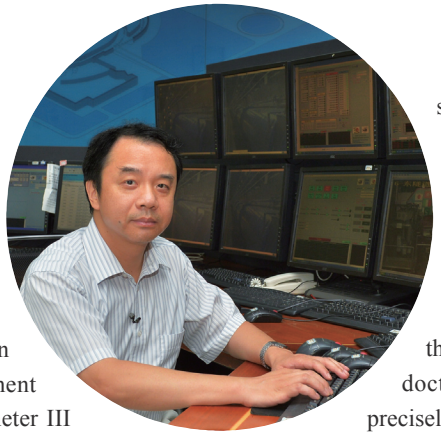
For A Neutrino Experiment of Our Own

By XIN Ling (Staff Reporter)



Fourteen years ago, following his dream of "doing China's own neutrino experiments", WANG Yifang left Stanford University to join the Institute of High Energy Physics (IHEP), Chinese Academy of Sciences. Today, he is leading two biggest particle physics groups in China: the neutrino detection experiment at Daya Bay and the Beijing Spectrometer III experiment on the Beijing Electron Positron Collider.

First recruited through the Hundred-Talent Program in 2001, WANG worked hard to deliver his neutrino dreams. Under his leadership, the Daya Bay international collaboration discovered a new type of neutrino oscillation in 2012 which was hailed as "the most important physics finding made by China since 1949". In 2013, he and coworkers in Beijing revealed a rare four-quark structure dubbed $Z_c(3900)$, opening a gateway to peep into the world of exotic particles predicted by the Standard Model.

As IHEP director and a leading figure in the Chinese particle physics community today, WANG regarded the Hundred-Talent Program to "have laid a solid foundation" for his research career in China, and led to the most exciting and remarkable particle physics leapfrog in the nation's history.

"A Neutrino Experiment of Our Own"

After graduating from the Department of Physics, Nanjing University in 1984, WANG was chosen by Samuel C. C. Ting to participate in the famous L3 Experiment. From there, he stepped into the world of high energy physics, a field unknown to many Chinese back then. From the University of Florence to the CERN in Geneva, he completed his graduate and postdoctoral studies under the supervision of Ting.

Working with more than 400 scientists from across the world in Geneva, WANG kept several records that marked his diligence and talents: author of three papers published in one year; the only student leader on the experimental physics team during his doctoral study; the one who managed to precisely measure the polarization of lepton tau to wow his coworkers.

However, with time passing by, he realized that for a top-class project like L3, everyone only worked as a small part of it and it would be difficult for young men like him to "grasp the whole picture".

For that reason, in 1996, he left the L3 Experiment to join a smaller scale neutrino project at Stanford University and soon became a key member of the group.

In 2000, he decided to go back to China. He gave up his Stanford position as a research associate, and settled down in Beijing – with the one biggest dream he has ever been holding on to: China's own neutrino experiments.

Experiments that Lead the World

Ambitious as WANG was upon his return, the research status at IHEP was somehow different from what he had imagined. Neutrino detection was not a hot field in China at that time. Instead, he was appointed to take charge of the upgrading project of the Beijing Spectrometer.

"As I look back, although neutrino has been my life-long aspiration, I still well cherished the chance to lead the Spectrometer's upgrading. I worked with various people in the institute; we had really nice communication and collaboration, which finally made us a highly efficient team. Without such cooperation, the Daya Bay project couldn't

have worked out so smoothly," he said.

"I came to know Yifang back in 1992, when we met in Italy," recalled WANG Huanyu, a coworker at IHEP. "I was impressed by his competence. He was not very talkative but always thinking about his research."

In the eye of SHEN Xiaoyan, the current spokeswoman for Beijing Spectrometer III, from technical design to personnel arrangement and fund spending, WANG demonstrated "superb organizational capability, especially the ability to communicate and collaborate with foreign colleagues."

Ten years of research in Europe and six years in the States gave WANG not only a strong academic background but also rich experiences in working with people from different fields.

With WANG as its chief designer, the Beijing Spectrometer III demonstrated a number of cutting-edge technologies and lursd hundreds of physicists across the globe to work on it.

At the same time, he was still holding tight to his neutrino dreams.

Around the year 2003, seven nations proposed different oscillation experiments to measure the last mysterious and the smallest neutrino mixing angle dubbed theta-13. One of them was WANG's idea to build a neutrino detector in the mountains near Daya Bay nuclear power plant on China's southeastern coast, Guangdong Province.

After three years of lobbying and fund collection, the Daya Bay project was finally approved. "I even put some of my Hundred-Talent grant in it," he revealed.

His idea even attracted sponsors from abroad. The US Department of Energy ended up suspending a similar plan of its own to turn to Daya Bay with 34 million dollar of funding.

The multinational team made up of about 200 physicists from six nations became the largest one of its kind in China's basic research sector at that time. And for the very first time, China was taking the leadership.

"We are confident about our design and research capacity. This is the kind of experiments I've always wanted to do," WANG said.

Daya Bay's success was embraced by the world. "This is a milestone in neutrino physics," applauded Antonio Ereditato, then spokesman of the OPERA collaboration in Italy. "Congratulations for the beautiful and fast data. You did it," wrote Giorgio Gratta, spokesman of the US' EXO-200 project in his letter to Wang.

The discovery was praised by T. D. Lee, Noble Laureate of Physics, as "a major achievement of fundamental importance in physics."

More Dreams Ahead

The neutrino magic shows staged by WANG and his group are far from ending. As a scientist with outstanding research aspiration and leadership, WANG is on his way toward a more ambitious dream that he envisions for three decades ahead: the Jiangmen Underground Neutrino Observatory (JUNO).

According to him, upon completion, JUNO will be the largest underground lab in China. Within a cylinder space of 50m in diameter and 70m in height, some 400 scientists from China, Europe and the United States will work together to hunt down the elusive neutrinos and pin down their mass hierarchy. Other scientific goals of JUNO include improving measurement precision and astrophysics studies on supernovas and solar neutrinos.

"The total investment of JUNO will come to 330 million dollars, tenfold what we spent on Daya Bay," WANG told *BCAS*. The groundbreaking of JUNO took place on January 10, 2015. "Hopefully the construction would wind up by the end of 2017, with all facilities installed for full operation by 2020."

JUNO is designed to operate for at least 20 years. It will be equipped with the world's biggest and most precise liquid scintillation detector for neutrino, which involves many technical challenges as well as opportunities. "We are looking forward to making such a big dream come true," WANG said.