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Next Questions In Neutrino Physics with the NOvA and LBNE Experiments

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The discovery of neutrino mass in 1998 opened a new window of particle physics for exploration. Since then, we have learned much of this new landscape. We have learned that neutrinos are very light and that they mix in large combinations, unlike quarks which mixing only slightly, and we have, in some cases, precise, measurements of these mixings. Many questions, however, remain. Fermilab is embarking on a long term program to fully explore these remaining questions. The next major step will come from the NOvA experiment which will use beams of both muon neutrinos and muon antineutrinos and measure the rate of disappearance of these neutrinos from the beam as well as their oscillation probabilities to electron-type neutrinos. From these observations NOvA will probe unanswered questions of the neutrino mass hierarchy and the symmetries of the neutrino mixing, as well as make tests of the standard framework used to understand neutrino oscillations. Construction of the experiment is well underway and first data will begin when operation of the Fermilab accelerators resumes in June of this year. Beyond NOvA, planning for the next experiment, LBNE is underway. LBNE will expand the physics program started by NOvA by lengthening the neutrino flight distance to 1300 km and studying the oscillation probabilities over a wide range of energies. With a large detector located underground LBNE will target discovery of CP violation in neutrinos while also probing physics at the GUT scale through study of proton decay.

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