



Photo: Reidar Hahn, Fermilab

Science opportunities deep underground

If you're a dark matter particle or a neutrino, it's a constant struggle to make yourself heard. The universe is an exceptionally noisy place, filled with a rain of cosmic-ray particles—mainly high-energy protons. One of the few places to escape the noise is deep underground, where the rock, earth, or water above shields against cosmic rays and allows other particles to tell whatever they are trying to say.

If we're going to listen to them, we need to work underground. But working underground is not easy. It requires a significant investment in resources to build an underground laboratory, which not only has to be deep, but also clean. Experiments there need extra attention in their design, construction, and transport. Due to the expense of digging deep, most underground laboratories around the world piggyback on some other facility like a mine, tunnel, or underground storage facility.

Currently in the United States, there are a few underground facilities. However, none lie at the depths required to block enough cosmic rays to let us hear the signals of ultra-rare particle events that hold the key to discovering the fundamental nature of the universe. Many experiments are conducted in existing shallow US facilities, but those requiring greater depths are installed in underground labs overseas, where they typically come second to the domestic science priorities of host countries.

A US deep underground lab would allow this country to be a leader in many areas of science. Our magazine tends to focus on particle physics, but we recognize that geology, geomicrobiology, and other fields also need a deep science facility to progress, and we discuss some of those possibilities in this issue.

The US Department of Energy and the US National Science Foundation are exploring ways that they might work together to develop a deep underground laboratory for science and engineering research. If created as proposed, it would be a world-leading facility, offering enough space for a wide range of experiments addressing fascinating and important scientific questions. We hope that such a facility will be constructed and help drive US and global physics, geology, and biology.

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