Curved Focal Plane Arrays

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Many NASA missions rely on imaging and spectroscopy instruments. The NASA vision of smaller, lower cost, and more frequent missions mandates the miniaturization of instruments. For optical systems, the designer generally must introduce one or several additional optical elements to flatten the inherently curved focal surface. This complication and its corresponding penalty in mass, performance, and cost can be avoided if the detector itself is made to conform to the naturally-curved focal surface of a much simpler optical design. The simplification can be a mission-enabling factor. Present examples are two NASA mission instruments of FUSE and Rosetta in which micro-channel plates are used as curved detectors. Using solid state detectors as curved focal plane arrays offers further simplification and better performance for optical instruments while reducing mass, volume, and power. Such simplification would likely be mission enabling in the case of other, future long-range space exploration missions. Some applications will also benefit from a resulting ultra wide field of view and increase in useful spectral bandwidth, especially at short wavelengths where absorption by optical glasses is often a performance-limiting factor.

A novel class of curved detector arrays are being developed that promise to revolutionize future space imaging systems in terms of science-instrument size, mass, simplicity, optical performance and cost. The advantage of these detectors over conventional flat arrays is twofold: The first advantage is that these detectors are curved to the specific curvature and shape dictated by the specific applications, and second, the curvature of the back surface is independent from the front surface VLSI fabrication process of CCDs or other imaging arrays. We have modified fully-processed thick, high-resistivity detectors as well as thinned membrane standard CCDs to have a curved imaging surface. In this talk, we will discuss the range of required curvatures for FPAs, our two approaches for fabrication of CFPA, the results of the fabrications, and a comparison of the two approaches.

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