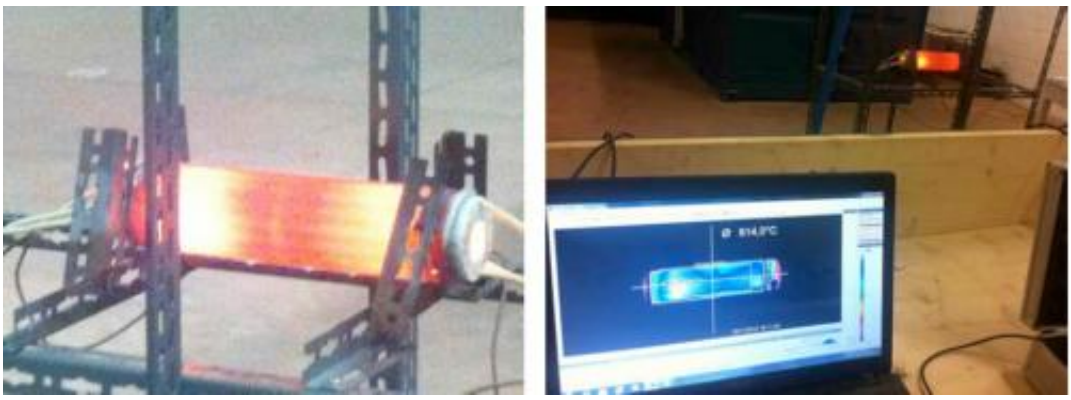
Tests find Rossi's E-Cat has an energy density at least 10 times higher than any conventional energy source

May 23 2013, by Lisa Zyga



(Left) 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 temperatures. (Right) Thermal data of the cylinder taken from a high-res thermal camera. Credit: Levi, et al.

(Phys.org) —In the ongoing saga of Andrea Rossi's energy catalyzer (E-Cat) that promises clean, cheap power for the world, the latest events continue to bring as many questions as answers. Several scientists have performed supposedly independent tests of two E-Cat prototypes under controlled conditions and using high-precision instrumentation. In a paper posted at arXiv.org, the researchers write that, even by the most conservative of measurements, the E-Cat produces excess heat with a

resulting energy density that is at least 1 order of magnitude—and possibly several—higher than any other conventional energy source, including gasoline.

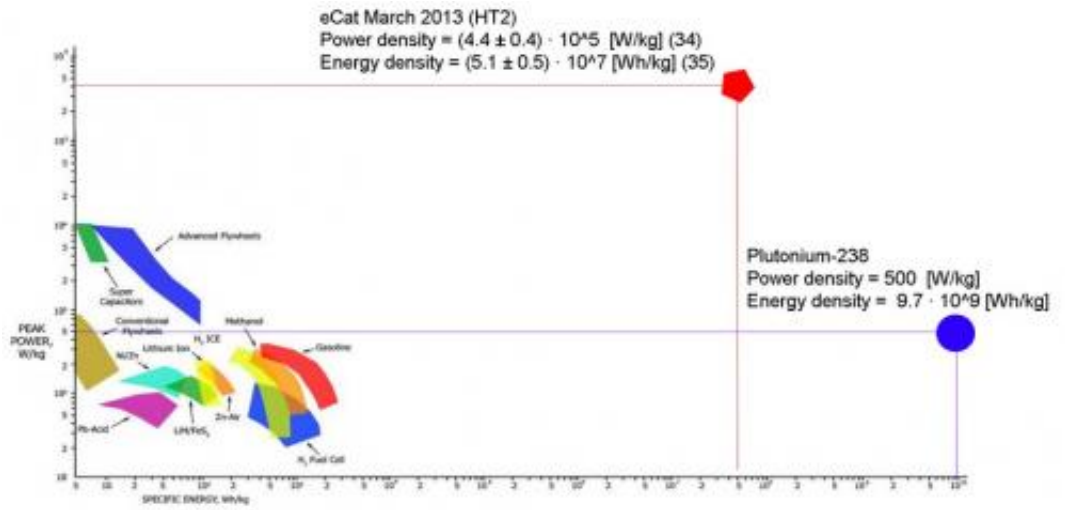
Of the seven scientists who authored the paper, two are from Italy (Giuseppe Levi at Bologna University and Evelyn Foschi of Bologna, Italy) and five are from Sweden (Torbjörn Hartman, Bo Höistad, Roland Pettersson and Lars Tegnér at Uppsala University; and Hanno Essén at the Royal Institute of Technology in Stockholm).

Essén, who submitted the paper, is an associate professor of theoretical physics at the Swedish Royal Institute of Technology and former chairman of the Swedish Skeptics Society.

"I have followed the Rossi E-Cats for a couple of years now and participated in two experiments (including the present one) and read, and heard, about several other more or less independent ones," Essén told *Phys.org*. "My overall impression is that there must be something there, but scientists must always be cautious until everything has been checked and rechecked."

Essén said that there are plans to submit the paper to a peer-reviewed journal, although they understand that it may be difficult. Even though the subject is controversial, he explained that he thinks the cost of involvement is worth it.

"I got involved since, for the first time, an inventor of a new energy source was willing to allow meaningful observation and measurement," he said. "There is always a risk that career and reputation is damaged, but for me scientific curiosity always has higher priority."



Ragone plot of the energy density and power density of various sources. The plot has been expanded to show conservative estimates of the E-Cat from the March tests, as well as known values of Pu-238. Credit: Prepared for Forbes by Alan Fletcher based on the original figure by Ahmed F. Ghoniem. "Needs, resources and climate change: clean and efficient conversion technologies," Progress in Energy and Combustion Science 37 (2011), 15-51, fig. 38

Rossi himself was not part of the study. However, the tests were performed on E-Cat prototypes constructed by Rossi and located in Rossi's facilities in Ferrara, Italy.

The paper presents the results of two separate tests on two different prototypes, called E-Cat HT and E-Cat HT2. The first test was carried out by Levi and Foschi in December 2012, while the second was carried out by all seven authors in March 2013. Although the E-Cat HT2 had several improvements over the E-Cat HT, both tests revealed the same important result: more heat was produced by the device than would be expected from any known chemical source of energy.

According to the researcher's conservative measurements and calculations, the E-Cat HT and E-Cat HT2 have energy densities of

680,000 Wh/kg and 61,000,000 Wh/kg, respectively. Even with a "blind" evaluation that probably underestimates the energy production significantly, the researchers still get a value that is an order of magnitude higher than all other conventional energy sources. Considering that gasoline has an energy density of 12,000 Wh/kg, these values are extraordinary and would blow all other energy technologies out of the water.

With that being said, exactly what kind of reaction is producing the large amount of heat energy remains unknown. While the reaction was originally touted as cold fusion when Rossi first unveiled the device a few years ago, most analysts now suspect that the mechanism is more likely a low-energy nuclear reaction (LENR) that is not fusion. If the reaction involves the conversion of nickel into copper, as it seems, then it would be considered a transmutation.

Somewhat frustratingly, the seven scientists were not allowed to look inside the steel cylinder that houses the fuel, which is a combination of nickel powder, hydrogen gas, and—most mysteriously—a catalyst composed of unknown additives. This catalyst is an industrial trade secret, and the secrecy makes it impossible for independent scientists to understand exactly how the device works.

"It is frustrating to observe a mysterious phenomenon but not be allowed to investigate it fully, yes," Essén said. "I understand, however, that inventors are mainly interested in commercial applications and that this requires the keeping of industrial secrets."

What the scientists could do was to operate the device, measure the heat energy it produced, and compare that to the input energy to calculate the impressive values stated above. They could also assess the prototypes for any potential radioactive emissions, of which they found none.

The basic design of the E-Cat (both versions) consists of three cylinders: an outer ceramic cylinder (33 cm long and 10 cm in diameter, or roughly the dimensions of a bowling pin), a smaller ceramic cylinder located within the outer one and containing wire coils, and finally the steel cylinder that contains the fuel. At just 3 mm thick and 33 mm in diameter, the steel cylinder is not much bigger than a quarter. By comparing the weights of the steel cylinder when containing fuel and when empty, the researchers estimated the weight of the fuel in the March test to be about 0.3 grams.

When power (here, no more than 360 W) is fed to the wire coils inside the middle cylinder, the coils heat up and cause the steel cylinder and its powder to heat up as well. The scientists used a thermal camera to measure the E-Cat's surface temperature for the entire duration of the two tests, which were 96 hours and 116 hours, respectively. They also continuously monitored the electrical power input that was supplied to the coils. In the first test, the power input was constant, while in the second test, the scientists experimented with turning the power on and off to test the self-sustaining mode. In the self-sustaining mode, they observed a periodic heating and cooling cycle that warrants further study.

To investigate whether there really is something special about the powder fuel in the small cylinder, the researchers performed a "dummy" test with an empty cylinder. They ran the test in March on the E-Cat HT2 for about 6 hours, taking measurements exactly as they did when the cylinder was loaded. They found that no extra heat was generated beyond that expected from the electric input. Whatever kind of catalyst is in the fuel seems to be indispensable for generating the excess energy.

Whether this paper gains the approval or disdain of other scientists working in related areas remains to be seen, but the seven authors of the current paper seemed to have taken pains to take all the precautions that

they could, given the circumstances, to perform a valid investigation. At nearly every step of their measurements and calculations, the scientists repeatedly emphasized that they adopted the most conservative methods in order to not overestimate the device's energy generation.

The paper has so far received a mixed response on the web, with Steven B. Krivit of New Energy Times arguing that Rossi has manipulated the scientists to create the illusion of an independent test, while articles at Pure Energy Systems and Forbes are more supportive.

At the end of their paper, the researchers added that another test is planned to begin this summer. This test will last six months in order to monitor the long-term performance of the E-Cat HT2, and may help the scientists get a better understanding of the origins of the excess heat energy.

More information: Giuseppe Levi, et al. "Indication of anomalous heat energy production in a reactor device." arXiv:1305.3913 [physics.gen-ph]