Development of a Soft X-ray Telescope with an Adaptive Optics System

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We are developing a soft x-ray telescope with an adaptive optics system for future astronomical observation with very fine angular resolution of an order of milli-arc-second. From a technical point of view, we are trying to develop a normal incident telescope with multi layers. Thus the wave length is limited to be around 13.5 nm with a band pass of roughly 10nm. Since the x-ray telescope must be installed on a satellite, a stable conditions of temperature, gravity etc, can not be expected. Therefore, we investigate to use an adaptive optics system using an optical light source attached in the telescope. In this paper, we report our present status of the development.

The primary mirror is an off-axis paraboloid with 80 mm effective diameter and 2 m focal length. This mirror has been coated with Mo/Si multi-layers. The reflectivity of the 13.5 nm x rays is ranging from 35% to 55%. We use a deformable mirror for the secondary mirror, which has been coated with Mo/Si multi-layers. This mirror consists of 31 element-bimorph-piezo electrodes. The surface roughness of the mirror is ~6 nm rms. The reflectivity of the 13.5 nm x rays are roughly 65%[1].

The adaptive optics system using an optical laser and a wave front sensor has been performed. We are using a shack-hartmann sensor (HASO 32) with a micro-lens array and a CCD. A pin hole with one micron diameter is used for the optical light source. The precision of the measurement of the wave front shape is a few nm.[2][3]

X-ray exposure test has been achieved, although the optical adaptive optics system has not yet be installed. The x-ray detector is a back illumination CCD. The quantum efficiency for 13.5 nm x ray is ~50%. The pixel size is 24 micron square. X-ray source is an electron impact source. We confirmed the x-ray intensity around 13.5 nm region is bright enough for our experiment. The imaging performance is now trying to improve and the adaptive optics system will be installed in this year.

References

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