Dark matter or background noise? Results intriguing but not conclusive

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Physicists may have glimpsed a particle that is a leading candidate for mysterious dark matter but say conclusive evidence remains elusive.

A 9-year search from a unique observatory in an old iron mine 2,000 feet underground has yielded two possible detections of weakly interacting massive particles, or WIMPs. But physicists, who include two University of Florida researchers, say there is about a one in four chance that the detections were merely background noise -- meaning that a worldwide hunt involving at least two dozen different observatories and hundreds of scientists will continue.

"With one or two events, it's tough. The numbers are too small," said Tarek Saab, a UF assistant professor and one of dozens of physicists participating in the Cryogenic Dark Matter Search II, or CDMS II, experiment based in the Soudan mine in Northern Minnesota.

A paper about the results is set to appear Thursday in Science Express, the journal *Science*'s Web site for selected papers that appear in advance of the print publication.

Scientists recognized decades ago that the rotational speed of galaxies and the behavior of galaxy clusters could not be explained by the traditional forces of gravity due to the mass of visible stars alone. Something else -- something invisible, undetectable yet extremely powerful -- had to exert the force required to cause the galaxies' more-rapid-than-expected rotational speed and similar anomalous

observations.

What came to be known as "dark matter" - dark because it neither reflects nor absorbs light in any form, visible or other - is now estimated to comprise as much as 23 percent of the universe. But despite abundant evidence for its influence, no one has ever observed dark matter directly.

There are several possibilities for the composition of this mysterious, omnipresent matter. Particle physics theory points toward WIMPs as one of the most likely candidates.

WIMPs are "weakly interacting" because, although their masses are thought to be comparable to the masses of standard atomic nuclei, they have little or no effect on ordinary matter.

Among other things, that makes them extremely difficult to detect.

However, scientists believe WIMPs should occasionally "kick" or bounce off standard atomic nuclei, leaving behind a small amount of energy that should be possible to detect.

The CDMS II observatory is located a half-mile underground beneath rock that blocks most particles, such as those accompanying cosmic rays. At the observatory's heart are 30 hockey-puck-sized germanium and silicon detectors cryogenically frozen to negative 459.58 Fahrenheit, just shy of absolute zero. In theory, WIMPs would be among the few particles that make it all the way through the earth and rock. They would then occasionally kick the atoms on these detectors, generating a tiny amount of heat, a signal that would be observed and recorded on the experiment's computers.

Durdana Balakishiyeva, a postdoctoral associate in physics at UF, and Saab have participated in the analysis of data produced by the

experiment as well as simulations of the detectors' response. Beginning in 2007 they have helped to test many of the detectors at the UF campus in Gainesville which are being used in the successor SuperCDMS experiment. The UF tests involved cooling and operating the detectors just as they are operated in Minnesota to verify that they were up to par.

The 15 institutions participating in CDMS II gathered data from 2003 to 2009. Observers recorded the two possible WIMP events in 2007, one on Aug. 8 and the second on Oct. 27. Scientists had estimated that five detections would be sufficient to confirm WIMPs -- meaning that the two fell short, according to the CDMS. But while the two detections may not be conclusive, they do help to set more stringent values on the WIMPs' interaction with subatomic particles.

"Up until now, not only us, but everybody was operating without statistics -- we were blind in that sense," Balakishiyeva said. "But now we can speak of statistics in some way."

At the very least, the finding helps to eliminate some theories about dark matter -- raising the profile of the WIMP and potentially accelerating the race to detect it.

"Many people believe we are extremely close -- not just us, but other experiments," Saab said. "It is expected or certainly hoped that in the next five years or so, someone will see a clear signal."

Provided by University of Florida