Performance of X-ray Beam Position Monitors for ID Beamlines

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1. Introduction

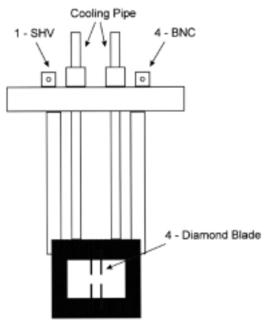
The X-ray beam position monitors (XBPMs) have been designed and prepared to diagnose a X-ray beam position with high resolution and good stability under the severe heat load conditions [1]. We use diamond blades as a detector head which works in photo-emission mode. At present each frond-end section of the insertion devise (ID) beamline has a blade type XBPM at 20m from the source point. We have designed three structures of this type to match various X-ray beam profiles. The current signals are measured with remote range I/V converters[2] and acquired by the BL-workstation.

Here we describe the performances of XBPMs for the ID beamlines during beamline commissioning periods and user experiment time.

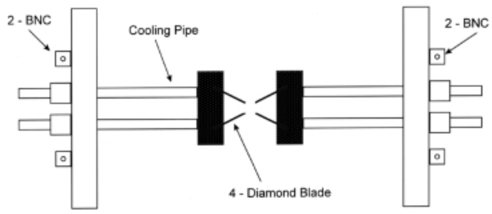
2. Structures of Blade Type XBPMs

Blade type XBPMs are operated in photo-emission mode. Four blades are mounted on the blade holder which is a water cooled copper block, and they are parallel to the beam axis to reduce the heat load. The typical pressure of a XBPM is about the order of 10-8 Pa. The beam position (X, Y) can be calculated from the current signal ratio of four blades by using the correction factor (Ax, Ay) . We prepared threes structure of XBPMs as shown in Figure 1. Fixed-blade style (a) is mainly for standard undulator beamlines. Horizontally-parted-blade style (b) is for a wiggler beamline and a twin helical undulator beamline. Four-blades-drive style (c) is for figure-8 undulators. These styles are designed to match their X-ray beam profiles. Each style has horizontal(H) and vertical(V) drive mechanisms so as to move the center of four blades on to the beam axis. To reduce the complexity of structures and to avoid the bother maintenance, most parts of XBPM are standardized.

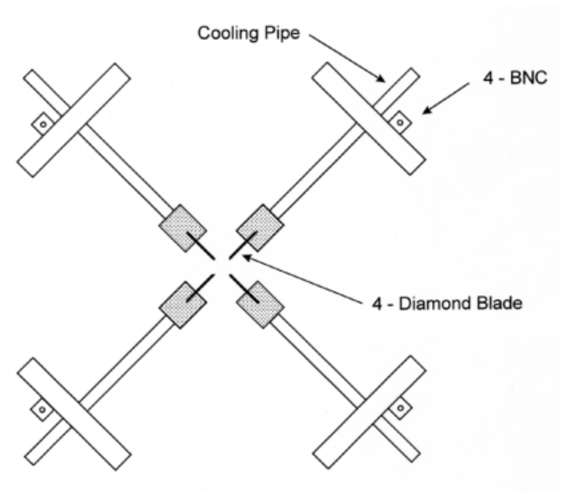
In our XBPMs, CVD diamond is used as base material of the blades. The typical number of electric resistivity is about 1010Ωcm. We designed two shapes of blades. One is 60×20×0.24t for the fixed-blade style, and the second is 20×20×0.24 for the other styles. The electrodes of the blades are coated with titanium to have electric conduction, but the contact surfaces onto the copper block are coated with gold to have good heat contact and isolated electrically against electrodes.



(a) Fixed-blades style



(b) Horizontally-parted-blades style



(c) Four-blades-drive style

Figure 1 Schematic views for tree structure of XBPMs

3. Beam Tests and Results

The commissioning of XBPMs have been carried out before user time started. We didn*t meet serious problems. The determination of (Ax, Ay) and (H, V) has been done smoothly. The outlines of the above determination are to

(1) check the reliability of output signals,

(2) find the monitor head position (H, V) where the output beam position (X, Y) is the zero point (0, 0), in other words, where the signal from four blades are equal,

(3) do the scan measurement horizontally and vertically and find the correction factor (Ax, Ay).

The following data are from the standard ID beamlines, where the fixed-blades style are used . The bias voltage electrodes by the side of blades , which collect photo-electrons, are used at +100 V, where the out put of (X, Y) is stable as shown in Figure 2 (a) and (b). Figure 3 shows that the storage ring current does not effect the position readout.

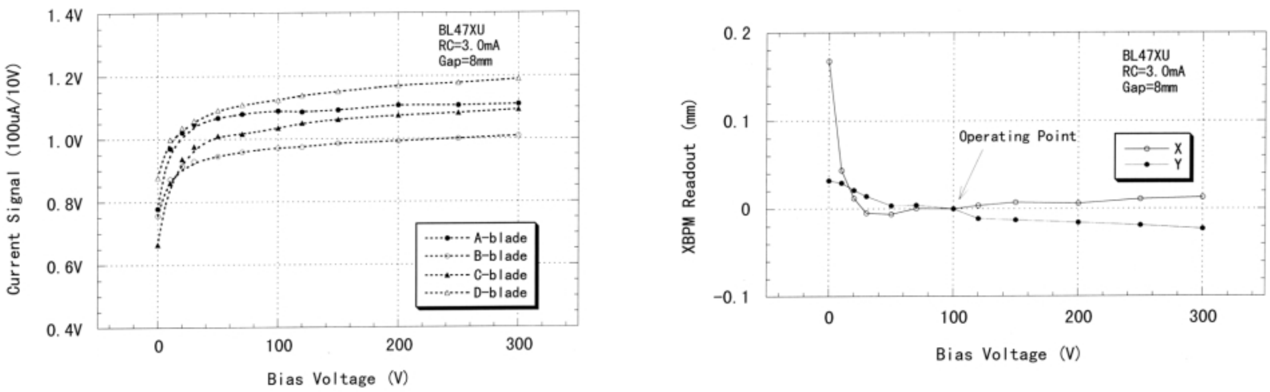
In the ID beamlines, the profiles of the X-ray beams change drastically as the K-values of ID vary. In this case the XBPMs do not keep good positions. We have measured the K-value dependence of the readout positions as shown in Figure 4. We figured out that the discrepancy of the readout is about 100 μm, typically. This problem can be resolved by using data tables against all conditions, but essentially the point is to develop new monitor which measures not the center of the power profile, but the beam axis itself directly.

References

[1] H. Aoyagi et al., SPring-8 Annual Report 1996, p202

T. Kudo et al., SPring-8 Annual Report 1996, p200

[2] T. Kudo et al. in this Annual Report.



(a) Bias voltage dependence of the current signal. (b) Bias voltage dependence of the XBPM readout.

Figure 2

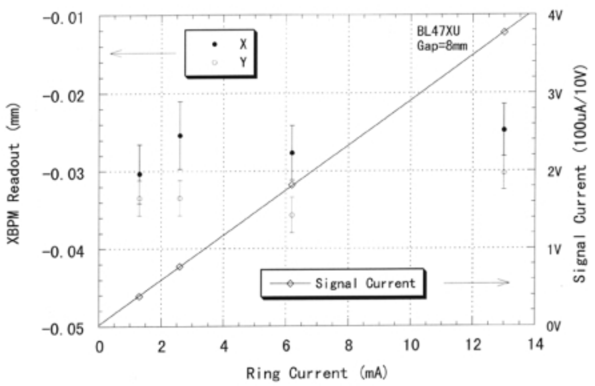


Figure 3 Storage ring current dependence of the XBPM readout.

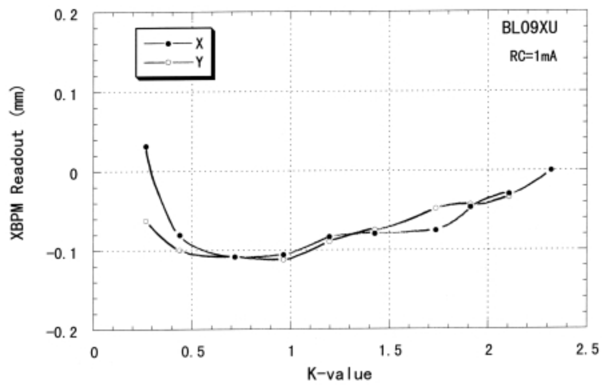


Figure 4 K-value dependence of the XBPM readout.