A novel approach for modeling the cluster detector and the SPI spectrometer

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A probabilistic approach has been presented for modeling a general composite detector. If we consider the full energy peak counts (from single and multiple module interactions), and the decomposition of background counts to counts corresponding to the escaping gamma-rays and counts for gamma-rays which could be recovered in the addback mode, it is observed that the operation of a composite detector could be understood in terms of a few probability amplitudes and a parameter. Considering up to triple detector hit events, we have obtained expressions for peak-to-total and peak-to-background ratios of the cluster detector [1], which consists of seven hexagonal closely packed encapsulated HPGe detectors. The formalism has been extended to the SPI spectrometer [2] which is a telescope of the INTEGRAL satellite and consists of nineteen hexagonal closely packed encapsulated HPGe detectors.

Using available experimental data on cluster detector, predictions for the peak-to-total ratio have been given for energy region having no direct experimental information about them. The predictions for the fold distribution are found to be in agreement with the experimental data. Our formulation [3 – 8] does not include ad-hoc fits, but expressions that are justifiable by probability flow arguments. Instead of using an empirical method or simulation, we present a novel approach for calculating the peak-to-total ratio of the cluster detector and the SPI spectrometer for high gamma energies. Our work could provide a guidance in designing new composite detectors and in performing experimental studies with the SPI spectrometer for high energy gamma-rays.

References:

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