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Spin-dependent dark matter-electron interactions

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Detectors with low thresholds for electron recoil open a new window to direct searches of sub-GeV dark matter (DM) candidates. In the past decade, many strong limits on DM-electron interactions have been set, but most on the one which is spin-independent (SI) of both dark matter and electron spins. In this work, we study DM-atom scattering through a spin-dependent (SD) interaction at leading order (LO), using well-benchmarked, state-of-the-art atomic many-body calculations; and derive exclusion limits with experiments data. The detector's responses to the LO SD and SI interactions are analyzed. In non-relativistic limit, a constant ratio between them leads to an indistinguishability of the SD and SI recoil energy spectra. Relativistic calculations however show the scaling starts to break down at a few hundreds of eV, where spin-orbit effects become sizable.

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