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[Physics][International Cooperation] Taiwan's Cross-Institute Research Team in Physics Takes Part in Dayabay Neutrino Experiment, Trying to Explain the Asymmetry between Matter and Anti-matter

[Physics][International Cooperation] Taiwan's Cross-Institute Research Team in Physics Takes Part in Dayabay Neutrino Experiment, Trying to Explain the Asymmetry between Matter and Anti-matter (Chinese Version)

NTU Newsletter (Issue 1059) The Dayabay neutrino oscillation experiment is now ready to investigate the phantom of the particle physics – neutrino, from which some lasting puzzles around the basic particle physics and cosmology are aimed to get resolved. The first detector set has begun to operate, taking down the statistics of the antineutrinos produced in the nuclear power generator in Dayabay Power Plant. The Dayabay neutrino experiment is conducted by a team consisting of more than 200 researchers from 39 institutes in China, the U.S., Taiwan, Hong Kong, Russia and Czech. The researchers from Taiwan, consisting of members from National Taiwan University, National Chiao Tung University and National United University, are in charge of building the three-meter acrylic tube in the core of the antineutrino detector and the data acquisition system.

Neutrino is uncharged particle which can be produced via the nuclear reaction. The big bang, the core of a fixed star and a nuclear reactor are all the sources of a large number of neutrinos. Neutrinos can easily penetrate human bodies, buildings and even the entire globe without inducing any material reaction, so they are extremely difficult to observe. By now, the neutrinos are understood in three types named after their partner leptons in the Standard Model: electron neutrino, muon neutrino and tau neutrino, and the quantum mechanical phenomenon that a neutrino created with a specific lepton flavor (electron, muon or tau) can continuously be measured to have a different flavor during its transmission, is called “oscillation.” Neutrino oscillation is described with six factors, four of which can be measured in solar neutrinos, atmospheric neutrinos, reactor neutrinos and accelerator neutrinos. The last two factors, namely, neutrino mixing angle θ13 and phase angle d are not determined yet. By now, only the upper limit of the mixing angle θ13 has been measured in nuclear reactors, while whether the phase angle d could be measured in experiments still relies on the value of the measured mixing angle θ13. When the measured mixing angle θ13 has a value not too low, the phase angle can be obtained with long baseline neutrino experiment measures, and, consequently, we may find an explanation for the asymmetry between matter and anti-matter. Hence, the precise measurement of mixing angle θ13 becomes the most important issue in the contemporary neutrino physics, and the Dayabay experiment has the most precise measurement of θ13.

The experiment is conducted in the Dayabay Nuclear Power Plant in Shenzhen City, Guangdong Province, China, 55 km away from Hong Kong. The plant has three sets of nuclear generator and is one of the most efficient generating plants in the world. Eight neutrino detectors are placed in three sites, the Dayabay close site, the Ling-ao close site and the remote site. Both close sites are within 500 meters from the nuclear reactors, taking down the antineutrino flow data, while the remote site is two km away from the reactors, taking down the post-oscillation antineutrino flow data. With the data, the value of θ13 can be computed and obtained. The Dayabay close site has begun its operation since this August, while the Ling-ao close site will begin to work in this autumn. According to the plan, the three sites need to work for two to three years to reach the goal. The sites are built among mountains to increase the accuracy, for the rocky mountains can reduce the interference of cosmic rays.

Beside of the Dayabay experiment, the participant scientists from Taiwan also take parts in Hong Kong Aberdeen Tunnel experiment as well. The experiment is conducted by a team consisting of members from The University of Hong Kong , The Chinese University of Hong Kong, University of California, Berkeley, Brookhaven National Laboratory and Institute of High Energy Physics, Chinese Academy of Sciences. The underground tunnel experiment aims at creating a similar environment with Dayabay experiment's which can provide with various radiation backgrounds. The conduct of the experiment has already begun.

Further Information:
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