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Extending dark matter searches in liquid xenon to single scintillation photons

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Dark matter experiments searching for weakly interacting massive particles (WIMPs) probe a variety of rare processes leading to $O(\text{keV})$ energy transfers to ordinary matter. Two-phase xenon detectors record two different signals per interaction: a prompt scintillation response (S1) and a delayed signal from ionisation (S2), with the energy threshold of standard analyses (S1+S2) largely determined by the S1 signal. We present a novel WIMP search analysis of LUX data from 2013, using a class of events with an S1 consisting of a single detected scintillation photon. This exploits a feature in the response of photomultiplier tubes to vacuum ultraviolet light which brings additional sensitivity for light WIMP interactions. We present also a projected WIMP sensitivity for the forthcoming LUX-ZEPLIN (LZ) experiment, with a lower S1 threshold achieved through the same analysis technique.

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