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Determining the WIMP Mass from Direct Dark Matter Detection Data

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Weakly interacting massive particles (WIMPs) are one of the leading candidates for Dark Matter. Currently, the most promising method to detect many different WIMP candidates is the direct detection of the recoil energy deposited in a lowbackground laboratory detector due to elastic WIMP-nucleus scattering. So far the usual procedure has been to predict the event rate of direct detection of WIMPs based on some model(s) of the Galactic halo from cosmology and of WIMPs from the elementary particle physics. This can be used to e.g. estimate the mass of halo WIMPs only by fitting the predicted recoil spectra to future experimental data. Now we develop a model-independent method to determine the WIMP mass by directly using experimental data (i.e., the recoil energies) of direct detection. This method is independent of the as yet known WIMP density near the Earth as well as of the WIMP-nuclear cross section. Moreover, according to our simulations, we can already get meaningful information about the WIMP mass from less than one hundred events.

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