Particle collision thought to replicate Big Bang forces, may help explain how things exist

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By the logic of science, things simply shouldn't exist. The best scientific minds of several generations have reasoned that shortly after the Big Bang created the universe, matter and antimatter should have wiped each other out.

So that explains the global chain reaction of excited e-mails among physicists last month, after scientists at the Fermi National Accelerator Laboratory "opened the box" -- their jargon for taking a peek at newly crunched data -- and raised hopes of some day solving the riddle of existence.

"It's like looking back to the instant where everything began," said Joseph Lykken, a theoretical physicist at the sprawling research facility near Batavia, Ill.

Simply put, the Fermi team sent protons and antiprotons around its underground Tevatron accelerator ring into a head-on collision, which produced slightly more tiny fragments called "muons" than tiny fragments called "antimuons."

It was a laboratory victory of matter over antimatter, and a minuscule replication of what scientists believe must have happened shortly after the Big Bang, though exactly how matter won out has long confounded them.

Previous tests slamming such infinitesimal particles together -- a proton is one one-hundred-thousandth the size of an atom -- have produced similar results. But they never have risen above a statistical shadow of doubt for physicists working with computer calculations about particles and interactions they can't see.

By contrast, the latest discovery by Fermilab's DZero team seems statistically solid. If it makes it past critical peer review, it will lead to a re-evaluation of existing theories and, possibly, a deeper understanding of physics and why things exist. It certainly will inspire a barrage of additional supercollider tests, as other labs try to verify the discovery or shoot it down.

Either way, it could be one incremental step toward the holy grail of atomic physics: the long-sought discovery of the elusive "Higgs boson," a theoretical particle assumed to be the fundamental building block of all matter.

"It'll be written about in physics books a hundred years from now," said Zoltan Ligeti, a physicist at the California Institute of Technology who was not involved in the Fermilab experiment.

For decades, Fermilab was the world's pre-eminent center for subatomic particle research. But increasingly, the expectation was that the next big breakthrough in physics would come from a new and more powerful European accelerator, the Large Hadron Collider outside Geneva, which has begun overshadowing Fermi and draining its talent.

So scientists at the older facility just west of Chicago have expressed a quiet satisfaction with the home team victory, which could help its efforts to remain relevant and fund-worthy.

In a Web site posting, Fermilab Director Pier Oddone said "I am

delighted to see yet another exciting result from the Tevatron." An official from the U.S. Department of Energy, which funds Fermilab, echoed that pride, saying the "result underlines the importance and scientific potential of the Tevatron program."

The question of existence is something that humans have wondered about ever since there were humans to wonder: "Why is there something rather than nothing?" as the 17th century philosopher Gottfried Leibniz put it.

Clearly, things do exist -- evidenced by the facility near Batavia, where bison graze above a subterranean, four-mile-circumference accelerator, or the tidy homes in nearby suburbs where Fermilab staff members live. But, theoretically, they shouldn't.

One of physics' foundation stones is the concept of a symmetrical universe. Everything has its mirror opposite, like humans' left and right hands. As schoolchildren learn, Newton said every action has an equal and opposite reaction.

"A good example is the Big Bang," Lykken said, putting his colleagues' discovery into context. "The universe began as a perfectly symmetrical object, a ball of energy."

The problem lies in what happened next. That energy condensed into matter but also into its opposite, antimatter. The two being mutually destructive, they should have canceled each other out. Instead, Lykken noted, matter joined together in ever larger concentrations -- nuclei, atoms, stars, galaxies.

Fermilab had that kind of question in mind 27 years ago when it built the Tevatron to imitate Big Bang-like collisions in miniature. The tentative breakthrough came last month when some of the Dzero team's 500

scientists looked at the latest of eight years' worth of results from collisions, monitored in a Buck Rogers-looking apparatus in a warehouse-type building atop one of the rings.

In the game of physics, the ball now passes from researchers to theoreticians like Lykken to figure out how the new data jibe with scientists' overall understanding of the universe, a collection of theories known as the Standard Model. His office at Fermilab is dominated by an enormous old-fashioned blackboard covered with mathematical expressions and graphs, each a trial-fit interpretation of experimental data, and perhaps such a chalk scrawl will someday explain how matter prevailed.

The discovery someday could have practical spinoffs, but it also could have immediate implications, among them in the clamorous intersection of politics and religion. Lykken hypothesized that proponents of "intelligent design" could seize upon the new findings to further support their argument that the laws of nature are so fine-tuned, they must be the handiwork of a creator.

From a scientific perspective, he postulated there could be an infinite number of universes, some vastly different and others quite similar, though not exactly.

"I can imagine a universe exactly like ours," Lykken said. "Except that the Cubs win a World Series."

In the course of their normal work, theoreticians and researchers freely exchange ideas in a regular rhythm of intellectual interaction -- except when a big breakthrough like the recent one is at hand.

"For about 10 days we kept quiet about it, not talking to other physicists, even those here at Fermi," said Stefan Soldner-Rembold, a member of

the research group.

Once their data and logic had been double-checked, the research team invited colleagues to a Friday evening wine-and-cheese party, a tell-tale method of tipping off colleagues.

Lykken was away at a scientific conference, half-listening to a panel presentation while checking e-mail on a laptop computer when his invitation arrived on his screen. The title of the presentation at the Fermi bash began with two exciting words -- "evidence for ... "

As a group, physicists don't indulge in frequent displays of emotion. But Lykken wasn't the only Fermi scientist elated by what was found when "the box" was opened on May 5. Soldner-Rembold said he got goose bumps.

"I said, 'Wow!' " recalled Dmitri Denisov, a physicist present at the opening.