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Single photon counting for the DEAP dark matter detector

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DEAP-3600, comprised of a 1 tonne fiducial mass of ultra-pure liquid argon, is designed to achieve world-leading sensitivity for spin-independent dark matter interactions. DEAP-3600 measures the time distribution of scintillation light from the de-excitation of argon dimers to select events. This measurement allows background events from Ar39 decays to be rejected at a high level. The performance of this analysis critically relies on DEAP's ability to identify pulses in the waveforms of the photomultiplier tubes and accurately assessing the number of photo-electrons contributing to each pulse. Photomultiplier tube effects, such as dark noise and afterpulsing, can degrade the measurement and weaken the level of background discrimination. An algorithm has been developed for finding pulses and identifying the number of photo-electrons.

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