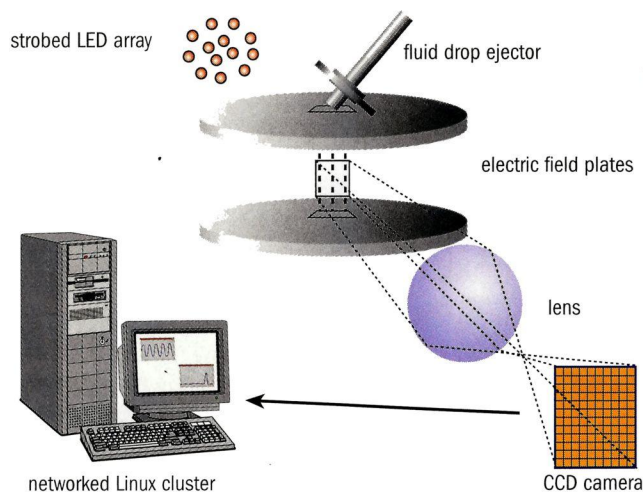


Edited by Archana Sharma

Modern Millikans search for exotic charge

"I have discarded one uncertain and unduplicated observation apparently on a singly charged drop, which gave a value of the charge on the drop some 30% lower than the final value of e ," reported Robert Millikan in 1910. His words provided the inspiration for Martin Perl to take up the search for fractional charge as the 20th century entered its final decade. Perl's experiment, the microdrop particle search at the Stanford Linear Accelerator Center (SLAC), searches for isolated, fractionally charged particles in meteorite matter suspended in tiny droplets of oil just 25 μm in diameter. Researchers monitor the ziz-zag journey of these droplets as they fall from an aperture and enter an alternating electric field. Using the same basic physics as Millikan did – along with modern imaging, computing and microdrop-generation equipment – the group is able to calculate the charges on the tiny spheres, looking for hints of fractional charge.



Modern Millikan apparatus – SLAC researchers hope their microdrop particle search experiment will reveal hints of fractional charge.

The discovery of stable, fractionally charged particles would open a new field in elementary particle physics, improving theoretical models (which have often skirted issues of fractional charge), answering questions about the early universe, and perhaps leading to technological exploitation of the particles. Until now, no evidence of fractional

charge has been seen, but with the introduction of carbonaceous chondrite meteorite matter the stakes have improved. The meteorite sample used by Perl's team is roughly 5000 million years old, and has never undergone any form of refining. This makes it a good candidate to have retained fractionally charged particles that may have been created during the Big Bang.

• Theorists who speculate about the existence of fractional charge expect that if such particles exist, they might, for example, show charges of multiples of $1/6$ the electron charge. The particles would also need

to be extremely massive to have so far escaped detection by detectors at the world's most powerful accelerator facilities.

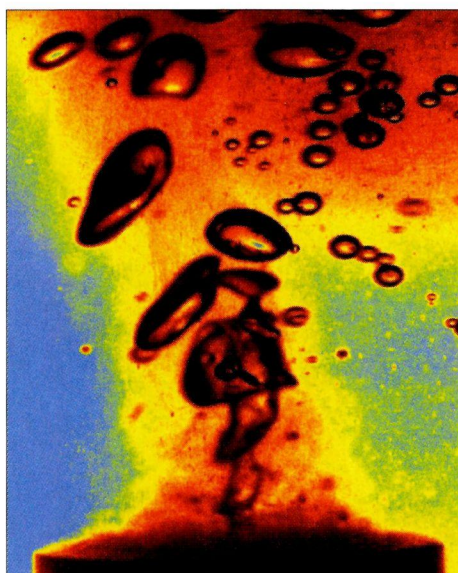
Further reading

Robert A Millikan 1910 *Philos. Mag.* **110** 209.
<http://www.slac.stanford.edu/exp/mps/FCS/FCS.htm>.

Sonoluminescence could be chemical

Research at the University of Illinois points to a chemical nature for sonoluminescence, the phenomenon whereby ultrasound is converted into picosecond light pulses via the rapid oscillations of bubbles in a liquid. Earlier this year, scientists at the US Oak Ridge National Laboratory raised the possibility that sonoluminescence might be linked to nuclear fusion (*CERN Courier* May p11). However, the Illinois team has found that intense sound can compress bubbles in a liquid, increasing their temperature to 10–20 000 K. This is high enough for the gas molecules inside to become ionized, and results in a series of chemical reactions. Studies on a single bubble of air in water revealed reactant products of nitrite ions, hydroxyl radicals and light. The sonic energy largely goes into chemical reactions, with a small fraction resulting in light, leaving precious little to generate nuclear fusion.

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Sonoluminescence appears to be chemical, rather than nuclear, in nature. (K S Suslick and K J Kolbeck, University of Illinois.)

X-ray microscope has 3D vision

Atomic-scale snapshots in three dimensions may soon be possible, thanks to a new X-ray device developed by researchers at Stanford University, US. The microscope, developed by Jianwei Miao and colleagues, has so far been used to image structures down to 8 nm. Reaching the atomic scale of a few tenths of a nanometre should come from using brighter X-ray beams or longer exposures.

Miao's technique combines elements of diffraction and microscopy. A beam of coherent X-rays incident on a sample gives rise to a diffraction pattern in the reflected beam. Diffraction patterns allow 3D structures to be mapped. However, since the diffraction originates from a small region of the sample, the result is a microscope-like image showing local structure in three dimensions.

Nature Science Update, 14 August 2002