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Accelerator-based Neutrino Oscillation Studies: Present and Future

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The study of neutrino oscillations using accelerator-based beams is entering a renaissance. Experiments on three continents aim to elucidate the nature of this phenomenon in its entirety as part of a world-wide program involving both accelerator and non-accelerator techniques. Neutrino oscillations represent the first evidence of physics beyond the Standard Model; the results will have profound implications for not only particle physics, but our understanding of how the universe evolved to its current state. The MINOS and upcoming OPERA and ICARUS experiments aim to confirm our understanding of the atmospheric neutrino phenomenon via oscillations and precisely measure its parameters. These experiments will be followed by the T2K and proposed NOvA experiments, which will search for a third, as-yet unobserved mode of oscillation that may hold the key towards understanding how antineutrinos differ from neutrinos and the hierarchy of their masses. Meanwhile, MiniBooNE at Fermilab is searching for oscillations indicated by the LSND experiment that would indicate a complete break from the Standard Model. Such new physics could take the form of heretofore unseen sterile neutrinos or exotic forms of symmetry breaking that would dramatically change the landscape of particle physics.