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Development of fine-pitch high-resolution hybrid TES microcalorimeter arrays toward the Lynx X-ray microcalorimeter

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We are developing hybrid transition-edge sensor (TES) microcalorimeter arrays for next generation X-ray satellite missions such as the Lynx X-ray microcalorimeter. The Lynx mission is one of four flagship mission concepts currently being studied for consideration in the National Academy of Science 2020 decadal survey. The proposed Lynx design combines a subarcsecond X-ray optic with a microcalorimeter imaging spectrometer incorporating ~100,000 pixels. The baseline design of the Lynx X-ray Microcalorimeter is a hybrid array consisting of three TES sub-arrays: main array, enhanced main array, and ultra-high-resolution array. The main array will provide 3 eV energy resolution over the 0.2–7 keV energy band with 1" pixels for 5'× 5' field of view (FOV). The enhanced main array is placed at the center of the main array and covers 1' × 1' FOV with 0.5" pixels, which will provide 1.5 eV energy resolution over the same energy band. The ultra-high-resolution array, which is placed beside the main array, covers 1' × 1' FOV with 1" pixels and will provide 0.3 eV over the 0.2–0.75 keV energy band. To match with the subarcsecond angular resolution, the pixel pitch is 50 μm for the main array and the ultra-high-resolution array and 25 μm for the enhanced main array. To reduce the number of sensors, the main array and the enhanced main array are position sensitive 5×5 multi-absorber 'hydra' microcalorimeters. Our prototype hydra array achieved 2.5±0.9 eV full-width-half-maximum (FWHM) and 3.4±1.0 eV FWHM at 1.25 keV for the 25 μm and 50 μm pitch pixels respectively, and the prototype for the ultra-high-resolution array achieved 0.3 eV FWHM at 3 eV. We will report the requirements to the detector, the concept of our detector design, and the recent achievements we have made.