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High spatial resolution detector for at-wavelength metrology of X-ray optics

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Recent advancements in the field of X-ray astronomy have relied significantly on innovations in grazing incidence X-ray optics technology, especially for the hard X-ray range for energies above 10 keV. The behavior of these X-ray telescopes for current and planned astrophysical and solar imaging missions needs to be well understood, and fully characterizing the optics includes measurement of the point spread function (PSF) and effective area as a function of energy for flight optics as well as understanding the scattering and reflectivity properties of substrate coatings. This requires unique, very high spatial resolution, high sensitivity, photon counting and energy discriminating, large area detectors. We report on the development of a detector that is well suited to meet these requirements. A prototype version of this camera was used to calibrate the X-ray focusing optics for the Nuclear Spectroscopic Telescope Array (NuSTAR) mission successfully launched in June 2012. The key piece of the detector is a high spatial resolution electron-multiplying charge-coupled device (EMCCD). The detector is back-thinned and optically bonded via a fiberoptic taper to a purpose-fabricated high resolution, high brightness CsI(Tl) scintillator with a microcolumnar structure. Here we present our recent work on the construction of the detector, scintillator development, production and testing as well as our software development efforts for single photon detection and energy discrimination. We will also present results from our final measurement campaign at an X-ray test facility at NASA's Marshall Space Flight Center (MSFC).

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