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Density-functional theory description of xenon for dark matter-electron scattering in liquid xenon targets

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We explore the effect of the interatomic interactions in the condensed phases of xenon on the dark matter-electron scattering process, with a focus on applications in liquid xenon detectors. We calculate the electronic structure of atomic, liquid and solid Xe using first-principles density functional theory (DFT), then compute material response functions for the dark matter-electron scattering process within an effective field theory framework. Finally, we use experimental data from XENON10 and XENON1T experiments to compare exclusion limits obtained for isolated atoms and for the condensed phase. Our results allow us to assess the impact of the interatomic interactions on dark matter-electron scattering in liquid xenon.

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