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Halo-independent tests of direct detection signals

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From an assumed signal in a Dark Matter (DM) direct detection experiment a lower bound on the product of the DM–nucleon scattering cross section and the local DM density is derived, which is independent of the local DM velocity distribution. This can be combined with astrophysical determinations of the local DM density. Within a given particle physics model the bound also allows a robust comparison of a direct detection signal with limits from the LHC. Furthermore, the bound can be used to formulate a condition which has to be fulfilled if the particle responsible for the direct detection signal is a thermal relic, regardless of whether it constitutes all DM or only part of it. We illustrate the arguments by adopting a simplified DM model with a Z mediator and assuming a signal in a future xenon direct detection experiment.

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