RF System

Masahiro HARA
Hiroyasu EGO
Yoshitaka KAWASHIMA
Yuji OHASHI
Takashi OHSHIMA
Takeo TAKASHIMA

1. Introduction

This year, the SPring-8 storage ring was commissioned from the middle of June and the stored beam reached 20 mA in the ring. During the summer-time shutdown, routine inspection work, maintenance, and repair work were performed. In October, user-mode operations were started, and in this period, the RF system was operated fairly smoothly and we were able to gain a lot of experience.

2. Before Commissioning

In preparing for the commissioning, optical fiber cables were distributed to the A, B, C, and D stations and to the injector synchrotron and linac, and timing standard signals were prepared in each of the stations [1]. The control program was prepared in accordance with the control system, and the interlock system was confirmed [2]. Before commissioning, a comprehensive test on the RF stations was performed, feeding power to cavities at 800 kW/station.

3. Commissioning phase

Through the success of one-turn injections, axial injections, and the adjustment of sextupole magnets, the electron beam was captured in RF buckets on March 25 [3]. In these processes, phase adjustments among the RF stations were performed and the RF frequency was adjusted so as to minimize the closed orbit distortions. The adjusted frequency was 508.579343, which was only 653 Hz lower than the designed value. This meant that the circumference was only 1.8 mm larger than the designed value and the alignment appeared good.

We succeeded in storing 20 mA in April. The main RF parameters used in this period are shown in Table 1. Only one serious problem with the RF system during this period was found [4]. It was a vacuum leak at a tuner found due to an initial failure in welding a water channel, which caused the direct leakage of water in the vacuum. The tuner was temporally replaced with a fixed plunger.

Coherent synchrotron oscillation was observed as sidebands at the harmonics of the accelerating frequency. RF disturbance was induced by ripple noise in the klystron power supply at the harmonics of the frequency of the AC power supply [5].

The total accelerating voltage was set at a high enough voltage to obtain a long quantum lifetime, and also to prevent the synchrotron frequency from being close to the harmonics of the AC power frequency.

In adition, the cavity cooling system was adjusted and the water temperature at the input of cavities ws kept almost constant within ± 0.02 ˚C [4].

Table 1. Typical RF Parameters

Beam Energy	7.975 GeV
RF	508.579343 MHz
Revolution Freq.	207.78 kHz
RF stations	3
Cavities/station	8
Energy loss per turn (without ID)	8.91 MeV/turn
Total cavity voltage	12.0 MeV
Synchrotron frequency	1.5 kHz

4. Summer time shutdown

For the storage ring, a summer-time shutdown (July to August) was implemented to install insertion devices and for maintenance and mending purposes. For RF system, a regular check up and maintenance work were performed. The temporary tuner was replaced with a new one [4].

5. User mode operation

After the dedication ceremony, user-mode operations were started at 2-week or 3-week

intervals. At the end of each interval, the beam operations were shared for dedicated machine study. Additionally, accelerator physics experiments and parameter search operations were performed.

References

[1] H. Suzuki, Y. Kawashima, N. Tani, N. Hosoda, Y. Ohashi, T. Ohshima, H. Ego, M. Hara, and H. Yonehara, "Timing system of SPring-8", Proc. of the 11th Symposium on Accelerator Science and Technology, Harima Science Garden City, October 21-23, 1997 pp 80-82.

[2] M. Hara, H. Ego, Y. Kawashima, Y. Ohashi, T. Ohshima and T. Takashima, "RF stations of the SPring-8 storage ring", Proceedings of the PAC97 Meeting of the American Physical Society, Vancouver, Canada, 12-16 May, 1997.

[3] M. Hara, H. Ego, Y. Kawashima, Y. Ohashi, T. Ohshima, and T. Takashima,"RF SYSTEM OF THE SPring-8 STORAGE RING", Proceedings of the 6th International Conference on Synchrotron Radiation Instrumentation, Himeji, Japan, Aug. 4-8, 1997, to be published in Journal of Synchrotron Radiation.

[4] T. Ohshima, H. Ego, M. Hara, N. Hosoda, Y. Kawashima, Y. Ohashi, H. Suzuki, T. Takashima, and H. Yonehara, "RF system for SPring-8 storage ring at the commissioning", Proc. of the 11th Symposium on Accelerator Science and Technology, Harima Science Garden City, October 21-23, 1997 pp 95-97.

[5] M. Hara, T. Nakamura, and T. Ohshima, "A RIPPLE EFFECT OF A KLYSTRON POWER SUPPLY ON SYNCHROTRON OSCILLATION", to be published in Particle Accelerators (submitted).