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Highly Improved Direct Detection Rate Calculation

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I introduce a new method for calculating the dark matter (DM) scattering rate in a directionally sensitive detector, which for the most complicated analyses can be multiple orders of magnitude faster than previous approaches. The new method projects each ingredient of the rate calculation, such as the DM velocity distribution, onto a basis of orthogonal functions. This reduces the rate calculation to an exercise in matrix multiplication, where previously it required high-dimension numeric integration. Thanks to this factorization, it is easy to perform the rate calculation on an ensemble of velocity distributions: e.g. to propagate the astrophysical uncertainties to the constraints on DM models, or to use results from galactic scale N-body simulations. I conclude with a preview of the soon-to-be released code that performs the needed calculations.

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