Experimental Studies of Neutrino Oscillations, by Kajita, Takaaki, World Scientific Publishing, (2016), ISBN 978-981-4759-26-7 pp. 98, Price: 46.80.

In 2015 Takaaki Kajita and Arthur B. McDonald were awarded the Nobel Prize in Physics for the discovery of neutrino oscillations. To celebrate his achievement, World Scientific Publishing released **Experimental Studies of Neutrino Oscillations** which is a collection of papers by Kajita. These papers were previously published in various conference proceedings between 2000 and 2009. Because Kajita heads the Super-Kamiodande (Super-K) collaboration, the book predominantly presents results from the Japanese neutrino observatories.

The book summarizes the current status of the neutrino oscillation measurements and discusses the next-generation experiments. Neutrino oscillations were discovered by the Kamiokande detector (1988) when the measured ratio of muon to electron neutrinos from the atmosphere fell well below predicted values. This deficit could be explained by neutrino flavour oscillations which implies that neutrinos have nonzero mass. Ten years later, the larger Super-K detector measured the zenith angle dependence of the neutrino flux. The deficit of downward-moving muon neutrinos that travel 15 km from the upper atmosphere to reach the detector was minimal, whereas a large deficit was found for upward-moving muon neutrinos that travelled 12800 km through the earth before being detected. The Super-K data showed that muon neutrinos were oscillating to either tau neutrinos or hypothetical sterile neutrinos (neutrinos that interact with matter only via the gravitational force).

The collaboration was able to place experimental bounds on the flavour mixing angle and the mass-squared difference. Kajita also explains how the Sudbury Neutrino Observatory (SNO) and the Japanese experiment kamLAND studied the deficit of solar electron neutrinos. These measurements gave evidence of electron neutrino oscillations and led to experimental bounds on a second mixing angle and mass difference.

In the most recent Super-K measurements, the collaboration has searched for evidence of either solar or atmospheric neutrinos oscillating to sterile neutrinos. So far, there is no experimental evidence in favour of the sterile neutrino. The Tokai to Kamioka (T2K) experiment uses an intense beam of accelerator-produced neutrinos that is directed to Super-K 295 km away. T2K is currently trying to measure the third mixing angle which is thought to be very small. The collaboration will also attempt to find evidence of CP violation by looking for differences between neutrino oscillations and antineutrino oscillations. This project may require an even larger detector, called Hyper-Kamiokande. In addition to searching for CP violation, the next generation neutrino experiments will also attempt to determine the ordering of the mass eigenstates.

Experimental Studies of Neutrino Oscillations by Kajita provides a nice summary of the current state of neutrino oscillation physics and the goals of the next generation experiments. The conference papers included in the collection do not provide a lot of experimental details, but rather focus on the results of the measurements and their implications. Because the seven papers occur over a relatively short time, there tends to be substantial repetition. Overall the book is an interesting read, but someone interested in the past, present, and future of experimental neutrino oscillation physics may get more value out of a good review article.

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