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Statistical analysis and correction of the pile-up effect in MAPMT single photoelectron counting with the SPACIROC-3 ASIC: application to the Mini-EUSO experiment

We present a comprehensive study addressing pile-up effects in single photoelectron counting with multianode photomultiplier tubes (MAPMTs) equipped with the SPACIROC-3 ASIC. Extended dead time in the electronics causes saturation and quenching of the counting rate, an effect we counter by inverting the saturation curve once the double pulse resolution is determined. Our work combines extensive numerical simulations with experimental validations to quantify the statistical uncertainties associated with the corrected event rates. We apply this methodology to the data of the Mini-EUSO experiment onboard the International Space Station. Machine learning techniques are employed to extract pixel-by-pixel double pulse resolutions from long-term photon count histograms. This integrated approach enables the accurate recovery of true photon fluxes essential for studying ELVES, meteors and other transient phenomena detected by Mini-EUSO.

Collaboration(s)

JEM-EUSO Collaboration

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