

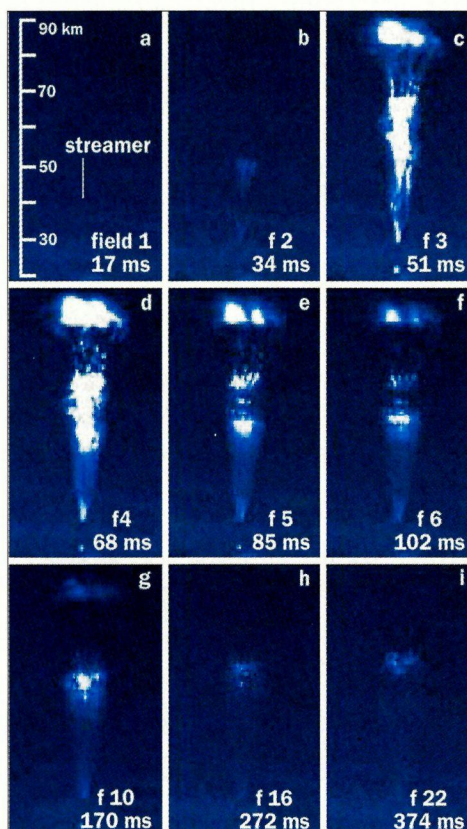
Taiwanese team observes new kind of lightning

Gigantic electrical discharges between thunderclouds and the ionosphere, observed by a team in Taiwan, represent a previously unrecognized form of lightning. Su Han-tzong and Hsu Rue-ron of National Cheng Kung University, and colleagues, have directly observed five gigantic jets extending from clouds about 16 km above the ground to the ionosphere at 90 km.

Initially, the team believed that the jets they recorded at the southern tip of Taiwan in July 2002 were a form of the so-called "blue jets" discovered by researchers in the US in 2001. However, detailed analysis revealed that the gigantic jets are a new type of high-altitude lightning. While there was no evidence that these jets were triggered by cloud-to-ground lightning, extremely low-frequency (ELF) radiowaves associated with four of the jets were detected in Antarctica and Japan, indicating negative cloud to ionosphere discharges. These observations are now making atmospheric scientists think in new ways about the still poorly understood planetary electrical circuit.

Further reading

H T Su et al. 2003 *Nature* **423** 974.



Images of one of the giant discharges recorded in Taiwan show the evolution of the jet over a period of about 350 ms.

Superconductor breaks high critical field record

Researchers at the University of Durham in the UK have set a new record in the strength of magnetic field that a superconductor can support before turning normal. H J Niu and Damian Hampshire found that a superconductor made from lead, molybdenum and sulphur, and fabricated out of nanocrystals, can reach a field of almost 100 Tesla. This is 10 times higher than can be achieved in the niobium-titanium alloys that are currently used in superconducting magnets for particle accelerators, and about five times higher than in the niobium-tin used in high-frequency NMR applications and high-field laboratories.

Theory shows that high critical fields, where the material turns normally conducting, can be achieved through increasing disorder in a material, either by increasing the resistivity in the normal state or by reducing the electron mean-free path. Chemical doping or alloying can produce such effects, but in this case the researchers used mechanical milling followed by hot isostatic pressing to make a disordered nanocrystalline form of the superconductor PbMo_6S_8 . The milling produces a disordered nanocrystalline powder, which is then formed into bulk material in the pressing stage.

The superconductor made in this way has higher normal resistivity, but unlike materials produced by doping techniques, does not have a reduced superconducting transition temperature. The disorder reduces the electron mean-free path to 1 nm, which is less than a tenth the size of the grains, and together with the higher resistivity, ensures the high critical field. While conventionally produced PbMo_6S_8 has a critical field of around 50 T, the disordered nanocrystalline form reaches around 100 T.

Further reading

H J Niu and D Hampshire 2003 *Phys. Rev. Lett.* **91** 027002.

Fluorine and the environment

After the bad press that freon and chloro-fluorocarbons (CFCs) have received over the years, it comes as something of a surprise to find that fluorine compounds are looking environmentally friendly. Dennis Curran of the University of Pittsburg in the US, and an increasing number of chemists, are realizing that fluorine-containing solvents can function well in place of dangerous chlorine-containing

ones, but can also be very unreactive and hesitant to mix with other solvents. Acting almost like liquid teflon (another fluorine-containing compound), and easy to separate and recycle, they could greatly increase the cleanliness of industrial chemical processes.

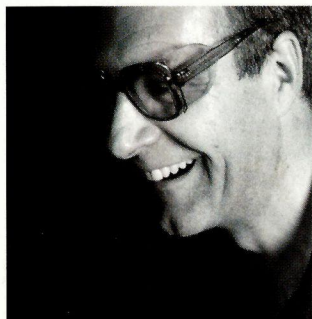
Further reading

D Bradley 2003 *Science* **300** 2022.

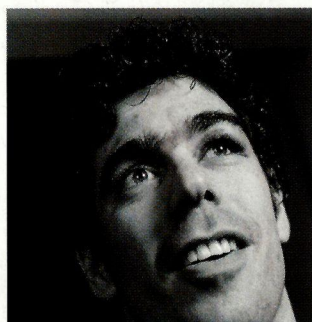
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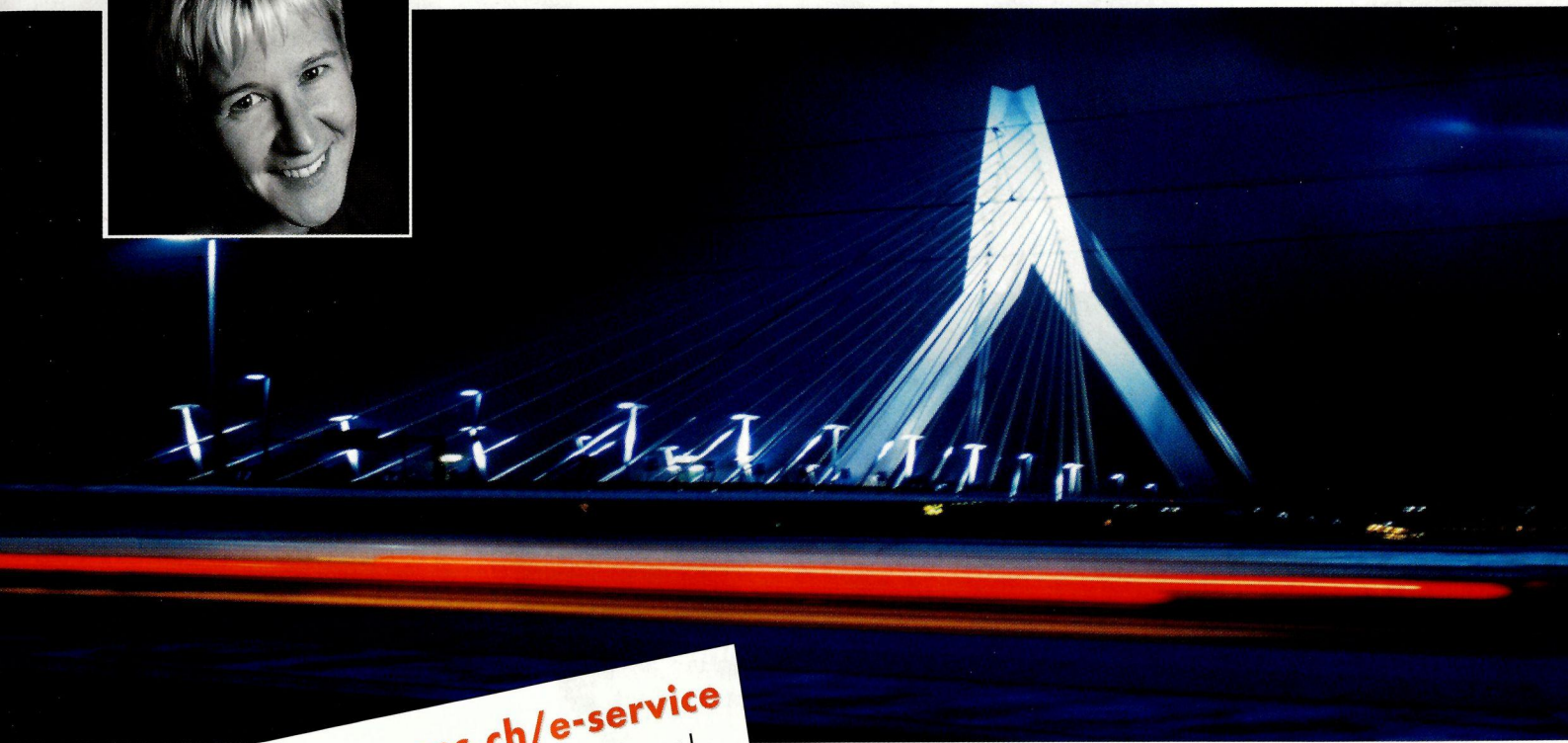
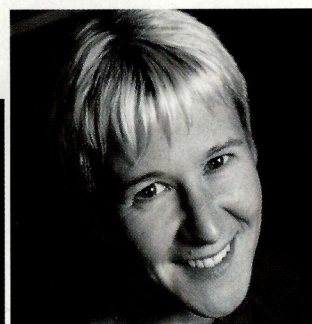
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