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Precision modeling and readout of germanium detector waveforms for MCMC machine learning

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The Majorana Demonstrator is a neutrinoless double-beta decay experiment using high purity p-type point contact germanium detectors. The waveforms produced by these detectors have subtle variation indicating the detailed energy and drift path information for each event. In addition, the waveforms depend sensitively on crystal impurity levels, temperature, and operating voltage. We have developed a machine learning algorithm which, given a set of calibration waveforms, can infer detector parameters. Once these parameters are known, the high precision detector model can be used to fit the drift paths of individual waveforms. This method can be used as a sensitive background rejection technique for the Demonstrator or the proposed future LEGEND experiment. In order to reach specific physics goals, the design of readout instrumentation must be considered. The development of data acquisition technology for the Demonstrator and future experiments is discussed.

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Description

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