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Neutrino Effects on Atomic Measurements of the Weinberg Angle

Atomic parity violation (APV) provides a unique determination of the weak mixing angle ($\sin^2\theta_W$) at low energies and therefore serves as a powerful precision test of the Standard Model. We show that previous APV calculations omitted a class of one-loop contributions arising from two-neutrino exchange, commonly referred to as "the neutrino force". We compute this contribution to APV and find that its effect is comparable to the current experimental sensitivity. Remarkably, incorporating this previously neglected contribution shifts the APV-extracted value of $\sin^2\theta_W$ toward the Standard Model prediction, thereby alleviating the existing (mild) tension between APV measurements and the Standard Model.

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