Overview

HOLMES is an experiment with the aim to directly measure the neutrino mass. HOLMES will perform a calorimetric measurement of the energy released in the Electron Capture decay of the artificial isotope \(^{163}\)Ho. 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 with fast response and pile-up recognition algorithms are needed. We have developed a code for testing the discrimination efficiency of a Singular Value Decomposition algorithm. This algorithm is based on the work of Alpert et al. (J. Low Temperature Phys., Vol 184 (2016)). The obtained time resolution closely matches the baseline specification of the HOLMES experiment.

Simulations of TES response

- Noise profile from the Irwin Hilton 1-body model
- Autoregressive Moving Average (1,1)
- Pulse profile obtained by solving three coupled differential equations (2-body model) + correction on the energy
- Only 52% of the energy is converted into the current pulse
- Fourth order Runge-Kutta method
- Non-linear behavior taken into account
- Sampling rate: 500 kHz

Simulation goal:
- Estimate the time resolution with our current analysis algorithms
- Raw filters, Optimized filter shape parameters (OFTVL+), Singular Value Decomposition (SVD)

Simulation details:
- Treast.ic pulse data
- Simulated pulses equal to the one obtained in our previous measurements
- Simulate energies according to the one and two hole electron excitation spectrum...
- with a 300 Hz activity (61% single pulses, 31% double p., 6% triple p., 2% quadruple p.)
- + 70000 events simulated (~1 h measure, one detector)
- Energies only from the Ho spectrum (no external source)

TES parameters

- \( \beta = 2.83 \) keV
- \( \nu = 10^{-6} \) eV
- \( E_{\text{EC}} = 2.833 \) keV
- \( \sigma = 0.01 \) eV
- Expected sensitivity \( \sigma_{\nu} < 2 \) eV

Results:

- \( \Delta T = \text{time interval between two consecutive pulses} \)
- \( \eta_{\text{pup}} = \text{fraction of events identified as pup} \)

\( \tau_{\text{eff}} \) is an effective time resolution
- It is the ratio of number of retained pup pulses to single pulses, divided by half ratio of original events
- Times 10 µs