Looking for dark matter a mile underground

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Physicist Andrew Sonnenschein inspects the COUPP bubble chamber.

For the past two years, a small bubble chamber has been on the lookout for dark-matter particles a mile underground at SNOLAB in Sudbury, Ontario. Now that experiment is about to get company – its big brother is moving in. The new particle detector, developed at the Department of Energy's Fermi National Accelerator Laboratory, will be much more sensitive to dark-matter particles than its predecessor.

The two bubble chambers, with volumes of 2 and 30 liters respectively, are part of an experiment known as the Chicago Observatory for Underground Particle Physics. Initiated by physicist Juan Collar at the University of Chicago, COUPP initially took data in a hall 350 feet underground at Fermilab to look for dark matter. When scientists improved the sensitivity of their particle detectors, particles stemming from cosmic-ray showers created too much noise and the COUPP collaboration decided to move to the deeper SNOLAB location, which provides more shielding against cosmic rays.

Moving the 30-liter COUPP detector into SNOLAB's clean rooms will require some unusual work. To enter the laboratory, scientists take a mile-long elevator ride underground, walk a mile through an old mining tunnel, take a shower to remove any uranium or thorium dust stemming from the surrounding rock and dress in gowns and hairnets. Like the scientists, all pieces of the detector will need scrubbing and cleaning, too. Only then can they enter the clean rooms that make up SNOLAB.

When operational, the new bubble chamber will contain superheated fluid. Most dark-matter particles will pass through the chamber without leaving a trace. But when a massive particle hits an atomic nucleus in the fluid, the energy released in the collision will bring a tiny region of the fluid to a boil, which leads to the formation of a bubble. Cameras will record all bubbles that develop. The challenge is to distinguish between bubbles caused by dark-matter particles and those caused by other known particles, such as neutrons. The COUPP scientists have developed various methods to separate those events, including listening to the sound created when a bubble forms.

The COUPP collaboration expects the new detector to be running by the end of the year and data collection to begin next year.

More information: www.snolab.ca/

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