'God particle' may shed light on dark matter

By Dan Vergano, USA TODAY

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Still wondering what all the "God particle" hoopla was all about?

Science Snapshot

By Dan Vergano

By J ouml/>rg Dietrich, University of Michigan/University Observatory Munich.

Color image of the galaxy clusters Abell 222 and Abell 223 connected by a dark matter filament. The blue shading and the yellow contours indicate matter density. The image on the sky is about twice as big as the full moon.

Well, try this out.

The subatomic particle is better known to scientists as the Higgs boson. And after decades of searches, it seems likely the elusive particle has been successfully detected inside an underground tunnel experiment run by the European Organization for Nuclear Research (CERN) outside Geneva. Results "consistent" with the hard-to-detect particle, in the words of CERN chief Rolf Heuer as he announced the discovery July 4, may be the opening act in explaining the structure of the sky over our heads.

A source of heartburn to serious science types now, the "God particle" nickname for the Higgs boson comes from the title of a 1993 book by Nobel-prize winner Leon Lederman, who was trying to play up the elusive nature of the particle.

For a glimpse of one implication of this latest big news in science, climb aboard a time machine, says physicist Jonathan Feng of the University of California-Irvine, and visit the birth of the universe 13.7 billion years ago.

"Simply take the universe backwards, to an early time when the cosmos was a hot mass, brand new, filled with particles that each weighed perhaps 500 times as much as a proton," says Feng (protons are positively charged subatomic particles inside atoms). "Now play the film forward. Just let it go until it expands to fill with today's stars and galaxies, and what you find is that it contains amounts of that particle that are just right to be 'dark matter' filling the universe."

Terrific, you might say, but what's so wonderful about dark matter?

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Dark matter is basically a bunch of stuff, likely exotic physics particles, that we can't really see (hence its name) but we know is out there. Astronomers realized a few decades ago that galaxies should be falling apart if the stars within them were the only things providing the gravity that holds them together. So, their theories go, there must be something extra — dark matter — holding them together.

It turns out that stars are just the shiny hubcaps on each galaxy, outweighed by a factor of nearly 6-to-1 by all the dark matter out there. Dark matter even pulls itself together through gravity. For example, the journal *Nature* last week reported that a dark matter cloud gravitationally connects two clusters of galaxies, called Abell 222 and Abell 223. This cloudy filament stretches over 11 million light years between the clusters and weighs 98 trillion times as much as our sun.

That's a lot of dark matter. So is the Higgs boson this elusive dark matter particle (or particles) then?

Nope. But it may be a key to dark matter, physicists say.

The Higgs boson is the physics particle that gives other particles their mass. Essentially it interacts with them to increase their resistance to being moved faster, which we can measure as mass.

Because the Higgs boson's basic job is to interact with other physics particles to give them mass, "the Higgs boson can interact with dark matter very easily," Caltech's Sean Carroll explained on NPR's *Science Friday*show after the recent "God particle" announcement. "Dark matter is one of the most exciting implications of this discovery," Carroll said.

How? That brings us back to Feng's rerun of the universe. "Having a particle out there theoretically just a little heavier than the Higgs boson, which interacts with it, is waving a red cape in front of the eyes of physicists," Feng says. "There is a lot more data coming from CERN ahead that may reveal the dark matter particle."

Dark matter particles that theoretically could be detected at CERN's underground Large Hadron Collider are envisioned by a theory called "focus point supersymmetry." Supersymmetry theories predict that the already-discovered particles that comprise everyday matter have much-heavier "super" counterparts awaiting detection (for example, the already detected "quarks" inside protons would have an undetected super-partner called "squarks").Focus point supersymmetry predicts both a Higgs boson with a weight similar to the one reported on July 4, about 130 times as heavy as a proton, and dark matter particles.

"In fact, the simplest focus point models predict that dark matter particles should be seen not long from now in the underground detectors that are searching for them," if the CERN lab indeed found a Higgs boson, Feng says. "So there are really two predictions — dark matter should be seen in underground detectors, and new particles should be seen at the Large Hadron Collider in the next few years." Some of the new super-partner particles theoretically weigh in the detectable range for the underground experiment.

Finding these new particles would crack the dark matter mystery and would indicate that even heavier super-particles are out there, ones that someday could allow physicists to explain gravity the same way they can explain electromagnetic and nuclear forces, a goal of cosmologists for nearly a century.

"The simplest outcome is that we'll be totally wrong and it won't find anything," Feng says. "But we are at a point in physics where we can talk about theories and experiments coming together very closely thanks to what is now happening, and we couldn't do that for a long time before ."

When do the next big results come from CERN that might offer more answers? Likely in December. So, Feng says, physicists celebrated one holiday, July 4, with new particle results and hopefully Christmas will bring them hints of new presents. "That would be excellent, we couldn't ask for better gifts," he says.