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Calibration of the DEAP-3600 photomultiplier tubes

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The DEAP detector uses 255 photo multiplier tubes (PMTs) to detect the faint scintillation light from possible WIMP interactions in liquid argon. A photoelectron released when a scintillation photon strikes the front face of the PMT is amplified inside the PMT, and the resulting single-photoelectron (SPE) charge signal recorded. Due to random fluctuations in the amplification process, the distribution of SPE charge signals is not a sharp line, but a broad bump with a shape unique to each PMT.

Knowing the shape of the SPE charge distribution, any measured signal can be related back to the number of photons that struck the PMT. Especially when working with more than one PMT, this normalization between PMTs is crucial to ensuring good energy resolution and to minimize systematic effects on the energy calibration.

We present the SPE charge distribution measurement techniques, and a physical model to describe this distribution, as used for calibration of the DEAP-3600 PMTs.

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