

Sciencewatch

COMPILED BY JOHN SWAIN, NORTHEASTERN UNIVERSITY

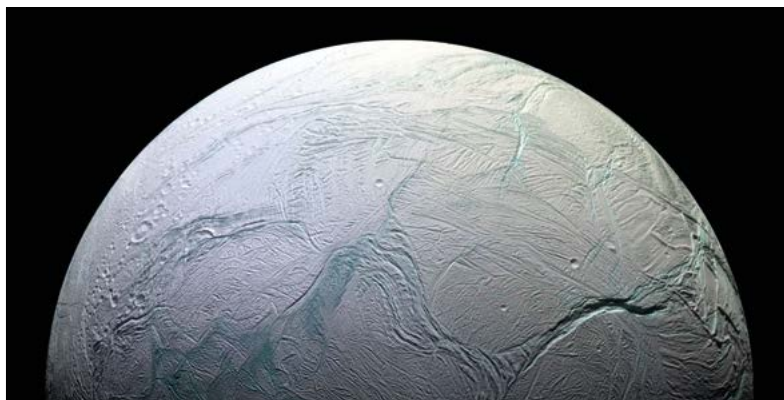
Ocean on Enceladus

Enceladus, one of Saturn's (62!) moons, has a global sub-surface ocean. Using pictures from the Cassini probe, P C Thomas of Cornell University and colleagues observed the object's libration and found it so large as to imply a global ocean. Liquid water and vapour had been seen in jets from a south-polar depression, but the new work rules out a localised polar sea. Salts and organic material have been detected in the jets, so this now looks like an interesting place to search for life.

● **Weblink**

[dx.doi.org/10.1016/j.icarus.2015.08.037](https://doi.org/10.1016/j.icarus.2015.08.037)

Saturn's moon Enceladus. (Image credit: NASA/JPL/Space Science Institute.)



Photonic molecules

Two photons can form a Coulomb bound state. This sounds, of course, ridiculous, because photons are uncharged, but M F Maghrebi of NIST/University of Maryland and colleagues took advantage of the photon coupling to Rydberg states via electromagnetically induced transparency, which provides an effective Coulomb potential, at least in theory. Such bound states could provide a means to couple to quantum information storied in photons for quantum computing, and it should be possible to couple arbitrarily many photons in this way.

● **Further reading**

M F Maghrebi *et al.* 2015 *Phys. Rev. Lett.* **115** 123601.

The farthest galaxy

The most distant galaxy yet observed is at $z = 8.68$, or more than 13.2 billion years old, dating just 600 million years from the start of our universe. Adi Zitrin of Caltech and colleagues used the W M Keck Telescope in Mauna Kea, Hawaii, to discover the EGSY8p7 galaxy via its Lyman alpha emissions, with a significance of about 7.5 standard deviations. Further spectroscopic studies could help our understanding of early galaxy formation.

● **Further reading**

A Zitrin *et al.* 2015 *Astrophys. J. Lett.* **810** L12.

Artificial leaf

An artificial "leaf" can make fuels from carbon dioxide, and possibly compete with solar cells, capturing energy in the form of combustible chemicals instead of electricity. Eva M Nichols of the University of California in Berkeley and colleagues use a scheme coupling photoactive inorganic materials such as platinum, or α -NiS, to release hydrogen from water. The hydrogen is used, together with carbon dioxide, by micro-organisms, which produce methane with a Faradaic efficiency as high as 86%. The basic scheme could be generalised to use sunlight to synthesize more complex chemical products.

● **Further reading**

E M Nichols *et al.* 2015 *Proc. Nat. Acad. Sci.* **112** 11461.

Self-interfering clock

Interference experiments give us much of our information about fundamental physics, and now they can be done with a new twist: self-interfering clocks.

Ron Folman of Ben-Gurion University of the Negev in Beer-Sheva, Israel, and colleagues demonstrated the idea using Bose-Einstein condensates of about 10,000 ^{87}Rb atoms prepared in a superposition of two Zeeman states as clocks. The clock time serves as a "which-way" witness. Because in standard

quantum mechanics, time is a global parameter, but in general relativity it is local proper time that matters, this opens new avenues to understanding the interplay between quantum mechanics and gravity.

● **Further reading**

Y Margalit *et al.* 2015 *Science* **349** 1205.

X-ray laser

A stable atomic narrow-band X-ray laser has reached the shortest wavelength ever: 1.5 Å, and about 10 times shorter than had been previously achieved.

Hitoki Yoneda of the University of Electro-Communications in Tokyo and the RIKEN SPring-8 Center in Hyogo, Japan, and colleagues used a photoionisation-pumping scheme proposed back in 1967, where an X-ray photon from a pump pulse removes an inner shell 1s electron from a copper atom, effectively making it an excited medium in which amplified spontaneous emission (ASE) can occur, with photons emitted from 2p electrons that fall to 1s. A second "seed" X-ray photon, tuned to the correct wavelength, is then sent in to be amplified. This is a proof of principle, with a rather low (2%) efficiency, but wavelength stability, which could make this sort of laser competitive with X-ray free-electron lasers in the future.

● **Further reading**

H Yoneda *et al.* 2015 *Nature* **524** 446.

KJLC® European Manufacturing is Expanding!

MANUFACTURING™ DIVISION

Hydra-COOL™
Water Cooling Method



Online
Chamber
Builder®



Increased
Component Stock



Precision CNC
Machining



Highest
Quality TIG
Welding



100% Inspection



- **Specialists in Vacuum Chambers**
- **Dedicated European Manufacturing Team**
- **Onsite Technical Expertise & Support**
- **Faster Lead Times for Europe**