Neutron tracks revive hopes for cold fusion

› 15:33 23 March 2009 by **Colin Barras**
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Twenty years to the day that two electrochemists ignited controversy by announcing signs of cold fusion at an infamous press conference in Utah (watch a video of the 1989 event), a separate team has made a similar claim in the same US state. But this time, the evidence is being taken more seriously.

Back in 1989, Martin Fleischmann and Stanley Pons at the University of Utah announced the tantalising prospect of abundant, almost-free energy, but their claims of fusion reactions in a tabletop experiment were dismissed by nuclear physicists, not least because such reactions normally occur inside stars. The small quantity of extra energy they found was widely considered a fluke or the result of experimental error.

Now Pamela Mosier-Boss and colleagues at Space and Naval Warfare Systems Command (SPAWAR) in San Diego, California, are claiming to have made a "significant" discovery – clear evidence of the products of cold fusion.

On 23 March, the team presented its work at the American Chemical Society's spring conference in Salt Lake City, Utah, a few months after the study was published in a peer-reviewed journal (*Naturwissenschaft*, DOI: 10.1007/s00114-008-0449-x).

Plastic fantastic

Using a similar experimental setup to Fleischmann and Pons, the researchers found the "tracks" left behind by high-energy neutrons, which, they suggest, emerge from the fusion of a deuterium and tritium atom.

The team used a low-tech particle detector: a plastic called CR-39 that is otherwise used for spectacle lenses. When CR-39 is bombarded with subatomic charged particles, a small pit forms in the material with each impact.

The researchers placed a sample of CR-39 in contact with a gold or nickel cathode in an electrochemical cell filled with a mixture of palladium chloride, lithium chloride and deuterium oxide (D_2O), so-called "heavy water". When a current was passed through the cell, palladium and deuterium became deposited on the cathode.

Triple tracks

After two to three weeks, the team found a small number of "triple tracks" in the plastic – three 8-micrometre-wide pits radiating from a point (see diagram, top right). The team says such a pattern occurs when a high-energy neutron strikes a carbon atom inside the plastic and shatters it into three charged alpha particles that rip through the plastic leaving tracks. No such tracks were seen if the experiment was repeated using normal rather than heavy water.

Johan Frenje at the Massachusetts Institute of Technology, an expert at interpreting CR-39 tracks produced in conventional high-temperature fusion reactions, says the team's interpretation of what produced the tracks is valid.

"I must say that the data and their analysis seem to suggest that energetic neutrons have been produced," he says, although he would like to see the results confirmed quantitatively.

More controversial is the team's suggestion for the process that produced the neutrons. High-energy neutrons are unlikely to be produced by a normal chemical reaction, says Mosier-Boss. So, it's possible, she says, they are created during the fusion of deuterium and tritium atoms tightly packed in palladium framework at the cathode. The tritium also being a product of the fusion of two deuterium atoms.

Some researchers in the cold fusion field agree. "In my view [it's] a cold fusion effect," says Peter Hagelstein, also at the Massachusetts Institute of Technology.

Alternative theory

Others, though, are not convinced. Steven Krivit, editor of the *New Energy Times*, has been following the cold fusion debate for many years and also spoke at the ACS conference. "Their hypothesis as to a fusion mechanism I think is on thin ice … you get into physics fantasies rather quickly and this is an unfortunate distraction from their excellent empirical work," he told **New Scientist**.

Krivit thinks cold fusion remains science fiction. Like many in the field, he prefers to categorise the work as evidence of "low energy nuclear reactions", and says it can be explained without relying on nuclear fusion.

In 2006, Allan Widom at Northeastern University in Boston and Lewis Larsen of Lattice Energy, LLC, suggested that the key to the process was oscillating surface plasmons – waves of energy rippling through electrons on the surface of the electrode.

They said that the rough surface of the palladium on the electrode focuses the energy into small pits, where it can be transferred to a single electron. The high-energy electron can then shoot into the nucleus of a nearby deuterium atom and combine with a proton to release a neutron and a neutrino (*European Physical Journal C*, DOI: 10.1140/epjc/s2006-02479-8).

"Electrons and protons don't have trouble attracting," Widom told **New Scientist**, and he says the explanation conforms to the Standard Model of particle physics. He speculates that this theory could explain instances of exploding laptop batteries, and could be harnessed as an energy source – something Larsen's company hopes to commercialise.