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Development of 60 μm pitch CdTe double-sided strip detectors for the FOXSI-3 sounding rocket experiment.

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We have developed a CdTe double-sided strip detector (CdTe-DSD) with a fine strip pitch of 60 μm for the FOXSI-3 sounding rocket experiment. The experiment aims to observe the Sun using direct-focusing optics in the hard X-ray range to achieve superior sensitivity and imaging dynamic range over that of previous, indirect imagers. The CdTe-DSD is the focal plane detector for the hard X-ray telescope. In the CdTe-DSD, there are 128 strips at a pitch of 60 μm, both on the anode and cathode sides of the CdTe diode device. In order to reduce the leakage current, guard rings surround the readout electrodes on both sides. The thickness of 750 μm of the detector provides almost 100 % detection efficiency up to 50 keV, well above FOXSI's range. Signals are read out by low noise photon-counting ASICs developed for the soft gamma-ray detector onboard ASTRO-H. The ASIC has 64 channels, each consisting of a CSA and two CR-RC shaping amplifiers, one for self-triggering and the other for pulse-height measurement. Fully digital readout by a Wilkinson-type 10-bit ADC, implemented for each channel of the ASIC as well, enables us to make the readout board very compact. In preparation for the launch of FOXSI-3, a prototype detector with an improved design of the front-end-circuit board, from that used for the FOXIS-2 experiment, was fabricated and thoroughly tested to start the production of the flight models. Study of spectral and imaging responses of the CdTe-DSD has been carried out by using various radioactive X-ray sources. Thus far, an energy resolution of 780 eV(FWHM) for the 14 keV line of 241-Am has been achieved and the detector shows uniform response on the entire detector plane. Six flight model detectors are now under production and their calibration and integration into the system will be conducted by the end of this year to meet the launch schedule of summer 2018. In this presentation, results of performance tests of the prototype and the flight detectors will be presented.

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