

PS

Video  
Inside!  
PG. 04

# POPULAR SCIENCE

THE  
FUTURE  
NOW

## BEYOND

Exploring  
the Martian  
moon Phobos  
in a suit designed  
for deep space

HOW NEW  
MATERIALS WILL

- ▶ TAKE US TO MARS
- ▶ HEAL YOUR BODY
- ▶ MAKE BETTER STEEL
- ▶ HARNESS ENERGY
- ▶ REPAIR THEMSELVES

APOCALYPSE  
GEAR  
PG. 16

**COLD FUSION** A Special Investigation PG. 62

**DIG HERE!**

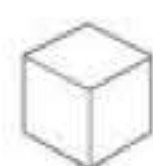
A BEGINNER'S  
GUIDE TO  
SPACE MINING  
PG. 60



**I A N D R E A**  
**R O S S I ' S**  
N F I N I T E  
**E N B L A C K**  
E R G Y **B O X**

A lone Italian inventor says he has built a machine that can power the world. Could the answer to humanity's energy troubles be so simple?

**BY STEVE FEATHERSTONE**



Text



## ON JANUARY 14, 2011, a 61-year-old Italian inventor named Andrea Rossi staged a spectacular demonstration.

In a warehouse in Bologna, he switched on a strange contraption that looked like a leg of lamb wrapped in aluminum foil. He called it the "E-Cat," short for "energy catalyzer." It contained a pinch of powdered nickel, a puff of hydrogen gas, and a dash of a secret catalyst. When the mixture was heated with an electrical current, a mysterious reaction occurred, generating large amounts of excess heat—far more than any known chemical reaction could produce. The heat boiled water into steam. The steam could be used to spin a turbine to make electricity.

Here, Rossi claimed, was a machine that harnessed a previously unknown type of nuclear reaction—a machine that could produce nearly infinite energy cheaply and with no radioactive by-products. It would put the oil companies out of business. It would enable humanity to explore space on the cheap. It would change the world overnight.

A handpicked audience of 40 journalists and scientists watched Rossi's E-Cat gurgle steam for an hour. Physicist Francesco Celani, who had traveled to Bologna from Rome, brought along a



spectrometer to measure spikes in gamma radiation, which could provide evidence that nuclear reactions did indeed power Rossi's machine; Rossi demanded that Celani turn it off, lest he divine his secrets.

Despite the rebuff, three weeks later Celani presented observations of Rossi's "black box," as he called it, at a special session of the 16th International Conference on Cold Fusion. He also circulated an e-mail in which he estimated that Rossi's E-Cat produced 15 to 20 times more energy than it consumed.

If it were true, Rossi's invention would be a miracle—the boundless energy source that physicists have been pursuing since the dawn of the nuclear age. But could it be true? Could a solo inventor working out of a warehouse in Bologna really have built a fusion device that could power the planet?

■ **SCIENTISTS HAVE BEEN** captivated by the promise of commercial fusion power for more than half a century. During nuclear fusion, light atoms combine to form heavier elements; in the process, a small fraction of mass is converted into energy. Lots of energy. Fusion is one of the most powerful processes known to physics. "Hot" fusion, in which hydrogen atoms combine to form helium and tritium at temperatures of tens of millions of degrees, lights the sun. Recreating the 200-million-degree plasma soup necessary for nuclear fusion to take place on Earth requires vast amounts of energy, far more than scientists have been able to squeeze out of multibillion-dollar machines, making hot fusion little more than an expensive lab experiment.

*The machine would put the oil companies out of business. It would enable humanity to explore space on the cheap. It would change the world overnight.*

Yet in 1989, Martin Fleischmann, an electrochemist at the University of Southampton in England, and Stanley Pons, a professor at the University of Utah, held a press conference to announce that they had fused nuclei of deuterium (a heavy isotope of hydrogen) in an inexpensive tabletop apparatus—not at millions of degrees, but at room temperature. Their experiment was deceptively simple: Attach electrodes to strips of palladium and platinum. Place the metal in a jar of heavy water (water in which the hydrogen atoms are replaced by deuterium). Run an electrical current through it. The force of electrolysis, Fleischmann and Pons claimed, packed deuterium nuclei into the palladium's atomic-scale lattice structure closely enough for them to overcome their natural repulsion and fuse into helium. In went a modest amount of electricity; out came a thousand times more heat than any known chemical reaction could produce—enough heat, Fleischmann and Pons said, that its source had to be nuclear.

Researchers the world over scrambled to replicate their results. While a few claimed success, most of them failed. They said that Fleischmann and Pons measured heat incorrectly. They said they didn't stir the heavy water in their cell. As the negative reports poured in, Fleischmann and Pons were pilloried in the press and denounced by their peers. Months later, a scathing Department of Energy report recommended that cold-fusion research should receive no public funding. Since then, it has been all but banished from mainstream science.

Nevertheless, a community of a few hundred researchers continues to pursue the energy

source that Fleischmann and Pons claimed to have discovered back in 1989. Some of them work in government labs, others in private facilities. A few conduct experiments in their homes. But they don't call it cold fusion anymore. The field has more aliases than P. Diddy: condensed matter nuclear science, lattice-assisted nuclear reaction, chemically assisted nuclear reaction. The current term of art is low-energy nuclear reaction (LENR).

The identity crisis stems from the simple fact that cold-fusion researchers don't understand how these reactions work. All they know is that their experiments produce excess heat, along with neutron fluxes, alpha particles, transmutations, and other signatures of nuclear activity. Sometimes. Some experiments emit a hint of gamma rays; most don't. Some show evidence of transmutation products (one element turning into another, requiring an exchange of protons and neutrons); many don't. One might produce a single watt of anomalous heat; another might pump out 200 watts. There's a lot of evidence that *something* is going on. What that is, not even the true believers can say for sure.

Many LENR researchers now agree that the mystery reaction is not, in fact, a true fusion reaction. This is a reasonable conclusion. Nuclear fusion is the mechanism that endows the hydrogen bomb with such terrifying explosive power. If Fleischmann and Pons had achieved nuclear fusion on a tabletop, radiation would have probably killed everyone in the room. More recent theories, such as one proposed in 2005 by Allan Widom, a physicist at Northeastern University, and Lewis Larsen, CEO of the LENR startup Lattice Energy, suggest that, through a complex interaction of hydrogen and a host metal (palladium, nickel), low-energy neutrons are captured by nearby nuclei, releasing heat without creating dangerous radioactive by-products.

Whatever the eventual explanation, a few LENR researchers have put aside theory to focus on commercializing their results right now. That's certainly true of Andrea Rossi. Scientific understanding can wait until he starts shipping E-Cats to Home Depot.

Rossi isn't the best ambassador for a field with credibility problems, though. In the '80s, he invented a machine that magically transformed household garbage and industrial waste into oil—only it didn't create a drop. Leaky storage tanks at Rossi's "poison factory," as one Italian newspaper called it, contained 77,000 tons of toxic sludge that cost \$50 million to clean up. While under investigation for environmental crimes, Rossi was also charged with gold trafficking; he went to jail for six months and was later acquitted. As it happens, his engineering degree is from Kensington University, a notorious diploma mill shut down in 1996 by the state of California.

The cold-fusion faithful knew about Rossi's checkered history when he unveiled the E-Cat, but they were still willing to buy in, for a while. Mahadeva Srinivasan, a nuclear physicist and member of the team that created India's first nuclear bomb, invited Rossi to speak at an international conference, even though Rossi's name has never appeared on a single peer-reviewed scientific paper. An eminent Swedish physics professor who attended one of Rossi's demonstrations publicly stated that what was happening inside the E-Cat had to be a nuclear process. NASA

**Everything about Rossi—his patently phony website, his clumsy demonstrations, his history as a convicted scam artist—screamed fraud.**

offered to test Rossi's E-Cat (for a fee). The U.S. Naval Research Laboratory and DARPA each arranged private demonstrations. Nobel Prize-winning physicist Brian Josephson uploaded a video to YouTube arguing that the E-Cat "may well be the most important technological advance of the century."

But Rossi soon began to raise suspicion. Since a public E-Cat demonstration in October 2011—his most recent, and probably his last—he has issued a steady stream of contradictory statements and unfulfilled promises. He claims to operate a state-of-the-art E-Cat factory

in Florida, but the only property he owns there is a condo in Miami located a few blocks from the beach. He has no verifiable customers or investors. He has severed ties with business partners and reneged on every agreement to test the E-Cat. Josephson recently put a disclaimer on his YouTube video saying he doesn't endorse Rossi's E-Cat. Some of Rossi's most steadfast supporters—mostly starry-eyed bloggers on the alternative energy beat—have stopped astroturfing for him online.

As late as this summer, when Rossi's story seemed thoroughly debunked, he continued to make outlandish claims about his E-Cat. He looked like a con man clinging to his story to the bitter end. Maybe he'd even conned himself.

■ **WHEN I FIRST HEARD** the story of Andrea Rossi, I found it baffling that anybody took him seriously. Everything about him—his patently phony website, his clumsy demonstrations, his history as a convicted scam artist—screamed fraud. I wanted to know: How could someone with no real credentials and a history of deceit fool a small army of researchers?

So I decided to take a trip to a LENR conference at the College of William and Mary in Virginia. Around 50 people attended, including some of the field's top experimentalists and a contingent from NASA. The atmosphere was congenial, like a class reunion of a small high school.

On the first day, I sat near the front of a large conference room overlooking a football field where players practiced in wilting heat. I tried to glean some understanding from presentations on arcane LENR theories and experiments. During a break, I ran into John Martin, an aerospace engineer at NASA's Langley Research Center. I asked about Rossi, whose career Martin had been following closely. Why was Rossi so convincing? "He's pretty good at selling things, for one," Martin said. "The other thing is he's attached himself to one of the respected experimentalists in the field. That was his ace in the deck, connecting with him."

That ace was a retired physics professor from the University of Bologna named Sergio Focardi, Rossi's paid consultant and part-time photo prop. Focardi was often seen at Rossi's early press conferences, an owlish man in thick eyeglasses posing stiffly with Rossi's arm around his shoulders. In the 1990s, Focardi had teamed up with Francesco Piantelli, a biophysicist from the University of Siena in Italy who pioneered experiments on nickel-hydrogen LENR systems—the same type of system that powered Rossi's E-Cat. This legitimacy pyramid scheme, which started with Piantelli, compensated for Rossi's tarnished credentials.

## ANDREA ROSSI'S BLACK BOX

During another break, I struck up a conversation with Larry Forsley, president of the firm JWK International and a member of a research team at the Space & Naval Warfare Systems (SPAWAR) lab in San Diego. I'd heard Forsley laugh derisively when Rossi's name popped up in a panel discussion. I expected him to elaborate on why Rossi was a fraud, but he declined. "Rossi is an idiot," Forsley said. And yet: "It's entirely possible—I think it's highly improbable—that he actually managed to scale up Piantelli's work," Forsley said. "It's possible."


Over lunch I asked Robert Duncan, vice chancellor of research at the University of Missouri, for his opinion. Duncan acknowledged that Rossi didn't have the right credentials, but said that hundreds of LENR experiments undeniably produced excess heat. "He might be on to something that's empirical," Duncan said.

On the last day of the conference, Dennis Bushnell, chief scientist at Langley Research Center, summed up the state of LENR research. Guys like Rossi play a crucial role, for better or for worse. "This will go directly from the garage, the Edisonian experiments, to market, bypassing the science and the rigorous engineering research," Bushnell said. "And there are major investors ready to move on this—an amazing number—given a credible third-party seal of approval. I mean, this can move *fast*. If we ever get a credible assessment in the kilowatt range—one kilowatt will power ten 100-watt lightbulbs—"the world changes overnight." Bushnell paused and took a sip of water. "We have so screwed up this planet," he said, raising his voice. "This is one of the few things I know of that's capable for atoning for our sins."

To my astonishment, after three days of asking every cold-fusion researcher in the house, I couldn't find a single person willing to call Rossi a con man. The consensus was that he had something, even if he didn't understand why it worked or how to control it. The more I learned, the more confused I became. Could Rossi actually have something real? The only way to know for sure was to go to Italy.

■ **WHEN I RETURNED HOME** from the conference, I sent Rossi an e-mail using the address listed on his blog, which goes by the beguiling title *Journal of Nuclear Physics*. Last year, Rossi sandbagged himself behind his blog's comments section. From there he drops hints about new factories, responds to fans, and fires back at the "snakes," as he often calls his critics. He responded the same day, inviting me to a private demonstration of the E-Cat at his "factory" in Bologna.

When I got off the plane in Italy, the weather was brutally hot. Driving to my hotel, air-conditioning cranked up, I thought about the carbon my car was pumping into the atmosphere, my small contribution to a repeat of the Permian extinction that Dennis Bushnell warned about. When I got to my hotel, I fired up my laptop and checked my e-mail. There was a terse message from Rossi canceling our interview. No explanation. Given what I'd heard about Rossi's capricious temper, I suspected something like this might happen, but not before I'd unpacked my suitcase. I dashed off a bewildered reply and got a response within the hour:



*After three days of asking every researcher in the house, I couldn't find a single person willing to call Rossi a con man.*



*I REPEAT THAT I WILL NOT RELEASE ANY INTERVIEW. I HAVE TO WORK AND I HAVE NOT TIME AT ALL TO POLEMIZE WITH ENEMIES, COMPETITORS, ETC. THE RESULTS OF MY WORK WILL BE JUDGED BY THE CUSTOMERS, NOT BY THE CHATTERS.*

I wrote back explaining that I'd come all the way to Bologna because I'd been told he might have something real and I wanted to see it for myself. Then I Googled the address of his Italian company, EFA, and drove into the medieval maze of central Bologna. I found Rossi's office in an old three-story building on a narrow cobblestone street. It didn't look like a place of business. I walked up to a counter in the lobby and spoke to a woman who scribbled my name on a slip of paper and took it into an adjacent room. She came back to tell me that Mr. Rossi was unavailable and would be leaving soon. I parked near the building's garage entrance and sat there for three hours, swigging water. Rossi never materialized.

When I returned to the hotel, I had a new e-mail from Rossi. Apparently he'd rediscovered the caps lock key—a good sign. An informant had tipped him off that I was meeting with a "gang" of character assassins paid to slander him. (This was partly true. I'd arranged a meeting with a few LENR skeptics from nearby universities.) He also accused me of trying to pit him against his "enemies" in order to concoct a "thrilling" story line. We exchanged e-mails long into the night, but the result was the same—no interview.

The next morning, I received a brief e-mail from Rossi. "You have convinced me about your honesty," he proclaimed. As my reward, he would grant me an interview. He scheduled it for the same day and hour I was supposed to meet with the skeptics.



#### POWER SUPPLY

In his factory in Bologna, Andrea Rossi assembles one-megawatt plants—containers filled with 106 individual cold-fusion modules. Rossi's Australian licensee is taking preorders for \$500,000 down.

■ **ROSSI'S FACTORY** is in a warehouse on the outskirts of Bologna, among a tidy cluster of low concrete buildings. He greeted me at the entrance, hand extended, his thinning hair swept back as if he'd spent the day cruising in a speedboat off Miami Beach. A pair of prescription glasses dangled around the collar of his bright red polo shirt.

"Excuse me if I made some problem yesterday," Rossi said, pressing his palms together. "I had the persons very, very, very hostile, you know? And that's why I was—let's just forget it."

He ushered me to the back of the warehouse, where a 10-kilowatt (kW) E-Cat module—about the size of a footstool and sheathed in aluminum foil—sat on a test bench. Rossi explained that it contained three stainless-steel reaction chambers, each about the size of a D-cell battery. Each chamber holds 100 grams of nickel powder, a small amount of hydrogen gas, and Rossi's "secret catalyst."

The E-Cat is essentially a boiler, but the mechanism that drives it is as mysterious as the warp core on the Starship *Enterprise*. According to Rossi, the nuclear reactions occurring inside the E-Cat emit low-level gamma rays. Lead shielding surrounding the reactor chambers converts these gamma rays into thermal energy, which heats up the water. This is significant. Proof of gamma ray emissions could solve one of LENR's big riddles: If it's truly a nuclear process, where's the radiation? But Rossi has refused to allow independent measurements of his machine, perhaps because he doesn't always know whether he's going to pull a rabbit out of his hat or a cobra. Last year, he demonstrated the E-Cat for a group of private investors who were considering a commitment of up to \$150 million. The E-Cat came apart at the seams, hissing steam and spitting water. Rossi blew a gasket, too. The investors could still hear the echoes of his curses as they sped away from his warehouse.

Rossi had been warming up the E-Cat for an hour, which he said was necessary to trigger the nuclear reactions. The module

was plugged into the wall. Critics have slammed him for not unplugging it during live demonstrations, casting doubt on his claims of excess energy output. Some even suggested that Rossi juiced the E-Cat through hidden wires. To show me he had nothing to hide, Rossi circled the table, methodically clamping a handheld ammeter around every wire.

"Zero amperes," Rossi said, showing me the ammeter's display. He clamped it again. "You see? Zero amperes."

He decoupled the E-Cat's power cord with a theatrical flourish and darted over to a laptop. The computer logged temperature data from a probe stuck into the top of the E-Cat. The temperature gradient on the laptop's screen peaked around 140°C and remained there. The E-Cat was running in what Rossi called "self-sustained mode," implying that the reaction occurring inside of it—whatever that reaction might be—generated enough excess heat to keep itself going. The E-Cat ran at 140°C, unplugged, for about an hour. It's impossible to say what produced the heat. Even if Rossi was showing me an accurate calorimeter reading, it wouldn't be enough to conclude that his machine contained a nuclear reaction. A device the approximate size and volume of the 10kW E-Cat module would have to operate in self-sustained mode for at least one week to rule out the possibility of an exothermic chemical reaction.

Rossi jutted his square chin and clasped his hands behind his back. "We are not making some water or some laboratory experiment," he said. "We are making an industrial product that is going to the market to make real kilowatt hours. This is our revolution."

■ **ROSSI'S PAST DEMONSTRATIONS** were tightly controlled affairs. A month after the botched investor demo, when he debuted his 1-megawatt (mW) E-Cat for the public, he made people stand outside in the cold, inviting them in one at a time for a five-minute glimpse. So I was surprised when he left me

alone to poke around his warehouse for hours.

It was stifling inside, and occasionally Rossi came out of his office to offer me something to drink or to steady a stepladder as I teetered on the top rung taking photos. I crawled around every inch of a big blue shipping container that housed 106 linked E-Cat modules—one of Rossi's 1mW plants. I'd seen pictures of a similar unit on the Web, but Rossi said that one had been sold to a "military concern."

After I finished clambering around the plant, I met Rossi in his office, a small gray room decorated only by a wall calendar featuring a blonde woman wearing a bikini. "Maybe you brought luck to us," Rossi said, pouring me a cup of water, "because the certification examination of today has been very good. Has been pretty final."

That very morning, he said, the Swiss industrial certification firm SGS had completed safety tests of the 1mW plant. He didn't have the actual paper certificate from SGS to show me (he expected to receive it by mail in August), but he did have new customers—sort of. Two more plants would be going out the door in September.

"We will deliver a 1-megawatt plant in Europe to a nonmilitary concern, and most likely in the United States," Rossi said, adding that he would only release the names of his customers "when the plant will be enough consolidated not to make possible for the snakes to shoot at it."

This seemed unlikely, but it wasn't impossible. For \$1.5 million, Australian customers can order a 1mW plant right now to heat their hospitals, sports stadiums, or swimming pools, through

the website of Rossi's licensee in Australia. Buyer beware applies. Even if SGS really had certified that the E-Cat is safe, no independent third party has verified that it actually works. Not that Rossi hasn't had that opportunity. Twice he approached the University of Bologna and NASA about testing the E-Cat. Both times he withdrew. "All NASA wanted to do is test the device, under his full supervision," said Langley's John Martin. A team of engineers met Rossi at NASA's Marshall Space Flight Center to discuss the testing procedure. They assured him they wouldn't reveal any proprietary secrets. "We just plug things in, test what goes in and what goes out, and run it for a while, and that's it," Martin said. "And he backed out. It's really strange."

When I asked Rossi about these aborted attempts at independent verification, he cut me off. "Validation," he said, "I had it, the day before yesterday." He seemed as surprised as I was about this revelation.

I pressed him for details. For the first time during our conversation, in which he had answered every question with polite candor and humor, Rossi faltered. He offered names of people involved in the test, their affiliations and areas of expertise, and trailed off into silence as if he was unaccustomed to giving specifics on the fly. The dry rattle of cicadas filtered through the transom. Everything was off the record, Rossi said, apologizing for his "Freudian lapses." He fell back into a familiar pattern of vague circumlocutions, stating that "an important university" had validated the "Hot Cat," a super-high temperature industrial device. I asked to see test data, but he declined under the terms of the nondisclosure agreement he'd signed giving the "important university" exclusive right to publish the report—perhaps in the scientific journal *Nature*, he suggested.

"When might they do that?" I said. "Six months? A year?"

"Noooo," Rossi frowned. "Maximum, by September."

He promised to send me a copy of the report.

■ **I NEVER DISCOVERED** who ratted me out to Rossi, but I managed to reschedule a visit with the ringleader of the skeptics gang, Ugo Bardi. Bardi is a professor of physical chemistry at the University of Florence. In 1989 he was doing research in electrochemistry at Lawrence Berkeley National Laboratory in California when Fleischmann and Pons announced their discovery of cold fusion. The news thrilled him, but his research director dismissed it as a hoax. Bardi set out to replicate the Fleischmann-Pons effect anyway. His experiment didn't work, and like thousands of other scientists who also tried and failed, Bardi promptly forgot about cold fusion. Then Rossi began stirring things up in early 2011. Bardi and his colleagues believed there was something to the story. "For a while, I must admit I had some revolution in my mind that told me maybe this guy invented something special," Bardi said. He smiled ruefully. "It's a scam. It doesn't work."

"How can you be so sure?" I said.

"The energy involved is enormous," Bardi said. "You don't make a hot water boiler for your bathroom. You have an atomic weapon." This was the standard argument against Fleischmann and Pons's idea of cold fusion. It wasn't, however, a cogent argument against low-energy



## What's in the Box?

No one knows, but the cold-fusion faithful have three leading theories



### The Fleischmann-Pons Effect

Martin Fleischmann and Stanley Pons weren't sure what caused the anomalous heat in their experiments, but their best guess was nuclear fusion at room temperature. They proposed that their experiment packed deuterium nuclei into the palladium lattice with enough force to overcome electrostatic repulsion—the "Coulomb barrier"—between the nuclei. Once the nuclei penetrated the Coulomb barrier, the strong nuclear force welded them together, releasing heat.



### Peter Hagelstein's Phonon Theory

Hagelstein, a professor of electrical engineering at MIT, believes that the deuterium nuclei in the reaction combine to form helium, but not in the way scientists currently understand fusion. When the deuterium nuclei fuse, the reaction doesn't release energetic nuclear radiation; instead, energy is distributed as phonons (vibrations of a metal lattice) back into the palladium, which keeps the reaction going.



### Widom-Larsen Theory

Allan Widom and Lewis Larsen propose that neutrons catalyze nuclear reactions. First, electrons orbiting outside nuclei get heavier through interactions with electromagnetic field fluctuations; the electrons react with protons, creating neutrons that are captured by nearby nuclei. The process triggers transmutation reactions (one element changing into another element), releasing gamma rays that get converted into heat.



**UNPLUGGED**

Rossi in his Bologna warehouse with a 10-kilowatt E-Cat module. He has been criticized in the past for not unplugging his machine during demos.

"Some people are," I said.

"Absolutely!" Polosa said, and then realized he was agreeing with me. "No, but that's the point," he said. "It's different. At this point, you have to look at the quality of the people." In the end, that's what it all came down to for Ruocco and Polosa. If "stellar" physicists like Carlo Rubbia, a Nobel prize winner, godfather of CERN's Large Hadron Collider, and supporter of cold-fusion research in Italy, couldn't prove cold fusion was real, what chance did "garage research men" have?

"So they're all wasting their time?" I said.

"Yes," Polosa said, "exactly."

"They are not serious insofar as doing a sort of religion work rather than doing science," Ruocco said at one point. "They believe in something and they want to demonstrate that."

As I walked back to the train station, I recalled something Ugo Bardi had said, that cold fusion was a "clash of absolutes." The description could easily apply to the attitudes of scientists on both sides of the divide. Each believes the other is wrong; each believes the empirical evidence is on his side. In this rigid context, Rossi's erratic behavior had a shrewd logic to it. The only thing that kept him in the game was his canny ability to straddle the intersection of science and belief.

■ **TWO WEEKS AFTER** I met with Rossi, he e-mailed me a 15-page "technical report" documenting a test that was performed on the Hot Cat. The report contained photographs of the Hot Cat and calculations of its thermal energy output. The data was "very confidential," Rossi wrote, but he gave me permission to "say that third-party validation test has been made with those results."

Days later he dropped hints on his blog that parts of the report "eventually will be published in a scientific magazine." E-Cat World ([e-catworld.com](http://e-catworld.com)), one of dozens of websites that post gossip from Rossi's blog, insinuated that the magazine might be POPULAR SCIENCE. It seemed like a clumsy attempt to launder his test data in this magazine.

Instead, I removed all identifying information and sent the report to an expert at NASA experienced in conducting third-party validation tests. While the NASA expert didn't entirely refute the report's findings, the test protocols and conclusions didn't meet the standards of a credible third-party evaluation. The outcome wasn't surprising, but I was disappointed nonetheless. Some small part of me wanted

nuclear reactions, which shouldn't (at least according to the theories circulating in the LENR world) produce thermonuclear levels of radiation. But to Bardi this was a distinction without a difference. It's all cold fusion to him. He didn't care how many researchers said they had produced results. These people, he says, are deluding themselves.

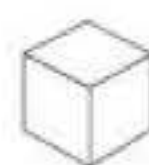
"Many people say, 'I have seen flying saucer,'" Bardi said with a shrug. "But it doesn't mean that flying saucers exist."

The next day, I took a train to Rome to talk to two more LENR skeptics, Giancarlo Ruocco, director of the physics department at the University of Rome, La Sapienza, and associate professor Antonio Polosa. Sepia photographs of famous La Sapienza scientists hung on the wall. Every time I tendered a question, Enrico Fermi glowered at me in the dim light.

I asked Ruocco if he had tried to replicate the Fleischmann-Pons effect. He shook his head no. I began to ask if he was aware of the work that many LENR scientists—

Ruocco raised his hand. "Why you say scientists?" he said, and then answered his own question. Mostly independent "garage research men" worked in LENR, he insisted, not scientists, and that was okay by him as long as they didn't waste public money on their experiments or waste his time by asking him to disprove their results. Let's talk about some of those results, I said, playing devil's advocate. I threw pitch after pitch in support of LENR, and they politely, but firmly, swatted them away. Anomalous heat? "Just normal chemistry." Widom-Larsen theory? A "patchwork" of theories that were "locally reasonable" but wrong as a whole. Yet as confident as they were when we were talking about theory, Ruocco and Polosa didn't refute specific LENR experiments. They didn't even seem to be aware of them.

"Imagine if they could have found something, even small," Polosa said, referring to the physicists who first tried to replicate Fleischmann and Pons's experiment. "They would've worked on [cold fusion] forever."



**"Many people say, 'I have seen flying saucer,'" Bardi said with a shrug. "But it doesn't mean that flying saucers exist."**

*continued on page 97*

## ANDREA ROSSI'S BLACK BOX

continued from page 70



Rossi to prove my suspicions wrong.

The director of the Hot Cat test, a retired colonel and friend of Rossi's, leaked the test results on the Web a week after Rossi sent them to me. The enthusiastic colonel "could not help to talk about this event and the remarkable results," Rossi said on his blog. Rossi used the occasion to make another big announcement: The University of Bologna would conduct a new independent test of the Hot Cat and publish the results in October. When I contacted Dario Braga, vice rector for research at the University of Bologna, he unequivocally denied any official relationship between the university and Rossi. "I'm not aware of any work being done by our scientists with Mr. Rossi in a formally correct way," Braga said. "I don't know how Mr. Rossi can say this."

If history is any guide, no such report would be issued. Rossi will reset the goalposts—the only thing he does with any consistency—and forestall his day of reckoning for another few months, and then another few months after that, until finally he disappears from the stage in a puff of smoke, taking his black box with him.

■ **ON MY LAST DAY IN ITALY,** I went to see Francesco Celani, a stalwart LENR experimentalist who worked at the National Institute of Nuclear Physics (INFN). He picked me up at the train station, drove me to the INFN complex in Frascati, handed

my passport to the armed guards, and headed to a white metal shed set on a windy hilltop next to a row of olive trees. Celani manufactured his own LENR cells, and the floor was littered with metal shavings. Dozens of glass cylinders of every size and shape cluttered the tabletops.

"Careful," Celani said, gripping my arm as I brushed past a lab table, "very hot."

He pointed to a narrow glass cylinder that resembled an oversize hypodermic needle resting on its side. It had been running for six weeks straight, Celani said. He called it his "special reactor." Kneeling down for a closer look, I could feel the heat coming off it. It was difficult to fathom that nuclear reactions thousands of times more energetic than any known chemical reaction were occurring on the hair-thin wire coiled inside the gas-filled cylinder. Celani had been experimenting with constantan wire, a nickel-copper alloy, for almost a year. He kept detailed records of various preparations, which involved roughing up the wire's smooth surface so that it had a spongelike quality that absorbed hydrogen atoms more efficiently. It took two days for hydrogen to "load" into the wire's atomic lattice and begin producing excess heat. Around 5 to 10 watts, nothing like the numbers Rossi was getting, Celani said, but he could switch the cell on and off and get excess heat every time. Most important, Celani wasn't working in secrecy. Any scientist could replicate his experiment, no belief required. He opened his logbook to show me a "very nice correlation" between a decrease



✓Yes



✓Yes



xNo



✓Yes



✓Yes



✓Yes



✓Yes



✓Yes

- ✓ Everyday Low Prices
- ✓ Easy To Use Website
- ✓ Huge Selection
- ✓ Fast Shipping



GO TO [WWW.ROCKAUTO.COM](http://WWW.ROCKAUTO.COM) ROCKAUTO, LLC (EST. 1999)

## ANDREA ROSSI'S BLACK BOX

in resistivity of the wire and an increase in heat production.

"I think there is no mistake in the instruments," Celani said, smiling impishly. "Anyway, always possible."

Celani would soon be taking his special reactor to Austin, Texas, where he would demonstrate it at an annual developers conference hosted by National Instruments (NI), a billion-dollar manufacturer of virtual instrument controls and monitoring equipment found in almost every major research lab in the world. NI had invited Celani and a handful of other LENR researchers to present at the event. They had also invited a few LENR firms; Rossi's is no longer the only company racing toward commercialization. The Greek technology firm Defkalion, for example, which started out as Rossi's first big licensee before splitting off, would be in Austin to discuss its own LENR device based on Rossi's nickel-hydrogen E-Cat reactor. The meeting was the biggest news in the LENR community since Rossi arrived on the scene. Many were treating it as a coming-out party. At last they were getting the respect they felt they deserved, and they owed some of that to Rossi. While Rossi wasn't invited, his talent for self-promotion got the attention of NI's CEO, James Truchard, who decided to give LENR a closer look.

When I spoke to Truchard in August, he said that he was impressed by the "absolutely precise and well-described" experiments conducted by Celani and others in the field. "I think we are just on the edge," Truchard added, stopping short of an endorsement of LENR. "And this could happen tomorrow or 10 years from now, because I don't know when the spark will come. But we are, I believe, close."

I asked Celani why he thought NI had invited him to the conference. He stopped what he was doing and looked around the chaos of his lab, as if searching for the answer among all the defunct LENR cells he'd built to replicate various experiments dating back to the early days of cold fusion, experiments that helped push the field, watt by watt, closer to legitimacy. "I don't know," Celani said, and burst into laughter. **FS**

*Steve Featherstone wrote about the ongoing cleanup at Chernobyl for the July issue.*

ps showcase

# TIME MACHINES



## Elmira Stove Works

For true originals.



Kitchen or bar; home, cabin or cottage. Vintage styling with today's features. Available in gas, electric or wood-burning.

ElmiraStoveWorks.com  
1-800-295-8498



RANGES • RANGE HOODS • REFRIGERATORS • MICROWAVES • DISHWASHERS



## The DR® LEAF and LAWN VACUUM

**36 MONTH FINANCING AVAILABLE**

For details please call or visit online.

# COLLECT A YARD FULL OF LEAVES...WHILE YOU RIDE!

**DON'T SPEND ANOTHER WEEKEND RAKING** It happens every fall. Your yard gets covered with leaves and you spend an entire weekend collecting them. But with the DR® LEAF and LAWN VACUUM, a weekend chore can be completed in hours.

**YOUR VACUUM-CLEANED LAWN WILL LOOK BEAUTIFUL** Using a high-powered vacuum that attaches to your mower's deck, the DR® LEAF and LAWN VACUUM collects leaves,

grass clippings, pine needles, pine cones, nuts, and twigs with an unstoppable 85 mph suction. As it's collected, the debris is shredded, reducing 10 garbage bags of leaves to just 1.

**PLUS! Self-Propelled models also available!**



76654X © 2012



Call for a FREE DVD & Catalog!  
TOLL FREE **1-888-201-6350**  
[www.DRleafvac.com](http://www.DRleafvac.com)

LIMITED-TIME OFFER  
**1★YEAR TRIAL**

**FREE SHIPPING**  
For a Limited Time