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Here Comes the Sun: Solar Parameters in Long-Baseline Accelerator Neutrino Oscillations

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Long-baseline (LBL) accelerator neutrino oscillation experiments, such as NOvA and T2K in the current generation, and DUNE-LBL and HK-LBL in the coming years, will measure the remaining unknown oscillation parameters with excellent precision. These analyses assume external input on the solar parameters, θ_{12} and Δm^2_{21}, from solar experiments such as SNO, SK, and Borexino, as well as reactor experiments like KamLAND. Here we investigate their role in long-baseline experiments. We show that, without input on solar parameters, the sensitivity to detecting and quantifying CP violation is significantly, but not entirely, reduced. Thus long-baseline accelerator experiments can actually determine the solar parameters, and thus all six oscillation parameters, without input from \emph{any} other oscillation experiment. In particular, Δm^2_{21} can be determined; thus DUNE-LBL and HK-LBL can measure both the solar and atmospheric mass splittings in their long-baseline analyses alone. While their sensitivities are not competitive with existing constraints, they are very orthogonal probes of solar parameters and provide a key consistency check of a less probed sector of the three-flavor oscillation picture. Furthermore, we also show that the true values of the solar parameters play an important role in the sensitivity of other oscillation parameters such as the CP violating phase δ.

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