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Performance of an X-γ ray detection system based on a thick silicon LGAD

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The performance of a 300 um thick silicon low-gain avalanche diode (LGAD) as X-γ ray detector has been experimentally acquired and studied in detail. The LGAD can operate with multiplication gains between $M_s = 10$ and $M_s = 20$, at which a wide energy range X-γ ray spectroscopy using a ^{241}Am radiation source has been done. It is shown that the main contribution to the FWHM of the spectral lines is the statistical noise of the charge multiplication inside the LGAD structure, while the other electronic noise components associated to the detector, interconnections and charge amplifier have been found to give minor contributions. The excess noise affecting the spectral line widths is found to be proportional to the multiplication gain M_s, while the series noise components (white and 1/f) reduce with increasing M_s. Consequently, the LGAD structure shows a significant shortening of the optimum peaking time, resulting in an improved X-ray spectroscopy performance with respect to an equivalent standard detector for fast signal processing.

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