THE T2K EXPERIMENT: THE NEXT GENERATION OF NEUTRINO OSCILLATION STUDIES*

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One of the most important recent developments in the field of elementary particle physics is the establishment of neutrino oscillations, in which neutrinos can transmute between three flavors as they propagate through space. The pattern of oscillations is determined by the masses of the neutrinos and a matrix that relates the neutrino flavors to the masses. Currently, there is an exciting world-wide program to elucidate the properties of neutrinos through further study of neutrino oscillations. In particular, one could probe the possibility of CP violation (differences in the oscillations of neutrinos and their antiparticle counterparts) as well as the mass ordering of the neutrinos. This in turn could have important implications for understanding how our universe came to its matter-dominated state, as well as the quest to have a unified understanding of the quarks and leptons which we believe to be the fundamental constituents of all matter.

The Tokai-to-Kamioka (T2K) experiment will study neutrino oscillations using an intense neutrino beam produced by the J-PARC accelerator complex north of Tokyo directed towards the Super-Kamiokande detector 295 km away. Canadian groups have a critical role in the experiment associated with the construction of a set of two detectors to determine the properties of the neutrino beam prior to any oscillation effects, a novel monitoring device using optical transition radiation to determine the properties of the proton beam delivered by the accelerator, and important components of the neutrino beamline itself. Construction of the beamline and detectors is underway, with data-taking commencing in 2009.

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