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A Search for Large Extra Dimensions in MINOS and MINOS+

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The MINOS experiment was designed to study neutrino oscillation between two scintillator-steel tracking-sampling calorimeters separated by a 734 km baseline using muon neutrinos and antineutrinos generated in the NuMI facility at Fermilab. Running for ten years with a neutrino beam peak energy of 3 GeV, MINOS yielded some of the best constraints on the atmospheric neutrino oscillation parameters to date. The MINOS+ experiment subsequently ran for about three years using a neutrino beam designed for the NOνA experiment, increasing the beam peak energy to about 6 GeV. This shift to higher neutrino energies improves the sensitivity to exotic phenomena such as large extra dimensions. Assuming the existence of large extra dimensions, sterile neutrinos can arise as Kaluza-Klein states. Mixing between the active neutrinos and Kaluza-Klein states alters the standard three-flavor oscillation probabilities, allowing neutrino oscillation measurements to constrain the size of large extra dimensions. Using MINOS ν_μ data corresponding to 10.6×10^{20} protons on target (POT), the size of large extra dimensions is constrained to be smaller than $0.45 \ \mu$m at 90\%,C.L. in the limit of a vanishing lightest active neutrino mass. To date, this is the strongest limit from a neutrino oscillation experiment. This result will be presented together with the status of the MINOS+ large extra dimension search.

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