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The neutrino roof

I identify the maximum cross sections probed by single-scatter "WIMP" searches in dark matter direct detection. Due to Poisson fluctuations in scatter multiplicity, these ceilings scale logarithmically with mass for heavy dark matter and often lie in regions probed by multiscatter searches. I will present a generalized formula for single-scatter event rates, and use it to recast WIMP searches by the quintal-to-tonne scale detectors XENON1T, XENONnT, LZ, PANDAX-II, PANDAX-4T, DarkSide-50 and DEAP-3600 to obtain ceilings and floors up to a few 10^{17} GeV mass and 10^{-22} cm^2 per-nucleus cross section. Future large-exposure detectors would register an almost irreducible background of atmospheric neutrinos that would determine a dark matter sensitivity ceiling that I dub the "neutrino roof", in analogy with the well-studied "neutrino floor". Accounting for this background, I will show the reaches of the $10-100$ tonne scale DarkSide-20k, DARWIN/XLZD, PANDAX-xT, and Argo, which would probe many decades of unconstrained parameter space up to the Planck mass, as well as of $10^3 - 10^4$ tonne scale noble liquid detectors that have been proposed in synergy with neutrino experiments. I will round up with ideas on how to raise single-scatter ceilings by orders of magnitude.

Track type

Dark Matter

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