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New Pulse Processing Algorithm for SuperCDMS

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SuperCDMS searches for dark matter in the form of Weakly Interacting Massive Particles (WIMPs) with cryogenic germanium detectors. WIMPs interacting with atomic nuclei deposit energy in form of lattice vibrations (phonons) which propagate through the cylindrical Ge single crystal (75 mm diameter, 25 mm high) until they are absorbed by the phonon sensors covering part of the flat surfaces of the crystal. A fraction of the phonons are absorbed when they first reach the surface; a large fraction, however are reflected numerous times leading to a homogeneous distribution in the crystal. This leads to a pulse shape with an initial sharp pulse whose amplitude depends on the distance between the interaction side and the individual sensor, followed by a slow pulse which is identical for all sensors. Traditionally CDMS has used an optimal filter algorithm to extract energy information, but the different pulse shapes lead to a noticeable position dependence on the reconstructed energy. A modification of this algorithm de-weights the initial part leading to a considerably improved energy resolution. A combination of both methods has been used to determine energy and position information. We developed a new algorithm which accounts for the pulse shape by fitting two pulse templates simultaneously to each pulse, one for the position dependent sharp peak and one for the position independent slow pulse. This algorithm has the potential to improve the energy and position resolution while reducing the overall processing time. We will present a first study of the performance of this algorithm.

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