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Novel analysis techniques for neutrino and dark-matter experiments with the DIANA framework

Elusive particles like low-energy neutrinos and dark matter candidates require extremely sensitive detectors to be revealed. In experiments probing nuclear recoils, induced by sub-GeV dark matter particles or $\text{CE}\nu\text{NS}$, a low energy threshold and minimal backgrounds are mandatory. For these purposes, an advanced offline analysis of triggered pulses from the detector stream can make a significant difference.

The DIANA analysis software offers a portable, fast and open-source toolkit for low-energy physics analysis, featuring sophisticated signal processing techniques and utilities for higher level data fitting and analysis.

The software has been recently upgraded with modified versions of the matched filter, a digital filter for the amplitude estimation of a single waveform. Combining signals from different sensors with a multidimensional matched filter, it is possible to lower the detector energy threshold, and an advanced analysis of the signal shape can aid in signal/background discrimination.

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