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Atomic Compton scattering effect on direct dark matter detection

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Atomic Compton scattering effect significantly contributes to low-energy electronic recoils below its k-shell energy for the direct dark matter detection. Searches on ADM models, dark photon models, leptophilic dark matter models as well as the conventional WIMPs for background understandings are vitally required to clarify the effect. We employed the relativistic impulse approximation (RIA) together with the ab initio Multiple-configuration Dirac-Fock theory to obtain the atomic Compton scattering [1] for Germanium (Ge) Silicon (Si) and Xenon(Xe) atoms. Comparisons on low momentum transfer regions with our calculations for Ge and Si are achieved. [2] In addition, millicharged dark matter particles estimated by RIA in the atomic ionization for Ge and Xe has been evaluated. [3] A factor-of-two discrepancy on the incoherent-scattering factor(Scattering Function) near 100 eV momentum transfer with the Ge system between our calculation and the latest version of Geant4 simulation data is observed. Plans on the experimental verification and the perspectives of the atomic Compton scattering effect for the direct detections will be discussed.

[1]C.K.Qiao et al., Journal of Physics B: Atomic, Molecular and Optical Physics, 53(07), 075002 (2020)
[2] C.K.Qiao et al., Journal of Physics G 47, 4, 045202(2020)
[3] C.K.Qiao et al., Journal of High Energy Physics, 03, 184 (2021)

Reference to paper (DOI or arXiv)

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