Performance of Microfocusing by Elliptical Bendable Mirrors for Soft X-ray

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In our study on an "Arm Method" mirror bender(1), we reported the performance of the horizontally focusing mirror. Following those evaluations, we have installed two bendable mirrors in Kirkpatric-Baez geometry to microfocus the SR light in the SPring-8 BL27SU. The vertical and horizontal demagnification ratios of the optics are 1/24 and 1/100, respectively.

The equipment used for vertical focusing was the same as previously reported(1). Since two bending moments can independently be added to a 50 (W) x 540 (L) x 25 (T) mm^3 plane Si mirror by two shafts equipped with UHV stepper motors, the mirror can be shaped to an arbitrary pseudo-elliptical cylinder with the smallest curvature of 400 m. For horizontal focusing, a trapezoidal 53.4 (base) − 19.4 (top) x 540 (L) x 13 (T) mm^3 Si mirror was used. Both edges of the mirror were mechanically bent by screws in atmosphere. The amounts of bending stresses were controlled so as to fit the optimal curvature, which was checked by LTP measurement.

The experimental profile obtained by a 5-micron pinhole detector is shown in Fig. 1. This profile was fitted by a convolution of the Gaussian distribution function and the instrument function of the 5-micron pinhole slit. Vertical and horizontal spot sizes defined as twice the standard deviations were 5.9 and 7.4 microns, respectively, which are much larger than the image sizes of 0.6 and 3.8 microns predicted from the source size (13.6 x 379 microns) and the demagnification ratios of the optics.

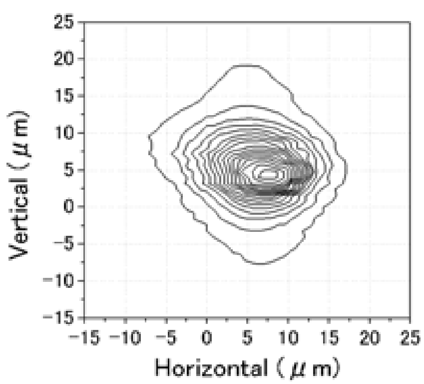

Figure 1. Observed image

These discrepancies can be explained by the slope errors of the bendable mirrors. The rms deviation of the slope errors of the vertically reflected mirror was reported to be 0.74 mrad by LTP measurement(2). The contribution from the slope error to the radius of the image at the focal point is roughly calculated as 4.3 microns, from the focal length (2.9 m) and twice the rms deviation of the slope error.

(1) N. Kamachi et al., MEDSI PROC-04-19 (2004).
(2) N. Kamachi et al., 8th Int. Conf. SRI (2003).