ALTERNATIVE POWER SOURCES

5 Reasons Cold Fusion is Bunk

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Leaves us cold

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Andrea Rossi, inventor of a cold fusion machine, meets with representatives from MIT, Boston University, and Northeastern at the State House in Massachusetts. JOANNE RATHE/THE BOSTON GLOBE VIA GETTY IMAGES

Fusion, the same process that powers stars including the sun, would be a relatively clean, safe and near-limitless source of power. Unlike the fission of nuclear reactors that splits atoms to make energy, fusion fuses atoms. In nature, a star's immense gravity works to do the job of crushing hydrogen nuclei, protons, to create the reaction. But on Earth, crushing hydrogen atoms is no easy matter. It typically requires a machine that generates plasma -- atoms stripped of their electrons -- and runs at ultra-high temperatures in the millions of degrees Fahrenheit range. In short, more energy gets put in than what comes out, and that is not efficient.

But some scientists are trying to figure out how to get a fusion reaction to occur at room temperature. If successful, a so-called "cold fusion" machine would require little energy to run, but conversely produce a tremendous amount. In 1989, two scientists, Stanley Pons and Martin Fleischman, said they managed to achieve cold fusion, but after some initial excitement, the general consensus was that they didn't achieve cold fusion and in fact probably never would.

VIDEO: Power from a Floating Metal Donut

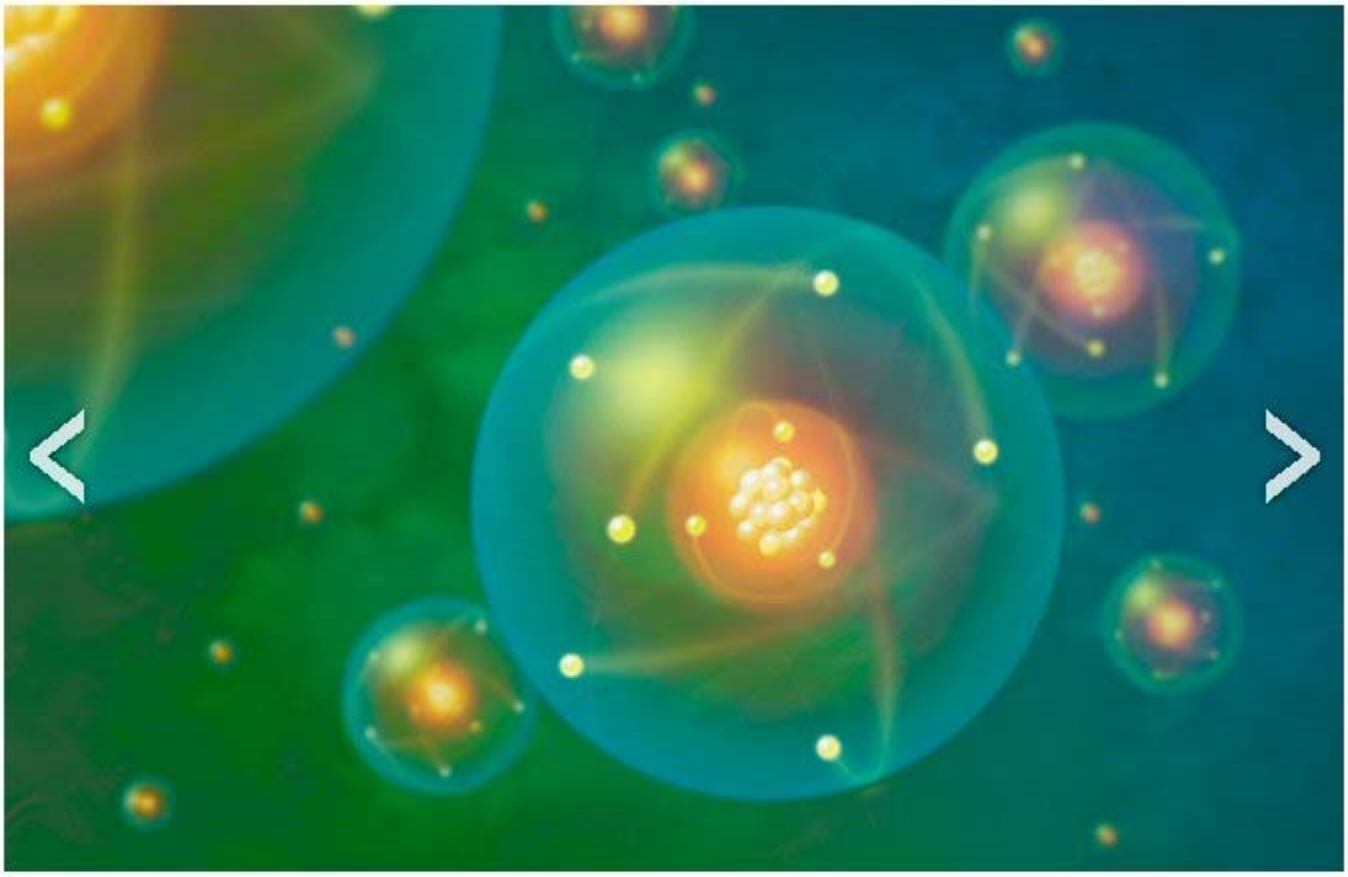
In the last couple of years, Italian inventor and entrepreneur, Andrea Rossi, claims he has achieved cold fusion with his "Energy Catalyzer," or "E-Cat" machine. The latest news is a supposedly **independent test** that validates his claims of a machine that somehow emits more energy (as heat) than it gets from the electrical outlets it is plugged into. A paper describing the test was posted on the **ArXiv**, a site where scientists post research before it goes for full peer-review.

Although Rossi **staged demonstrations** in 2011 attended by several journalists and a few scientists, he hasn't shared details about the machine or any of the data with other scientists nor has he allowed independent parties to confirm that a nuclear reaction has happened. In fact at one demonstration, he specifically **disallowed a physicist** from testing for the presence of gamma radiation. Despite the criticism, there are still supporters; among them Nobel laureate **Brian Josephson**, who pioneered superconductivity research.

Some types of nuclear reactions can theoretically occur at near-room temperatures, and there's a lot of active research into low energy nuclear reaction, or LENR. But that type of reaction isn't the same as cold fusion. "Cold fusion has no merit," said Steven B. Krivit, publisher and senior editor, of the New Energy Times, who has covered LENR research for nearly a decade and authored books on the subject.
The difference, Krivit said, is that low-energy nuclear reactions operate according to known principles of physics, largely involving weak nuclear force interactions and capturing neutrons. While there is still a good deal of scientific controversy over LENR, the research exploring it doesn't invoke any new physics. Cold fusion requires that at least a few basic principles, such as the Standard Model, be wrong. So far no experiments have shown that they are.

Here are five reasons that cold fusion probably can't work, at least according to the laws of physics.

The Coulomb Barrier



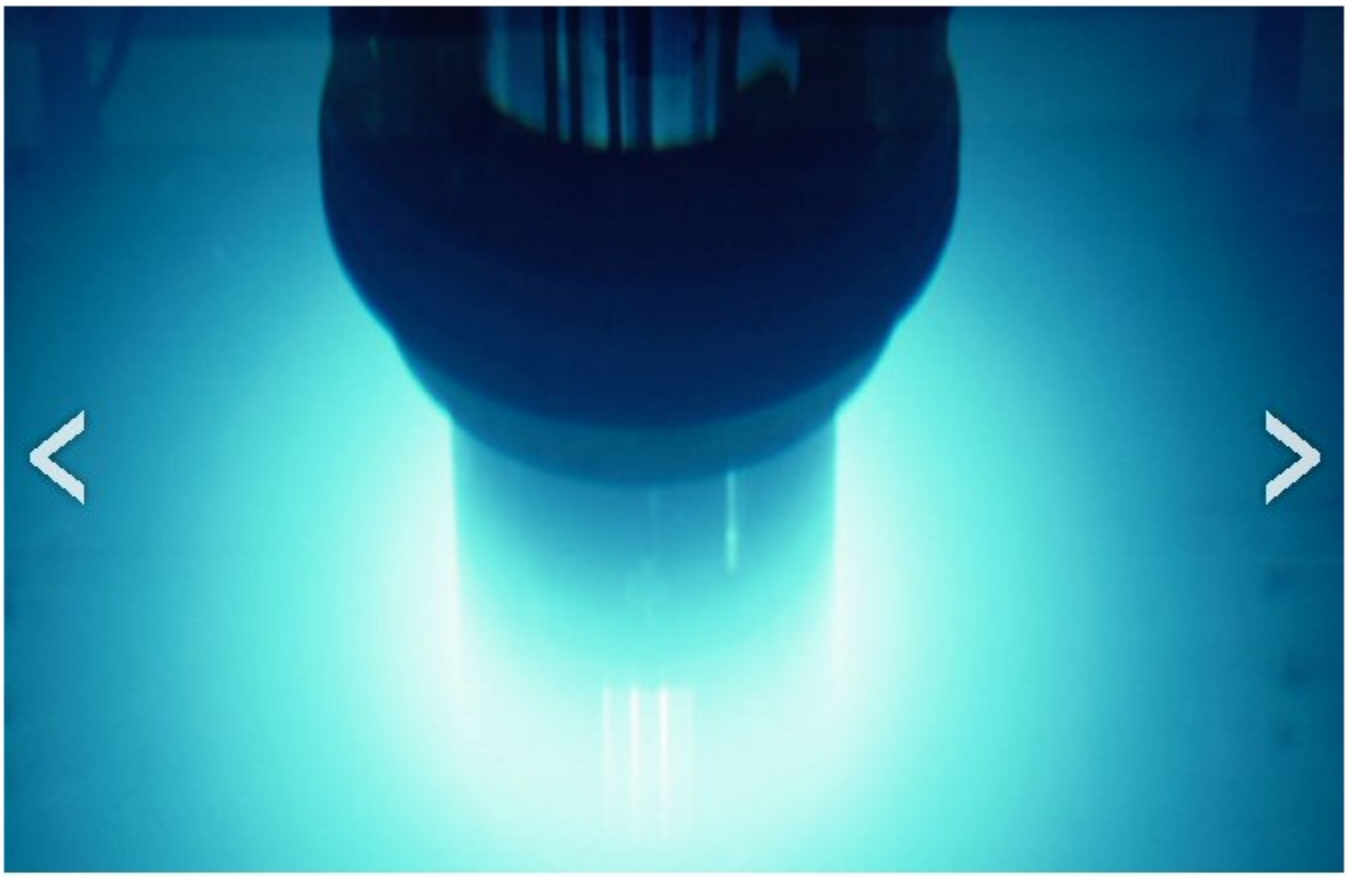
This conceptual visualization of the Bohr model of an atom shows a tightly packed nucleus composed of protons and neutrons. MARK GARLICK/SCIENCE PHOTO LIBRARY/CORBIS

The most obvious objection has to do with temperature. According to physics, fusion can't happen at temperatures lower than a few millions of degrees Fahrenheit. That is because protons are positively charged and repel each other. Bringing them close together in order to fuse them makes the repulsion forces stronger. This is known as the "Coulomb barrier."

Overcoming it requires a great deal of energy and stars can do it because they have so much mass that gravity's brute force smashes protons together. The only way earthly scientists can do it is with a particle accelerator or with a massive plasma containment facility. Containing the plasma so that reactions are self-sustaining is the current focus of a lot of fusion energy research.

"Cold fusion, the idea of positively charged nuclei overcoming the Coulomb barrier at room temperature, to me, has no merit," said Krivit.

Gamma Rays



A water-cooled nuclear core glows blue as rock samples are irradiated to make them radioactive so that the gamma-ray spectrum can be studied. ROGER RESSMEYER/CORBIS

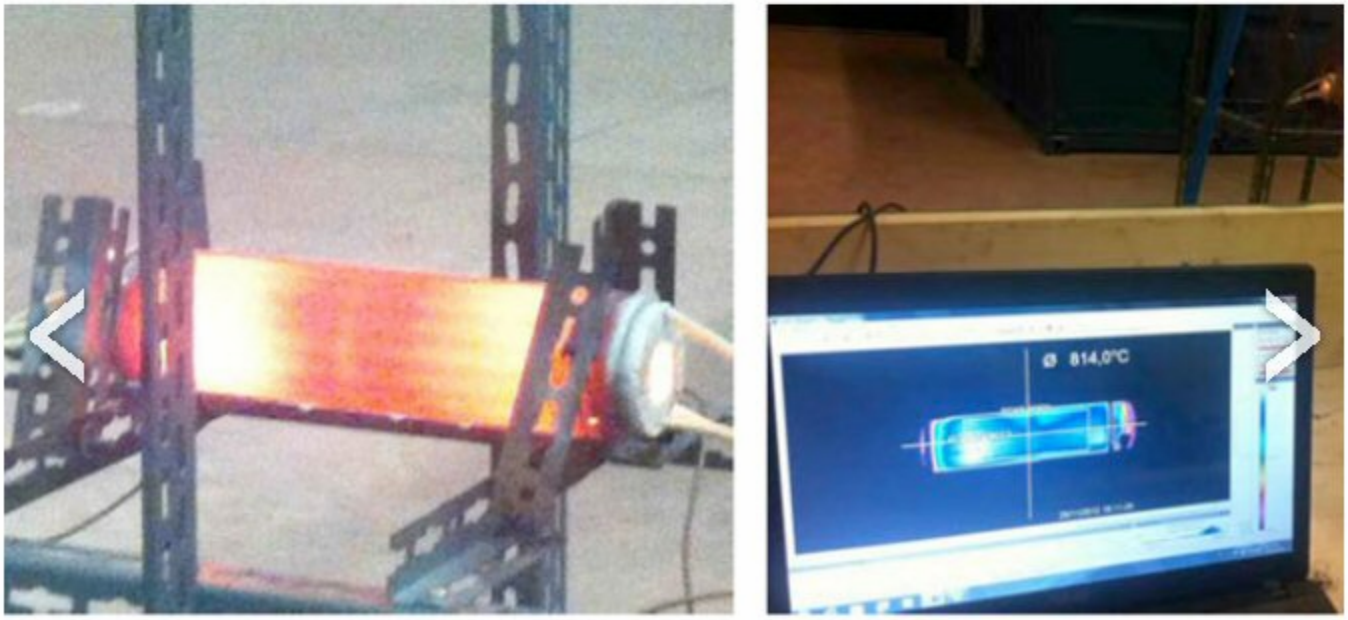
Fusion reactions generate dangerous amounts of gamma radiation. Any person standing near a fusion reactor without shielding would die, A shield could help. "Two inches of shielding gives you 96 percent shielding," said said Ethan Siegel, a professor of astrophysics at Lewis & Clark College in Oregon (and author of the **Starts With A Bang** blog). But even four percent is enough to cause radiation sickness, he said, and Rossi's machine didn't appear to have that much shielding around it- or any at all. If Rossi's machine were actually fusing elements as he says it does, there would be a lot of detectable radiation. In the case of the E-Cat, everyone in the room during the 2011 demonstration would have gotten massive radiation sickness.

It's Elementary

The addition of a proton to nickel makes copper, but that takes a great deal of energy. MARK SCHNEIDER/VISUALS UNLIMITED/CORBIS

Fusion reactions create heavier elements out of lighter ones -- but not just any heavy element. The evidence of real fusion is in the kinds of elements that come out of any machine. Rossi initially claimed to be making copper out of nickel. But the addition of a proton to nickel to make copper requires so much energy that not even dying stars that are collapsing into themselves, aka supernovas, can do it. The reaction in the universe that makes copper requires a neutron, a star that has collapsed and become extremely dense. The only place they are found in abundance on Earth is near nuclear reactors or in radioactive materials.

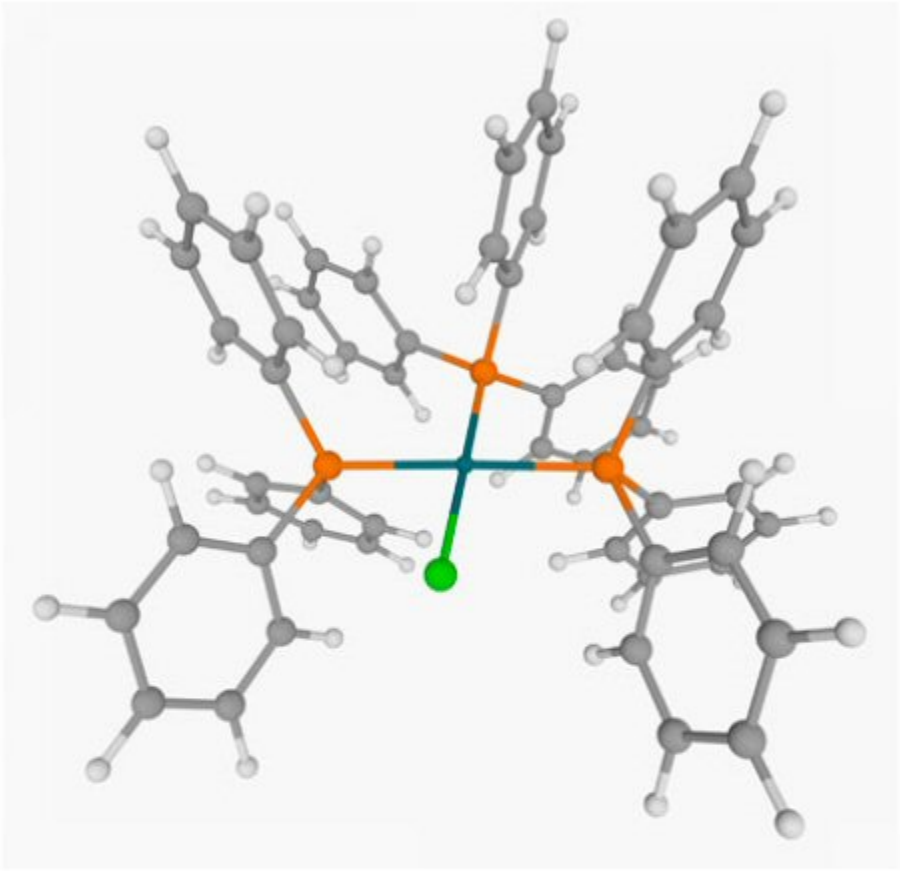
Testing



The ceramic cylinder visibly heats up in an experiment performed in November 2012. In this test, the device got so hot that the internal steel cylinder housing the fuel overheated and melted. The trials in the current study were performed at lower tempera LEVI, ET AL.

The testing that was posted to the ArXiv involved measuring the power output of Rossi's device and claimed that after the power was turned off, the machine kept generating heat. But the device was connected to the main power throughout the test; it was never completely disconnected. The testers used an AC power meter to measure whether there was current going in, but that wouldn't tell anyone if there was a hidden DC source. More to the point, nobody has been allowed top open up Rossi's E-Cat, to ensure that there are no other power sources inside.

Catalyst



Rossi claims his catalyst is a trade secret. LAGUNA DESIGN/SCIENCE PHOTO LIBRARY/CORBIS

Any low energy nuclear reaction experiment conducted on Earth needs a catalyst to initiate the reaction. Scientists typically use a metal such as nickel hydride or palladium immersed in water that has deuterium instead of hydrogen. There are other configurations but the metal catalyst is a pretty common thread. So far, Rossi hasn't divulged what his catalyst is or how it works, claiming that it's a trade secret. But trade secrets aren't really kept secret that way. He could have gone to the patent office with his invention and be entitled to license fees. Apple Computer, famously, has many patents that don't reveal all the details of the design itself. The fact that he won't allow certain kinds of measurements to be done is a big red flag to many scientists.