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Data analysis challenges with low-temperature microcalorimeters (a review)

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Low-temperature microcalorimeters for x rays and gamma rays can have energy resolving powers in excess of one thousand and can cover a very broad energy range. They will achieve their ultimate potential, however, only if we take great care in the analysis of their data. To estimate pulse sizes, we must use statistically optimal weighting of the data in the presence of non-white—and possibly non-stationary—noise. Nonlinear conversions from pulse size to photon energy must be estimated with a separate calibration for each sensor. We must ensure that all systematic errors and sources of cross-talk are eliminated or corrected to the level of hundredths of one percent. Uncertainties in the energy calibration must be kept below this level, too, for many applications. Furthermore, we would very much like to perform all of the analysis in real time, to the extent it is possible.

Several factors, including the complex analysis steps; our lack of *a priori* knowledge about calibration, noise, and systematics; the high data rates; and our need for rapid results, combine to create a particularly difficult data analysis problem. While this problem is far from solved, we are optimistic that it will be solved. I will describe some active areas of research into analysis techniques that promise to help us overcome the challenges inherent in the conversion of raw microcalorimeter data into high-quality spectra of photon energies.

Less than 5 years of experience since completion of Ph.D

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