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NEWS OF THE WEEK

PARTICLE PHYSICS:

Chinese Scientists Hope to Make Deepest, Darkest Dreams Come True

Dennis Normile

Particle physicist Yue Qian had his eureka moment in front of the TV set. For over a decade, Chinese scientists have longed for an underground laboratory that would enable them to join efforts across the globe to detect dark matter, observe neutrinos, and watch for exotic particle physics phenomena. Searches for suitable sites repeatedly came up empty-handed. But last August, after Yue caught a news report on the completion of two tunnels piercing Jinping Mountain in Sichuan Province, he felt that the long quest for such a lab might finally be over.

Going deep. Chinese scientists hope this tunnel will soon host a premier underground lab.

CREDIT: YUE QIAN

[Larger version of this image]

After months of negotiations, on 8 May Tsinghua University in Beijing, where Yue is an associate professor, signed an agreement with the tunnels' owner, Ertan Hydropower Development Co., to hollow out an experimental chamber. The Jinping lab would be the deepest underground science facility in the world, edging out—by 100 meters or so—the Deep Underground Science and Engineering Laboratory that the U.S. National Science Foundation may build in an abandoned mine in Lead, South Dakota. By placing sensors deep in the earth, physicists hope to reduce spurious signals from cosmic rays. China's subterranean aspirations have been circulating in Asia for months; the international community will get its first glimpse of the project at a dark-matter workshop in Shanghai on 15 June and at an astroparticle and underground physics conference in Rome next month.

An underground lab has been a dream for several generations of Chinese scientists, says Wang Yifang, a particle physicist at the Institute of High Energy Physics of the Chinese Academy of Sciences in Beijing. Past candidate sites, including an underground aviation museum near Beijing and coal and gold mines around the country, all were judged too shallow or impractical.

Jinping, on the other hand, "looks ideal," Wang says. The lab would have approximately 2500 meters of marble and sandstone above it: more shielding than any similar site in the world. Researchers will be able to make a 1-hour drive from a regional airport to the lab's front door. And the tunnels are sized for construction equipment, promising smooth delivery of instruments and supplies.

Short cut. Tunnels between the Jinping dams on the Yalong River offer a serendipitous lab site.

CREDIT: INTERNATIONAL WATER POWER & DAM CONSTRUCTION

[Larger version of this image]

Wang cautions that the lab is not a done deal. "It's really at a very early stage," he says. To start with, Yue's group must verify that the rock overburden really does screen out unwanted cosmic rays and that there is no unexpected radiation emanating from nearby rock or groundwater. To provide space for instruments, by the end of the year the team plans to have hollowed out a 5-meter-high, 5-meter-wide, 30-meter-long chamber. They will then measure cosmic ray flux and background radiation for about 6 months. And they will begin at least one experiment. Yue is forming a collaboration to install a germanium detector to search for a postulated component of dark matter known as WIMPs, or weakly interacting massive particles. Chinese physicists are also talking about observations of atmospheric and solar neutrinos as well as experiments to watch for neutrinoless double-beta decay, an extremely rare phenomenon that might help refine estimates of neutrino mass.

Yue doesn't yet know what the first phase will cost, as design efforts are just starting. "But [Tsinghua] university has promised strong support," he says, and they are seeking funds from the science ministry. If the project develops as hoped, says Yue, "we would want to get more universities and institutions from China and around the world to join us and push this project ahead."

The good fortune befell physicists thanks to a mammoth hydroelectric project about 350 kilometers southwest of Chengdu, the capital of Sichuan Province, where the Yalong River makes a 150-kilometer-long U-turn around Jinping Mountain. Ertan Hydropower is building two dams: Jinping 1 at the start of the U-turn and Jinping 2 at the end. To move workers and materials between the construction sites, Ertan blasted a pair of 17-kilometer-long access tunnels through the mountain. One will host the lab.

The hydropower project is controversial because some geologists think the weight of the impounded water could destabilize faults in the earthquake-prone region (*Science*, 8 May, p. 714). The prospect of an underground lab, though, is warmly welcomed by physicists throughout Asia. "It certainly is good news," says Henry Wong, a physicist at Academia Sinica in Taiwan, who will collaborate with Yue on the dark-matter experiment. Wong says he expects the lab to strengthen scientific ties between Taiwan and mainland China. Kim Sun Kee, a particle physicist at Seoul National University, is also enthusiastic. "Compared to other regions, in Asia, we don't have many underground labs," he says. Kim spearheads a collaboration hunting for dark matter in a lab in South Korea's

Jeombong Mountain (*Science*, 6 July 2007, p. 32). But the Korean lab is only 700 meters beneath the surface, and more sensitive detectors now being contemplated by the community would need better shielding. Jinping, says Kim, "will be a great place for next-generation experiments."

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