International cooperation

The Daya Bay experiment is a China-based multinational particle physics project studying neutrinos. It is one of the largest international projects in the field of basic research.

Jiangmen City of Guangdong Province is the best site for the Jiangmen Underground Neutrino Observatory.

The neutrino mass hierarchy is very important for our understanding of the evolution of the universe, the generation and propagation of Supernova neutrinos, and the oscillation of long baseline neutrinos. The precise measurements of 4 out of 6 neutrino mixing parameters also make it possible to check the validity of the neutrino mixing matrix and search for new physics.
Neutrino oscillation is a quantum mechanical phenomenon whereby a neutrino created with a specific lepton flavor (electron, muon or tau) can later be measured to have a different flavor.

What is a neutrino?

Neutrino is one of the fundamental particles that make up the universe. They are also one of the least understood. Neutrinos are a result of nuclear reactions in stars, in nuclear reactors, or when cosmic ray hits atoms.

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The Super-Kamiokande Collaboration announced the first evidence for neutrino oscillations (that one type can transmute into another type) in 1998. That was the first experimental observation supporting the theory that the neutrino has non-zero mass, a possibility that theorists had speculated for tens of years. Another two experiments (SNO and KamLAND) also observed clear evidence that neutrinos oscillate.

In the neutrino mixing matrix, all but two parameters have been measured: the smallest mixing angle, θ13, has implications for the CP-violating phase, δ13, the last mixing angle to be precisely measured, expresses how electron neutrinos (and their antineutrino counterparts) mix and change into other flavors. The number of electron antineutrinos that apparently vanish on many would be observed by the detectors in the far Hall if there were no oscillations. The number of muon antineutrinos that vanish would be 2/3 of the number of electron antineutrinos, and the number of tau antineutrinos that vanish would be 1/3 of the number of electron antineutrinos.

The accurate measurement of θ13 is of great importance to future physics research. In 2003, 7 countries in the world put forward 8 experimental proposals to measure θ13. Three of them, the Daya Bay Reactor Neutrino Experiment in China, the Double Chooz experiment in France, and the RENO experiment in Korea, were approved.

In the Daya Bay experiment, two halls were built near the reactor cores (near halls) and one hall is located far from the reactor core, respectively. The far Hall of Daya Bay is ideal for the MSW measurement.

The scheme of the experiment

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Civil construction of the tunnel and experiment halls

The Daya Bay nuclear reactor complex includes the reactors of the Daya Bay, Ling Ao, and Ling Ao-II Nuclear Power Plants. The reactor has a total thermal power of 17.6 GW, one of the largest in the world.

The tunnel and the experimental halls were designed by the Yellow River Engineering Consulting Co., Ltd., and the civil engineering was put forward 8 experimental proposals to measure θ13. Three of them, the Daya Bay Reactor Neutrino Experiment in China, the Double Chooz experiment in France, and the RENO experiment in Korea, were approved.

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The tunnel and the experimental halls were designed by the Yellow River Engineering Consulting Co., Ltd., and the civil construction was carried out by the China Railway 25th Bureau Group Corporation. Through the end of 2012, more than 3,000 blots were conducted, which met all the security requirements of the National Nuclear Safety Administration. A 3,200-m-long tunnel and the underground experimental halls were built.

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