Keeping dark matter detectors clean and accurate

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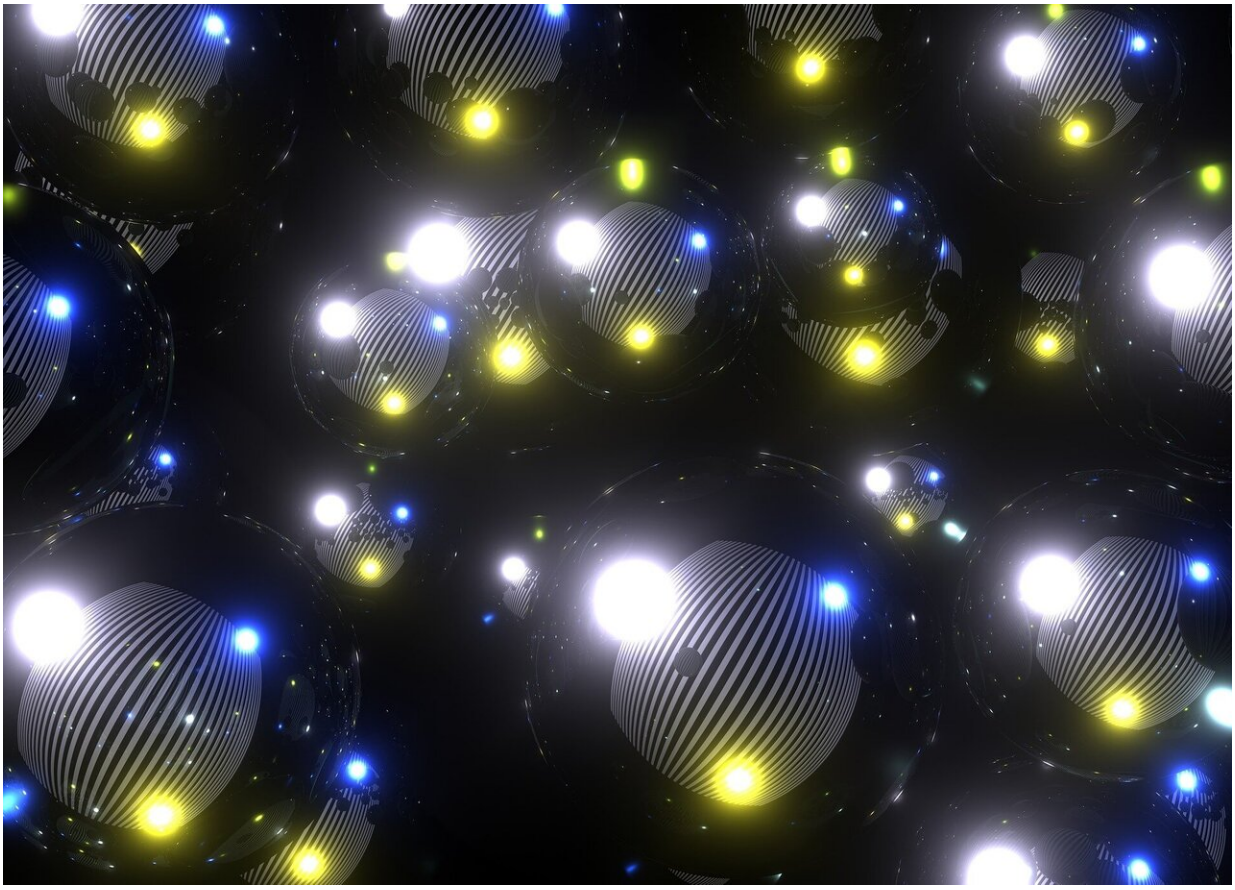

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A research team at South Dakota School of Mines & Technology has built an air purifier that has reduced the radon in the air to about 50

times lower than typical outdoor air. The team is helping to ensure success for one of the world's most sensitive dark matter experiments—LZ. Dark matter has never been directly observed. But it is believed to make up 85% of all the matter in the universe. The mystery of dark matter is considered to be one of the most pressing questions in particle physics. The LZ experiment is run deep underground where it will be protected from high-energy particles, called cosmic radiation, which can create unwanted background signals. But underground environments pose other challenges. They are often higher in radon, which can also impede sensitive experiments.

"Usually the concentration of radon underground is quite high, but the equipment that has been installed in SURF reduces radon background by a factor of a thousand," says Richard Schnee, Ph.D., the physics department head at South Dakota Mines. "Radioactive particles are a real problem for these super sensitive dark matter detectors." Even miniscule amounts of radon could contaminate and throw off the experiment. "Without this, the scientific community has no reason to trust our results," says Eric Morrison a Ph.D. graduate student at South Dakota Mines who is working on the project.

While radon gas in the air at SURF may be enough to disrupt a sensitive experiment, it is not enough to be dangerous to humans who work underground. Other air handling systems at SURF keep the air in the rest of the underground lab at safe levels.

Schnee's team also checked many of the components used to build LZ for background radiation as the LZ detector was being assembled. This understanding of the total level of background radiation in the equipment itself helps researchers predict the number of false positive events that look like dark matter interactions. The LZ recently moved underground at SURF and is set to start the hunt for dark matter in the coming year. South Dakota Mines is one of 37 institutions worldwide

working on LZ.

The South Dakota Mines team has also designed and installed a radon reduction system for the SuperCDMS SNOLAB experiment. This experiment is in the hunt for suspected dark matter particles alongside LZ. SuperCDMS SNOLAB will be assembled and operated at the Canadian laboratory SNOLAB, located 6,800 feet underground inside a nickel mine near the city of Sudbury, Ontario. It's the deepest underground laboratory in North America. SD Mines is one of 26 institutions worldwide working on SuperCDMS SNOLAB.

These two experiments, SuperCDMS SNOLAB and LZ, are powerful new tools that will try to solve one of the biggest mysteries of modern physics—dark matter.

Provided by South Dakota School of Mines & Technology