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Constraining Non-Standard Neutrino Interactions with Solar Neutrinos in Existing and Future Neutrino and Dark-Matter Experiments

In the standard model of particle physics (SM), the neutrino is an elementary particle that is significantly lighter than other massive particles and can exist in one of three flavor or mass states. Because of this, neutrinos can change states as they undergo a process called neutrino oscillations. Neutrino-oscillation parameters have been measured in many experiments and are mostly consistent with SM. Neutrino oscillations are also modified by matter, an effect that can be further altered by the presence of non-standard neutrino interactions (NSI). NSI are interactions that are not predicted by SM and can change existing reactions or result in new ones. In this work, we propose to use neutrinos that originate in the Sun to study NSI, as the core of the Sun is a dense medium that produces a high flux of neutrinos and where matter oscillations are significant. Additionally, a discrepancy exists between neutrino-oscillation measurements conducted with solar neutrinos and neutrinos generated by nuclear reactors. One of the potential explanations for this discrepancy is NSI with certain couplings. We consider existing and future neutrino and dark-matter experiments where solar neutrinos could be observed as an opportunity to improve our knowledge of neutrino interactions and constrain NSI.

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