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Progress Toward Improving Analysis of TES X-ray Data Using Principal Component Analysis

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The traditional method of applying a digital optimal filter to measure x-ray pulses from transition-edge sensor (TES) devices does not achieve the best energy resolution when the signals have a highly non-linear response to energy, or the noise is non-stationary during the pulse. We present an implementation of a method to analyze x-ray data from TESs that is based upon principal component analysis (PCA). Our method separates the x-ray signal pulse into orthogonal com- ponents that have the largest variance. We typically recover pulse height, arrival time, differences in pulse shape, and the variation of pulse height with detector temperature. These components can then be combined to form a representation of pulse energy. An added value of this method is that by reporting information on more descriptive parameters (as opposed to a single number representing energy) we generate a much more complete picture of the pulse received. Here we report on progress in developing this technique for future implementation on

x-ray tele- scopes. We used an 55Fe source to characterize Mo/Au TESs. On the same data set, the PCA method recovers a spectral resolution that is better by a factor of two than achievable with digital optimal filters.