Pile-up discrimination algorithms for the HOLMES experiment

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The HOLMES experiment is a new large scale experiment for the electron neutrino mass determination by means of the electron capture (EC) decay of 163Ho. In such experiment, random coincidence events are one of the main sources of background which impairs the ability to identify the effect of a non-vanishing neutrino mass. In order to resolve these spurious events, detectors characterized by a fast response are needed as well as pile-up recognition algorithms. For that reason, we have developed a code for testing the discrimination efficiency of various algorithms in recognizing pile up

events in dependence of the time separation between two pulses. The tests are performed on simulated realistic TES signals and noise. Indeed, the pulse profile is obtained by solving the two coupled differential equations which describe the response of the TES according to the Irwin-Hilton model. To these pulses, a noise waveform which takes into account all the noise sources regularly present in a real TES is added. The amplitude of the generated pulses are distributed as the 163Ho calorimetric spectrum. Furthermore, the rise time of these pulses has been chosen taking into account the constraints given by both the bandwidth of the microwave multiplexing read out with a flux ramp demodulation and the bandwidth of the ADC boards currently available for ROACH2. Among the different rejection techniques evaluated, the Wiener Filter technique, a digital filter to gain time resolution, has shown an excellent pile-up rejection efficiency. The obtained time resolution closely matches the baseline specifications of the HOLMES experiment.
We report here a description of our simulation code and a comparison of the different rejection techniques evaluated.