Sensitivity of direct detection experiments to neutrino magnetic dipole moments

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Abstract

With large active volume sizes dark matter direct detection experiments are sensitive to solar neutrino fluxes. Nuclear recoil signals are induced by ^8B neutrinos, while electron recoils are mainly generated by the pp flux. Measurements of both processes offer an opportunity to test neutrino properties at low thresholds with fairly low backgrounds. In this work we study the sensitivity of these experiments to neutrino magnetic dipole moments assuming 1, 10 and 40 tonne active volumes (representative of XENON1T, XENONnT and DARWIN), 0.3 keV and 1 keV thresholds. We show that with nuclear recoil measurements alone a 40 tonne detector could be as competitive as Borexino, TEXONO and GEMMA, with sensitivities of order $8.0\times10^{-11}\ \mu_B$ at the 90% CL after one year of data taking. Electron recoil measurements will increase sensitivities way below these values allowing to test regions not excluded by astrophysical arguments. Using electron recoil data and depending on performance, the same detector will be able to explore values down to $4.0\times10^{-12}\mu_B$ at the 90% CL in one year of data taking. By assuming a 200-tonne liquid xenon detector operating during 10 years, we conclude that sensitivities in this type of detectors will be of order $10^{-12}\ \mu_B$. Reducing statistical uncertainties may enable improving sensitivities below these values.

Referencias

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