Green light for next-generation dark matter detector

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Construction will begin on a next-generation dark matter detector with the UK taking a leading role and providing vital hardware for the project.

The LUX-ZEPLIN (LZ) experiment, which will be built nearly a mile underground at the Sanford Underground Research Facility (SURF) in Lead, South Dakota, is considered one of the best options yet to determine whether theorized dark matter particles known as WIMPs (weakly interacting massive particles) actually exist.

A significant milestone has now been reached with officials from the United States Department of Energy formally approving the final design last week, allowing construction to begin and propelling the project toward its April 2020 completion goal.

The LZ collaboration now has about 220 participating scientists and engineers who represent 38 institutions around the globe – with UK scientists, supported by the Science and Technology Facilities Council, representing about a quarter of the collaboration.

Henrique Araújo, from Imperial College London, said: "We are looking forward to seeing everything come together after a long period of design and planning."

The nature of dark matter, which physicists describe as the invisible component or 'missing mass' in the universe, has eluded scientists since

its existence was deduced by Swiss astronomer Fritz Zwicky in 1933. The quest to find out what dark matter is made of, or whether it can be explained by tweaking the known laws of physics, is considered one of the most pressing questions in particle physics.

LZ will be at least 50 times more sensitive to finding signals from dark matter particles than its predecessor, the Large Underground Xenon experiment (LUX). The new experiment will use 10 metric tons of ultra-purified liquid xenon, to tease out possible dark matter signals. Xenon, in its gas form, is one of the rarest elements in Earth's atmosphere.

The fast-moving schedule for LZ will help it stay competitive with similar international dark matter detection experiments, the XENON1T experiment at Italy's Gran Sasso National Laboratory and China's PandaX-II. Both of these projects have a similar schedule and scale to LZ, though LZ participants are aiming to achieve a higher sensitivity to dark matter than the other contenders.

"The science is highly compelling, so it's being pursued by physicists all over the world," said Carter Hall, the spokesperson for the LZ collaboration and an associate professor of physics at the University of Maryland. "It's a friendly and healthy competition, with a major discovery possibly at stake."

LZ is designed so that if a dark matter particle collides with a xenon atom, it will produce a prompt flash of light. The light pulses are picked up by a series of about 500 light-amplifying tubes lining the massive tank, over four times more than were installed in LUX, which will carry the telltale fingerprint of the particles that created them.

UK scientists are contributing hardware for most subsystems and the vessels that will surround the liquid xenon are also the responsibility of the UK participants. They will be built with the world's most ultra-pure

titanium to reduce background noise.

Provided by Science and Technology Facilities Council