How unexplained anomalies are keeping scientists interested in low energy nuclear reactions

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On November 6, the United States Patent Office published an application for a patent that made a disarming claim: that its inventor has a small reactor device that produces more heat than is put in, and this heat is also more than what is produced through a chemical reaction. The inventor, an American-Italian called Andrea Rossi, never mentions that nuclear fusion has happened in his vessel, but the implication is nothing less.

Rossi has no standing in the academic community. The topic of nuclear fusion at room temperature – called cold fusion sometimes – has no academic credibility either. But undeterred by criticism and disregard, a small community of researchers continues to work on this topic, and they are excited by Rossi's purported invention. Rossi has not made vital disclosures and is thus unlikely to get a patent this time, but his work suggests a shift in the way the cold fusion community now works.

“We gave up trying to science this into something,” says Michael McKubre of Stanford Research Institute (SRI), “and so we are now trying to build commercial products.” There are cold fusion research groups in the University of Missouri, Texas Tech University, several Japanese and Chinese universities and Italy.

Private companies in the US, Israel and a few other countries are still pursuing cold fusion, which now goes by the name Low Energy Nuclear Reactions (LENR). Recently, Bill Gates visited the Italian technology agency ENEA, which also works on cold fusion, and had supposedly expressed interest in funding LENR research. India's Bhaba Atomic Research Centre (BARC) had started an LENR project in 1989, but gave up in the mid-1990s when official support became difficult to obtain.

M. Srinivasan, formerly associate director of BARC, is now trying to revive the country's interest in this phenomenon. Srinivasan had headed the BARC project till it was stopped. He has since been lobbying with scientists to revive their interest, and now has generated enough curiosity for the Bangalore-based National Institute of Advanced Studies (NIAS) to hold a special brain storming session in February. Next month, the journal Current Science is preparing to bring out a special issue on the topic, and Srinivasan has got sympathetic ears at the political level as well. “Our energy situation is so terrible,” says Srinivasan, “that we should invest in LENR research even if there is only a 5 per cent chance of success.”

Fusion happens when two atomic nuclei fuse releasing enormous amount of energy. It is the reverse of the widelyused atomic fission, when an atomic nucleus splits releasing energy. Fusion releases less radiation than fission, and also leaves very little dangerous waste. The raw materials and by-products of fusion cannot be used to build bombs either. Because of raw material abundance, fusion has been called our best-possible energy source, but no one has been able to get a consistent fusion reaction going for long.

Around the world, a large number of scientists are working on governmental programmes on hot fusion, where they heat a form of hydrogen to 100 million degrees and force the nuclei together. This works for a short time, but no research group has been able to sustain a reaction long enough even at this temperature. It is so difficult that there are scientists who suspect that hot fusion may never be a reality, but governments still provide funding for building fusion reactors in hope rather than conviction. India, for example, has committed Rs 2500 crore to an international project in southern France. Very few governments now support cold fusion, but a trickle of funding has kept the subject alive in some places.

The objection to LENR is partly due to history and partly scientific. In 1989, electrochemists Martin Fleishman and Stanely Pons announced that they had achieved cold fusion in a beaker, using palladium and heavy hydrogen. The nuclear physicist community did not accept this as investigations were inconclusive and attempts to repeat the experiments failed. However, not everyone was convinced that nuclear fusion did not occur then. In the last 25 years, say some of these scientists, the science of metallurgy has advanced enough for them to improve their chances of success.

One of them is Robert Duncan, now chancellor of Texas Tech University in the US. He was a low-temperature physicist and a sceptic of the phenomenon, but was asked by a TV channel to verify cold fusion claims in a programme on cold fusion. Investigations and witnessing subsequent experiments convinced him that it was real, or at least an unexplained anomaly. He got funding from the philanthropist Sidney Kimmel to set up a centre for LENR research at the University of Missouri – where he used to work till recently – to investigate cold fusion. He is now setting up a laboratory in his new university to study cold fusion. “There is a clear anomalous effect,” he says.

Here lies the problem with cold fusion. According to known laws of physics, two atomic nuclei cannot fuse at ordinary temperatures. Their electric repulsion is far too strong. If the hydrogen isotope needs to be heated to 150 million degrees for fusion to occur, how can they muster enough energy to fuse at ordinary temperatures? The cold fusion scientists have no answer but point to new science that we do not yet know. “The picture that cold fusion is nonsense is not true,” says Srinivasan.

The anomalous effect, in terms of unexplained and substantial excess heat, is not produced in every experiment. But Duncan says that it is now seen more frequently. Those who are sympathetic to cold fusion research say that the anomaly needs to be investigated seriously. “We have not reached the stage of commercial energy production,” says former AEC chairman S Banerjee. “But the anomaly must be addressed, and it may lead to some other advances.” It also requires trivial funding when compared to hot fusion.