NEW BPM SYSTEM AT UVSOR

K. Hayashi, M. Katoh†, M. Hosaka, A. Mochihashi, T. Kinoshita, J. Yamazaki, Y. Takashima,
Institute for Molecular Science, Myodaiji, Okazaki, Japan
T. Honda, KEK-PF, Oho, Tsukuba, Japan
S. Koda, Saga University, Honjo-machi, Saga, Japan

Abstract

A new beam position monitor system was successfully comissioned at UVSOR. New system comprises 16 signal processing modules produced by Bergoz Co.. Each module gives the beam position as DC voltage. The signals are AD-converted and are accumulated in a PC. The system can measure an orbit in a second with resolution of a few microns. The system has revealed various types of orbit drift, which could not be observed with the old system.

1 INTRODUCTION

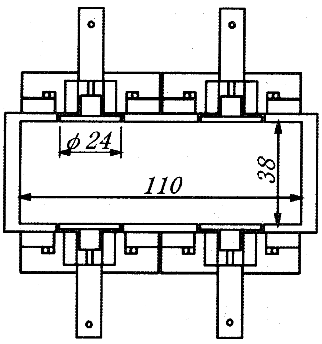
UVSOR, a 750 MeV synchrotron light source, has been successfully operational since 1983. The UVSOR accelerator complex consists of a 15 MeV linac, a 600 MeV booster-synchrotron and a 750 MeV storage ring. To keep the performance of the machine as high as possible, the aged components have been replaced one bye one, year by year. In FY2000, we have replaced the beam position monitor (BPM) system.

At UVSOR, we are proposing an upgrade plan [2]. Its main goal is to provide more brilliant synchrotron radiation in wider spectral region. The beam emittance will be reduced by a factor of 6. The number of the insertion devices will be doubled. After the upgrade, the role of the BPM system will become more important. Since the orbit drifts would reduce the effective brilliance, they should be precisely monitored and be cured. To realize the independent tunings of the insertion devices, the orbit movement caused by them should be precisely monitored and be corrected.

In the UVSOR storage ring, 16 BPMs are installed. One BPM head consists of four button-type electrodes, as shown in Figure 1. The old system was constructed early in 1980's [1]. In this system, the signal from each electrode was selected by a coaxial switch multiplexer system and detected by a linear detector.

It took about one minutes to measure an orbit with the old system. Since the attenuator control of the BPM signals was not automated, the operator must adjust the attenuation level before the measurement depending on the beam current. To measure the orbit more precisely and quickly, we decided to replace the BPM system.

†mkatoh@ims.ac.jp



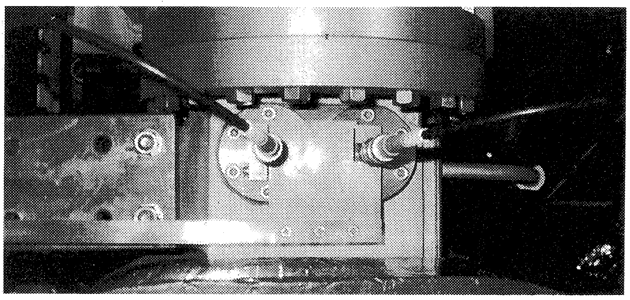


Fig 1. BPM Electrodes (upper; cross-sectional view, lower: top-view). They are mounted on the vacuum chambers at the bending magnets. Totally 16 monitors are installed in the ring.

2 NEW SYSTEM

The new system comprises 16 signal-processing modules, which are commercial products of Bergoz Co. [3]. In these modules, the bunch signals are filtered at the RF frequency (90MHz). The 90MHz signals are down-converted to an intermediate frequency and are amplified and detected. In the new system, all the electrodes are connected directly to the modules. There are no switches. Typical length of the cables is about 15 m. The lengths of four cables for one BPM head are adjusted with an accuracy of a few cm. The modules output two DC-voltage signals, which are proportional to the beam position in horizontal and vertical. They are AD-converted with 16-bit resolution and a cycle of 1 kHz. The data are averaged over one second to improve the resolution. The data are stored in a PC and sent to the main control system [4].

The standard deviations of the beam position data were measured for various values of beam current, as shown in Figure 4. For the beam current higher than 10 mA, the standard deviations are smaller than a few microns.

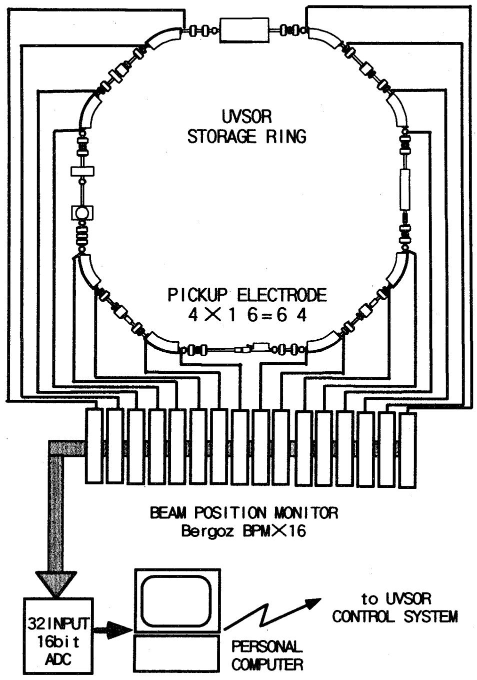


Fig.2 Schematic drawing of new BPM system

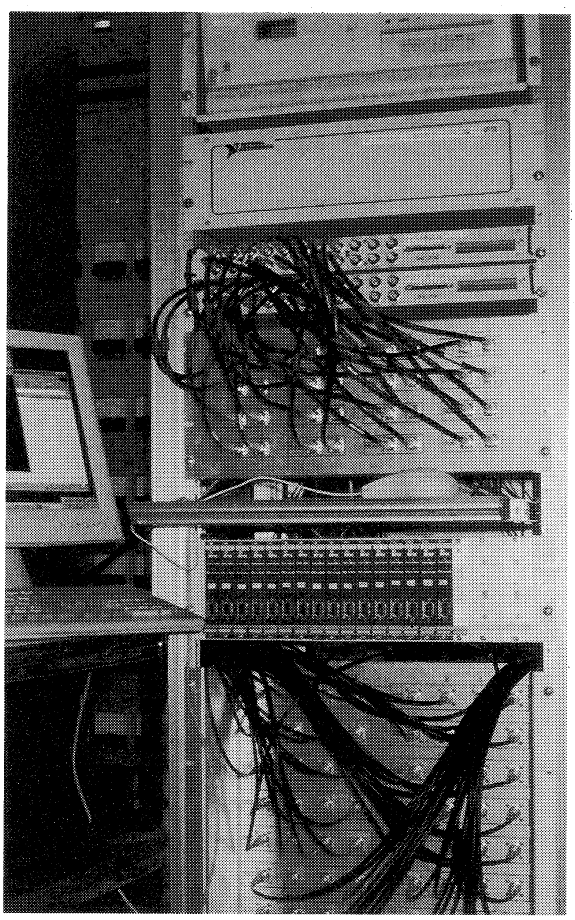


Fig. 3 New BPM Station

16 signal processing modules, AD-converters and a PC are mounted in one rack.

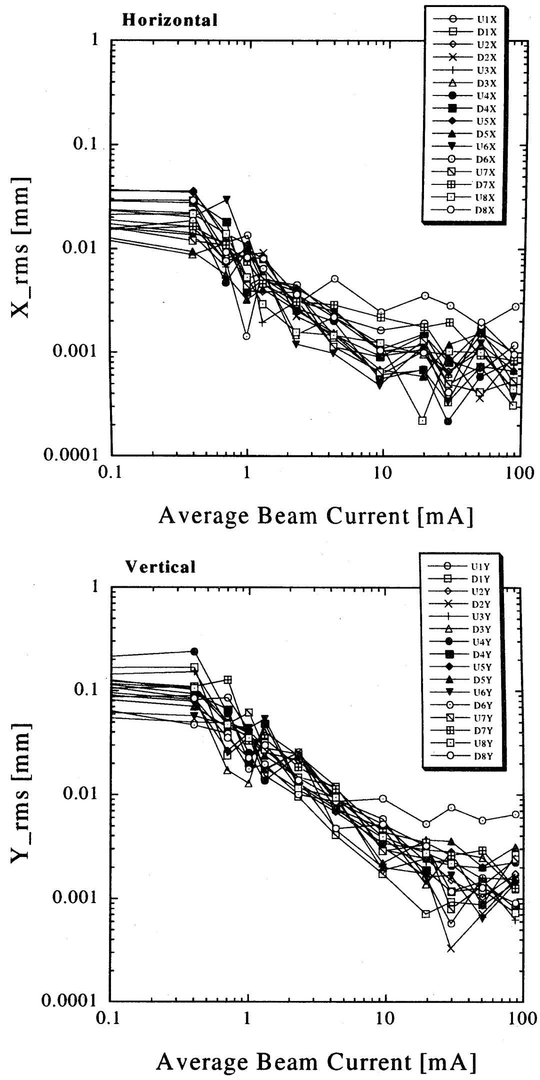


Fig. 4 Standard deviations of beam position data
Those for five samplings are shown against various beam currents. The data from all 16 BPMs are shown. The upper is horizontal and the lower vertical.

3 ORBIT DRIFT

New system has revealed orbit drifts in various time scales. In Figure 5, orbit drifts in a users run are shown. UVSOR is typically operated for users as follows. After the beam injection, the beam energy was ramped from 600MeV to 750MeV and the orbit was corrected. Then the users experiments start. The data in Figure 5 started also at this moment. There can be seen a rapid drift, especially in horizontal, during the first ten minutes. In vertical, there can be seen a slow drift in time scale of hours. The amplitudes of the drift motions are a few hundreds of microns.

In Figure 6, another orbit movement is shown. These data were taken when the temperature control system of the cooling water was malfunctioned. The temperatures of the cooling water of the magnets and the vacuum chambers were fluctuated with amplitudes of about 2 degree and periods of about 10 minutes. This was caused by periodic on and off of the cooling tower. There can be seen orbit movements in horizontal and vertical synchronized with the temperature changes. The amplitudes are about a few tens of microns.

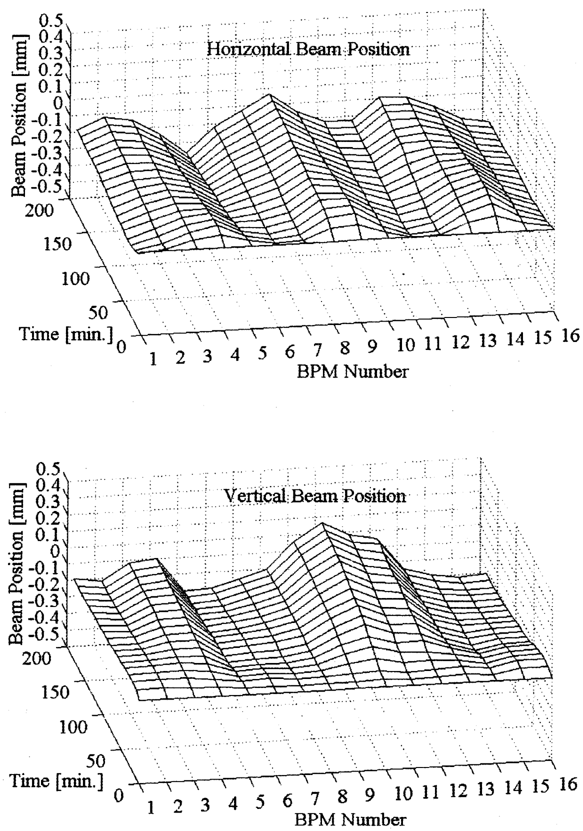


Fig. 5 Typical orbit drift observed during a users operation
The upper is the horizontal data and the lower the vertical data. The data interval is about 10 minutes.

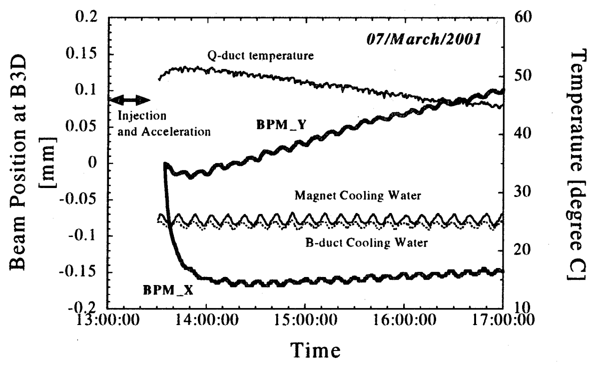


Fig. 6 Orbit movement caused by temperature fluctuations of the cooling waters for magnets and vacuum chambers
Beam position at one BPM (B3D) is shown.

5 CONCLUSION

The beam position monitor system at UVSOR was replaced this year. New system was successfully commissioned. It is providing a set of beam position data every second with a resolution of a few microns. It saves the time for orbit correction significantly. It has revealed the orbit drift at UVSOR in users operations. Their origins will be investigated with the beam position data from the new system. The orbit stabilizing system will be constructed based on the new system in future.

5 REFERENCES

[1] T. Kasuga et al., Proc. 5th Symp. Accel. Sci. Tech. (Tsukuba, 1984), 145
[2] M. Katoh et al., Nucl. Inst. Meth. A467-8 (2001), 68
[3] http://www.bergoz.com
[4] N. Kanaya et al., Nucl. Instr. Meth. A 352 (1994) 166