Performance of a Monochromator for 300-keV X-Rays

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At the beginning of the opening of the beamline BL08W, characteristics of a three-to-one asymmetric Si(771) Johan-type monochromator for extremely high energy x-rays has been examined. The monochromator can be bent by a pulsed motor-drive mechanism to a radius of curvature around 750 m, and horizontally focuses x-rays. The focusing point is 12.7 m from the monochromator. When the slit width is 25 mm, the exposed length on the surface along the beam direction is 423 mm, which covers half of the full length of the crystal rod. An expected 320-W heat load was designed to be guarded by indirect water cooling through a Cu backing block. During the performance, the initial ring current was 20 mA and the minimum magnet gap of the wiggler was 30 mm. Thus the observed intensity of the x-ray flux was about 85 times lower than the final capacity of the monochromator (100 mA ring current and 20 mm gap width). The search of the beam position of the monochromatized x-rays in the experimental hutch was troublesome, because ordinary fluorescent plates did not emit the fluorescense when high energy X-rays around 300 keV were exposed. It was partly due to a low flux density of the x-rays. Polaroid film (No. 57) was found to be effective for the measurement. The lowest tunable energy was 274 keV, which was defined by a width of a slit at the downstream position. The relative energy resolution of the monochromatized x-rays was evaluated by the energy width of elastically scattered x-ray peak detected by a pure Ge SSD, and was found to be 1.48×10^{-3} for a front end slit width of 30 mm: The energy resolution of the SSD was 0.85 keV at 276 keV γ-rays (^{133}Ba). The observed best beam spot measured by a x-ray film was 3 mm high and less than 1mm wide at the sample position, which is consistent with previous values by a computer simulation.
The intensity distribution of monochromatized 274 keV x-rays was measured by means of densitometry using an x-ray film, and the result is shown in Fig. 1.It should be mentioned that the Darwin width of Si(771) diffraction for 300-keV x-rays is extremely narrow, and the monochromatized photon number significantly reduces. The stability of the monochromator was checked by observing the elastic peak position and its line width by the SSD. Although the stability of an amplifier or an ADC was not satisfactory, it could be concluded that the monochromator was very stable for more than a week against the change of the heat load, within the present condition of the low flux intensity.

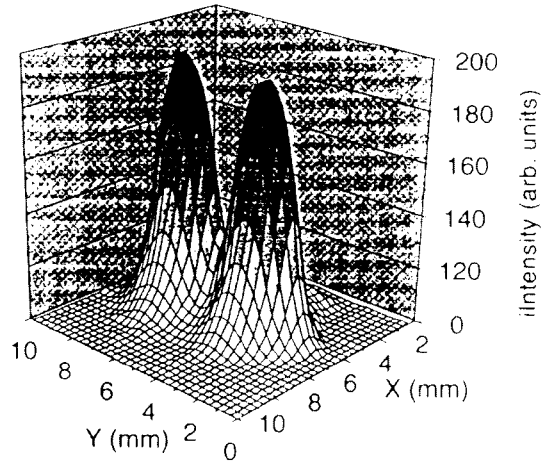

Fig. 1: Intensity distributions of focused 274 keV x-rays. The elliptcal multipole wiggler was operated with K_x=0.6 and K_y=11.2.