.

● Further reading

B Leksith *et al.* 2017 *Sci. Adv.* **3** e1601540.