1. The FFAST project

FFAST (Formation Flight Astronomical Survey Telescope) will cover a large sky area in the hard X-ray band up to 80 keV by a formation flight; two small satellites fly in tandem, and one of them carries a hard X-ray telescope and the other carries an SD CCD detector. The hard X-ray telescope is designed and manufactured by Nagoya University.

2. The Hard X-ray Telescope (HXT)

The FFAST telescope satellite carries a Hard X-ray telescope (HXT). An Scintillator-Deposited CCD (SD-CCD; see poster P-7 Nagino et al.) is placed at the foci of the HXT, and this combination makes it possible to take pictures of the high-energy universe with X-rays up to 80 keV. Also it is possible to obtain X-ray spectra with good energy resolution.

The HXT mirror employs tightly-nested, conically-approximated thin-foil Wolter-I optics (a schematic view is shown in the right figure).

The HXT of FFAST is designed based on the HXT of ASTRO-H (see the figure below); ASTRO-H is the 6th Japanese astronomical X-ray satellite and will be launched in 2015. The diameter and height of the mirror housing of FFAST are 450 mm and 400 mm which are the same as those for the ASTRO-H HXT. The number of nested mirrors is not yet fixed, though the number for the ASTRO-H HXT is 213.

3. Mirror design

As mentioned in section 2, the design of the HXT for FFAST is based on that for ASTRO-H. However, ASTRO-H will conduct mainly pointing observations, while FFAST will conduct mainly survey observations. Thus the grasp (Ω1), which is defined as an effective area (S) times a field of view (Ω), is also important for the HXT of FFAST. It would be possible to change the design of the ASTRO-H HXT to obtain larger Ω1.

First we studied the possibility of changing the space between mirror foils. If the foil spacing is increased, the number of nested foils is reduced and the effective area is decreased. However, the filed of view is increased. Thus it would be possible to obtain large Ω1 with a reduced total weight.

The effective area, field of view, and grasp are calculated for various energy of X-rays assuming the focal length of 12 m as shown below. Also the total weight is shown. The grasp depends on the foil spacing very weakly as expected. The grasp will be maximum at around ∆d/d ~ 0.3. In this case, the total weight will be reduced by 11 kg compared to the ASTRO-H HXT. However, increasing the foil spacing will increase the stray light. To determine the foil spacing, a detailed simulation study is required.

4. Mirror Production

Below is a summary of the mirror production of the HXT. The mirror production for the HXT of FFAST is now going on in Nagoya university.