The Daya Bay Reactor Neutrino Experiment: On track to completion

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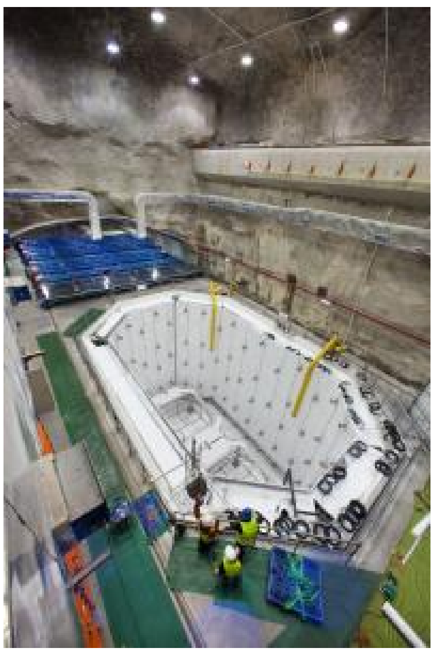
The building where the detectors are assembled is a class 1000 clean room; dust and even microscopic particles in the air are severely limited.

Berkeley Lab physicists and engineers are among the leaders of the unique Daya Bay Reactor Neutrino Experiment, where Chinese and American scientists, with colleagues from Russia, Taiwan, and the Czech Republic, have come together to investigate a peculiar phenomenon related to so-called neutrino mixing. Kam-Biu Luk of Berkeley Lab's Physics Division is Daya Bay's scientific co-spokesperson, with Yifang Wang of Beijing's Institute of High Energy Physics. Bill Edwards of the

Lab's Physics Division is the U.S. Project and Operations Manager.

What the researchers find at Daya Bay will bear on some of the most intriguing questions in basic physics: how much do different kinds of neutrinos weigh? And which kind is the heaviest? By weighing neutrinos scientists hope to learn how electrons and their cousins, muons and tau particles, came into existence in the moments after the big bang. The answers could explain why there is more matter than antimatter in the universe – and indeed why there is any matter at all.



The heart of the Near Hall is a pool of ultrapure water in which the antineutrino detectors will be submerged, shielded from radioactive decays in the surrounding rock by more than two meters of water on all sides. The pool is lined with PMTs to track any "stiff" (highly energetic) cosmic rays that make it all the way through the overlying rock. The blue supports beyond the pool indicate where a different kind of detector is being constructed, which will roll over the water pool like a roof and help locate the position of any cosmic rays that enter the water.

Clues to neutrino mass lie in measuring how one “flavor” of neutrino changes into another. (Electron neutrinos, muon neutrinos, and tau neutrinos, the three flavors, are named after the leptons with which each is associated.) The crucial value, written θ_{13}, is a term known as “neutrino mixing angle theta one three” – and the Daya Bay experiment is intended to measure it to within a few degrees. The following tour of the experimental site shows how the researchers hope to do it.

Provided by Lawrence Berkeley National Laboratory