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A compact, low-cost, high-resolution monochromatic X-ray source for characterization of X-ray calorimeter arrays

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X-ray calorimeters routinely achieve very high spectral resolution, typically a few eV. Unfortunately, the core line shape is usually dominated by the natural line width of most laboratory calibration sources. This compounds the data acquistion time necessary to statistically sample the instrumental line broadening, and can add systematic uncertainty if the intrinsic line shape of the source is not well known. To address these issues, we have built a simple, low-cost monochromatic X-ray source using channel-cut crystals. A commercial X-ray tube illuminates a pair of channel cut crystals which are aligned in a dispersive configuration for the K alpha line of the anode material. The entire device, including X-ray tube, can be easily
hand carried by one person and may be positioned manually or using a mechanical stage. The output monochromatic beam provides a collimated image of the 110 micron anode spot in the dispersion direction, and is unfocused in the cross-dispersion direction, so that the source image in the detector plane appears as a line. The theoretical FWHM energy
resolution of the monochromator is better than 0.2 eV for Cr K alpha and 0.1 eV for Cu K alpha. We characterize the monochromator line width using high resolution X-ray calorimeter data, and we show applications to detector development, as well as the characterization of the Astro-H Soft X-ray Spectrometer.