Improving the Calibration Efficiency of X-ray Focusing Mirrors - Simulation and Experiment

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Abstract

With the development of X-ray astronomy, X-ray focusing mirrors are evolving toward higher effective area, higher angular resolution, and larger fields of view. This introduces new requirements for the calibration of X-ray focusing mirrors. To efficiently and accurately complete the effective area measurements of the enhanced X-ray Timing and Polarimetry (eXTP) mission, we validated the feasibility of using the SDD detector, which provides high energy resolution and can operate under high photon flux conditions, for continuum effective area measurements. The feasibility of directly using the SDD for the measurements is first validated through Geant4. Subsequently, the method for aligning the SDD detector before the measurements is discussed. Later, the methods for dead-time correction and the calculation of measurement errors are considered. Finally, using the pnCCD as the detector, we measured the effective area of the eXTP 3-shells mirror module at different X-ray emission lines and compared these results with the effective area obtained by using the SDD detector for continuum measurements. The results showed that the deviation between the two methods was better than 3.6%, and the trends in the varying effective area with energy were consistent.

Note: Figure translations are in progress. See original paper for figures.