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Process development for dual-thickness, multi-absorber x-ray microcalorimeter arrays

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We are developing new focal plane arrangements of x-ray microcalorimeters to meet the needs of future instruments for x-ray astrophysics. The prototype focal plane for Lynx, a mission concept for an x-ray telescope, requires the flexibility to image large areas with moderate resolution across the 6 keV x-ray band while also imaging point sources with very high resolution for soft x-rays. Integration of multiple types of microcalorimeter into the same focal plane can lead to fabrication challenges. We tackle the large area array through a combination of 25 and 50 micron absorber pixels grouped with twenty-five thermal links to one TES (the Hydra design) and use a demonstrated high energy resolution detector design with a relatively small TES and an absorber thickness of 4 microns of Au. We use thermal links with micron-scale widths to keep the heat capacity of the thermal distribution network a relatively small fraction of that of the device. The narrow wires of Ti/Au are tuned to a target resistance of 20 mOhm/sq. We evaluate the width dependent resistance of the wires and their tendency to anneal to determine what impact those effects will have on the ultimate design. To address the array with ultrahigh resolution capability, we reduce the thickness of the absorber to as low as one micron. We show a substitution of photoresist with an AlOx hardmask enables fine gaps between these absorbers as narrow as 1 micron. Integration of this hardmask with a conventional photoresist mask enables ion mill definition of 4 micron and 1 micron absorbers in the same focal plane. We describe the fabrication methods and materials characterization for the devices. Progress toward a completed Lynx prototype is presented.

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

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Student (Ph.D., M.Sc. or B.Sc.)

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Primary author: Dr CHERVENAK, James (NASA GSFC)

Co-authors: Dr BEAUMONT, Sophie (NASA GSFC); Dr ADAMS, J. S. (NASA GSFC); Dr ECKART, M. E. (Lawrence Livermore National Laboratory); Dr FINKBEINER, Fred (NASA GSFC); Dr BANDLER, S. R. (NASA GSFC); HUMMATOV, R (NASA GSFC); KELLEY, R. L. (NASA GSFC); Dr KILBOURNE, C. A. (NASA GSFC); MINIUSSI, A. R. (NASA GSFC); Dr PORTER, F. S. (NASA GSFC); Dr SADLEIR, J. E. (NASA GSFC); Dr SAKAI, K (NASA GSFC); Dr SMITH, S. J. (NASA GSFC); Dr WASSELL, E. J. (NASA GSFC)

Presenter: Dr CHERVENAK, James (NASA GSFC)

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