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Weak mixing angle at direct detection

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Current ton-scale direct detection experiments have begun observing solar neutrinos. We probe the weak mixing angle using existing direct detection data. Leveraging recent measurements of ^{8}B solar neutrinos via coherent neutrino-nucleus scattering by PandaX-4T and XENONnT, we demonstrate that these experiments can probe the weak mixing angle in a region complementary to that of dedicated neutrino experiments. Furthermore, we show that the current XENONnT electron recoil data can probe the weak mixing angle through neutrino-electron scattering, in a momentum transfer region over an order of magnitude smaller than that explored by atomic parity violation experiments. Our findings reveal significant potential for probing a key Standard Model parameter in a completely new energy regime through the observation of neutrinos in future direct detection experiments.

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