Algorithms for identification of nearly-coincident events in calorimetric sensors

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For experiments with high arrival rates, reliable identification of nearly-coincident events can be crucial. For calorimetric measurements to directly measure the neutrino mass such as HOLMES, unidentified pulse pile-ups are expected to comprise a leading source of experimental error. Although Wiener filtering can be used to recognize pile-up, it suffers some errors due to pulse-shape variation from both detector nonlinearity and readout dependence on sub-sample arrival times. Since the underlying assumptions of Wiener filtering are not precisely fulfilled, we are exploring other processing methods that exploit tools from numerical analysis such as singular value decomposition and from machine learning such as support vector machines to construct better classifiers and also to assess what discrimination performance is possible in principle.

We show that the resulting processing advances can reduce the required performance specifications of the detectors and readout system or, alternatively, enable larger sensor arrays and better constraints on the neutrino mass. The new methods also offer potential for improved filtering of retained, mildly piled-up pulses.