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Evaluation of Galaxy at BL6C

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An Imaging Plate (IP) is one of the most powerful detectors for collecting diffraction data in the sense that it has a wide detection area, high sensitivity, large dynamic range, high accuracy, and reasonable pixel size. In spite of such excellent features of IP, a high-speed automatic data collection device that has enough speed to maximize use of SR X-rays is very difficult to make, due to the slow digitization speed of the IP.

We have solved this difficulty by using a fully cylindrical IP cassette (radius = 400mm, width = 450mm) where several diffraction images can be stored and be read by five IP reading heads. This devise called Galaxy has been developed and installed at BL6C in the PF. The characterization of the Galaxy is shown in Table 1, The maximum data collection speed is shown in Table II.

Table 1. Format of Galaxy

Items	Contents
Camera part: No of cylindrical IP cassette Radius of the IP cassette No of polariod film cassette	 2 400mm 1
IP reader part: Rotation speed of IP cassette Pixel size Reading time Net digitization time Gray level / x-ray photon Gray level	 3 turn/sec 100μm 200μm 5'54" 3'20" 5'00" 2'30" 1 1 1×10^6 1×10^6
Eraser: Erasing time	 1'18"

Running cycle time of a cassette is 17min 35 sec and 15min 03sec for pixel size being 100μm and 200μm, respectively. Actual running cycle time is a half of them because the Galaxy has two IP cassettes. This is enough speed for PF bending magnet beamline because exposure time per degree oscillation usually needs more than 30sec for ordinal protein crystal. One of the prominent features of Galaxy is that the maximum resolution along the direction of circumference is 0.58A when 1.0A X-ray is used and the dynamic range is very large (Figure 1).

We have collected data from 2Zn insulin crystal to 0.75A resolution using cryo-condition. After refinement of the structure using 1A resolution data and D-Fourier maps, we found electron densities around the Zn atom on the 3 fold axis. These densities can be explained by d-electron redistribution due to the ligands of three nitrogen atoms of imidazole ring and three water molecules [1]. The distance from Zn is about 0.6Å, which is reasonably near to the expected value of 0.5Å. It became shorter than that reported in 1982. At that time, the distance was 1.3Å, because the resolution of the data was 1.2Å.

Table 2. Maximum data collection speed

Items	Pixel size 100μm	Pixel size 200μm
Erase	1'18"	1'18"
Cassette transport to camera	1'55"	1'55"
Expose	5'27"	2'57"
Cassette transport to reader	1'42	1'42"
IP read	5'54"	3'20"
Cassette transport to eraser	1'20"	1'20"
Summation (cycle time with one cassette)	17'36"	15'03"
Real cycle time with two cassettes	8'48"	7'32"

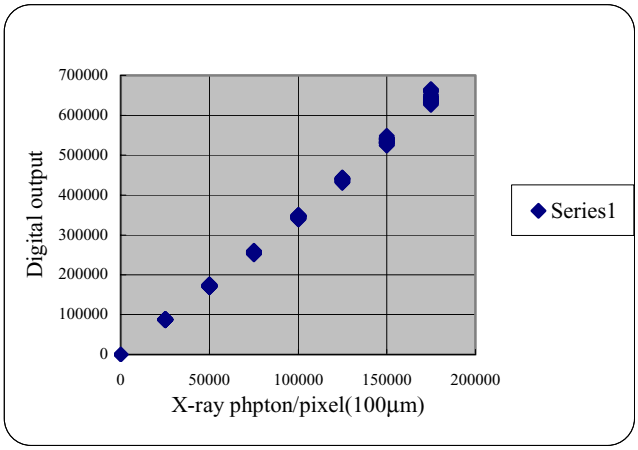

Figure 1. Linear response curve between the x-ray dose and the digital output .

This result shows that this beamline with Process_Auto coded by Dr. T.Higashi can give extremely good data up to high resolution.

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References

[1] N. Sakabe, K. Sakabe and K. Sasaki Methods and application in crystallographic computing, Oxford University Press, 273-285(1984).