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Science

Claim of Small-Scale Fusion Produces Early Skepticism

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In an echo of claims that limitless, cheap energy could be generated through "cold fusion" 13 years ago, a team of scientists will report in Friday's issue of the journal Science that it has achieved nuclear fusion in a small, tabletop experiment. But even before the findings reach print, many scientists are already expressing skepticism and are wondering why Science accepted the article over the doubts.

In the article, researchers led by Rusi Taleyarkhan, a senior scientist at the Oak Ridge National Laboratory in Tennessee and Richard T. Lahey Jr., a professor of engineering at the Rensselaer Polytechnic Institute in Troy, N.Y., say that by blasting liquid acetone with ultrasound, they cause bubbles in the acetone to collapse with such ferocity that they reach temperatures of several million degrees, where atoms can fuse and release bursts of energy.

"We've repeated it many times, and we made the first measurements more than a year ago," Dr. Lahey said in an interview yesterday. "I think it's real."

As the bubbles collapsed, they produced only minuscule amounts of energy, Dr. Lahey said, but it might be possible to enlarge the process to a scale that would be commercially useful. "We have some thoughts how to do it," he said. "If you could, it would really solve a lot of the issues that face nuclear energy."

Fusion does not produce plutonium and uranium waste as current nuclear power plants do.

Others, like Lee Riedinger, deputy director for science and technology at Oak Ridge, said the effect would be interesting physics, but as a practical source for energy, "To me, that's inconceivable," he said.

Dr. Riedinger was skeptical enough of the finding that last June he asked two nuclear physicists at the laboratory to make independent measurements. Using a different detector from the laboratory, the physicists, Dan Shapira and Michael J. Saltmarsh, found no sign of the telltale neutrons that would be emitted by fusion.

"This is an intriguing idea," said Dr. Saltmarsh, a retired scientist at Oak Ridge. "It's a bit off the wall. But that experiment does not support that it does happen."

He said he believed the researchers were detecting random particles from the background, not the product of fusion. "It's easy to be fooled," he said. "You've got to be really careful."

In fusion, two atoms of deuterium, a heavy form of hydrogen, merge together to form tritium -- an even heavier form of hydrogen -- which releases energy and ejects a neutron at a particular speed.

For decades, scientists have been seeking to harness fusion to produce electricity, trying with limited success to build reactors that mimic the physics deep within the sun that produce heat and light.

In 1989, B. Stanley Pons of the University of Utah and Martin Fleischmann of the University of Southampton in England asserted that by forcing deuterium into the metal palladium, they were able to bring the deuterium atoms close enough to fuse together. Theoretical physicists subsequently dismissed that idea as preposterous. Though some researchers believe there are still some unexplained physics at work in those experiments, almost all agree it is not fusion.

Scientists who reviewed the latest work say that in contrast with cold fusion, the underlying premise is sound. Scientists have long observed a puzzling phenomenon known as sonoluminescence, in which a burst of ultrasound causes a bubble in a liquid to collapse and emit a flash of light. Some theorists, like Seth J. Putterman, a physicist at the University of California at Los Angeles, hypothesize that this collapse could be so sudden that trapped gases could be heated enough to initiate fusion.

But when Dr. Putterman served as one of the paper's reviewers for Science, he recommended against publication. "I think the paper is wrong," he said.

The crux of contention is whether fusion-energy neutrons are streaming out of the collapsing bubbles. While the two Oak Ridge detectors operate similarly, the two teams collected their data differently and they disagree about which detector is more sensitive.

The measurement is difficult, because the researchers actually bombard the acetone with a stream of high-energy neutrons to create the bubbles. The bubbles grow to about a millimeter in diameter, then are pushed down by the ultrasound wave, all within a few hundredths of a second, Dr. Lahey said.

He said the researchers had spent months answering concerns of the reviewers. "We went through a very, very extensive peer review process with Science that lasted almost a year," he said. "Everyone and his brother was worried about whether it was real, including us. We don't want to have another cold-fusion type of experience."

Dr. Lahey said that Dr. Shapira's and Dr. Saltmarsh's data did show that the ultrasound raised the number of emitted neutrons. In turn, Dr.

Saltmarsh said that while the number of neutrons was about 1 percent higher, the emissions did not coincide with the flashes of light. "We see no evidence for any excess neutrons," Dr. Saltmarsh said.

Dr. Putterman of U.C.L.A. said the skeptical Oak Ridge team used "a superior method" of measuring neutrons. "I'm not faulting them a priori," Dr. Putterman said of the authors of the Science study. "It's a reasonable vision. Except it was done wrong."

Another reviewer, William C. Moss, a physicist at Lawrence Livermore National Laboratory, said the data in the Science paper was not precise enough to pinpoint emission of neutrons at the correct energy. "Therefore their claim is null and void," he said.

Dr. Putterman and Dr. Moss also dismissed the researchers' detection of tritium, the byproduct of fusion. "Things could be contaminated," Dr. Moss said. "There could be crazy reactions going on."

Donald Kennedy, editor of Science, acknowledged the controversy, but defended the paper's publication. In a draft of an accompanying editorial, he wrote: "In this instance, we see no good reason for suppressing the paper, and even less for attempts to discredit in advance. The premature critics of the result, and those who believe in it, would both do well to cool it, and wait for the scientific process to do its work."