MAINTENANCE AND IMPROVEMENT OF THE SYNCHROTRON RADIATION SOURCE HiSOR

Presented by Kiminori GOTO
Hiroshima Synchrotron Radiation Center, Hiroshima University
2-313 Kagamiyama, Higashi-Hiroshima 739-8526, Japan

Abstract

HiSOR is a synchrotron light source constructed at Hiroshima Synchrotron Radiation Center, Hiroshima University in FY1996. After some improvement, upgrade and tuning, the storage current of the HiSOR was up to 200mA in May 2000. As the stored current increased more and vacuum degree was better by repeating degassing operation, the beam instability problem at injection and at acceleration was severer. At present, changing the operation point at injection and updating the tracking pattern at acceleration from 150MeV to 700MeV is only a way to suppress the beam instability of the HiSOR. In near future, we will get approval from the radiation protection authority for the operation with 350mA. Then we are getting ready for upgrade of the HiSOR in order to operate stably.

1 INTRODUCTION

A compact synchrotron light source with a nickname "HiSOR" was constructed by Sumitomo Heavy Industries Ltd.(SHI) for the research and education at Hiroshima Synchrotron Radiation Center(HSRC), Hiroshima University[1,2]. The injector is a 150-MeV microtron[3]. The injected electrons are stored at 150-MeV, and accelerated to 700-MeV and stored. After the injection of electrons to the storage ring, the microtron is used as an injector for another electron circulator ring REFER (Relativistic Electron Facility for Education and Research) to investigate the interaction of the relativistic electron with matter (crystal). It is a property of the Venture Business Laboratory of Hiroshima University.

The total number of the HSRC permanent staff is 8. Five of them are operators(almost of them are beamline staffs and users) and one is a maintenance and machine staff. The maintenance of the light source system and the tuning with beam by the machine staff are scheduled on every Monday, and the light source is opened to users from Tuesday through Friday. The operation schedule for users is designed for the electron injection, generally taking for several minutes, into the storage ring at 9:30 in the morning once a day. The acceleration of the 150 MeV electrons up to 700 MeV is completed within two minutes. The 150 MeV electron beam from the injector microtron is then switched towards the REFER. The operation of both the REFER and the storage ring ends at 18:00. The job of operators is to turn on devices, to accelerate to 700MeV after injection and to switch towards the REFER in the morning and to turn off devices in the evening. Every operator is bound three times a month while about two hours by the job. Since storage current up to 200mA in May 2000, it is hard without help of the machine staff for operators to inject into the storage ring and accelerate the beam also.

2 STORAGE RING

The storage ring is of a racetrack type. The bending field is as strong as 2.7 tesla, so the total radiation power and the critical wavelength are comparable with those from 1-GeV ring with usual bending field, about 1.2 tesla. At one straight section, a linear undulator is installed, and in another straight section, a linear-helical undulator is installed[4]. We can control the elipticity of the synchrotron light by controlling the magnet array configuration. The betatron function and dispersion function of HiSOR storage ring is shown in Fig.1. The pole gap of the bending magnet is as narrow as 42 mm to produce strong magnetic field, then to suppress the vertical betatron function, an edge focusing scheme is employed. The vertical betatron function at the straight section should be also small because the undulator gap is as narrow as 24 mm. The betatron function of this part is controlled by quadrupole doublet at both ends of the straight section.

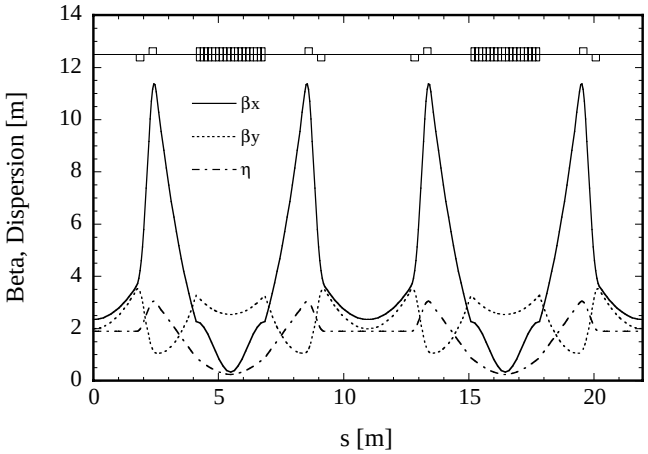

Figure 1: Beam optics of the HiSOR storage ring.

3 MAINTENANCE

Preventative maintenance by the maker is built into the HiSOR operating schedule. In Table 1, *Maintenance* is the number of the day for preventative maintenance and it includes days for some planned improvements. In FY1998, 98 days were used for test and tuning. In those

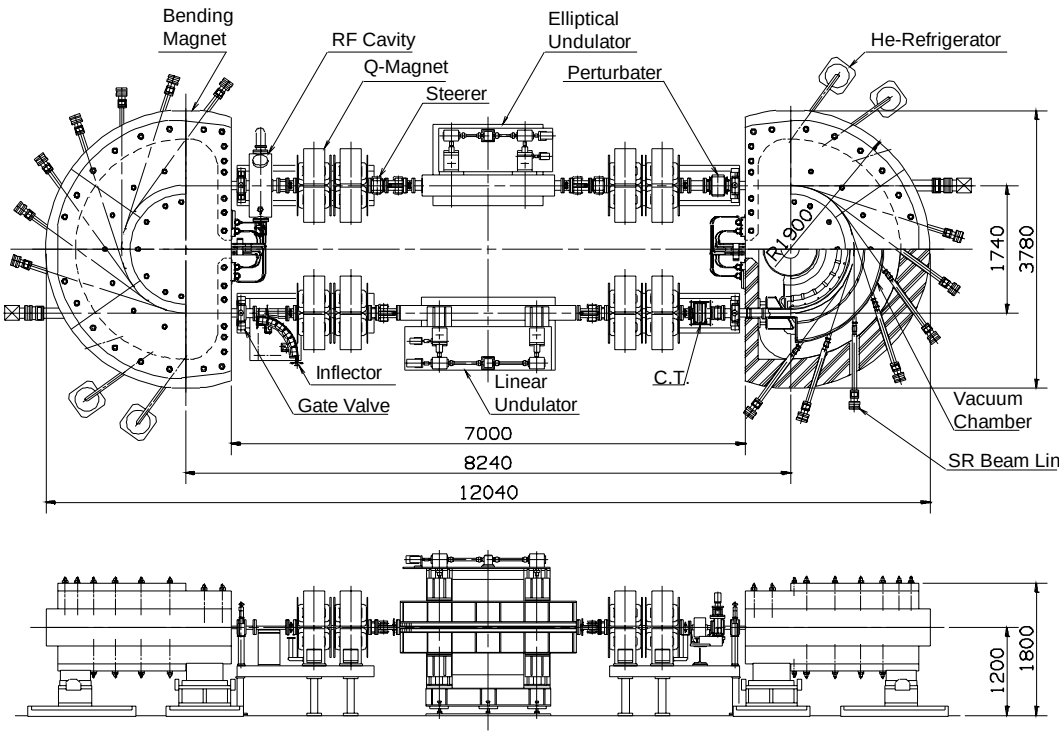

Figure 2: HiSOR ring.

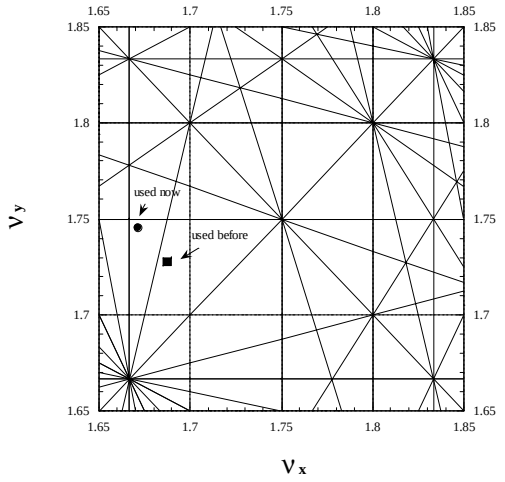

Figure 3: Tune diagram.

days, Monday and Tuesday were scheduled for the maintenance, tuning and self-cleaning by the synchrotron radiation. The stored current was made into 200mA mode from 100mA mode in May 2000. The vacuum degree of the storage ring became better by the self-cleaning day by day and this improved the beam lifetime but began to make the injection and the acceleration sensitive. In FY2001, the beam instability was severer and it was too hard to inject the beam up to 100mA. *Beam failures* in Table 2 show this. It means the number of the day when stored current was less than 100mA. Then injection point was changed to suppress the beam instability. Fig.3 shows the injection point used now. Though it is seemed severer than old point because the new point is close to the strong resonance, the resonance suppresses the beam instability and it is not easy but possible to inject until to 200mA at this point until now.

Table 1: The number of the day for maintenance, repair and tuning.

	1998	**1999**	**2000**	**2001**
Maintenance	40	44	17	30
Repair with failures	70	53	67	44
Test and tuning	98	47	9	36
total	208	144	93	110

Table 2: The number of the day for users and the day of failures by beam instabilities.

	1998	**1999**	**2000**	**2001**
User days	61	99	139	150
Beam failures	0	0	1	12

4 IMPROVEMENT

The HiSOR facility was completed in 1997, five years ago. Since then, we have made some improvements on the light source. Some of them are as follows:

- Upgrade of the storage ring vacuum system[5].
- Install of the kicker magnet for the tune measurement system and the single bunch operation[6].
- Install of four steering magnets to correct more the orbit distortion.
- Install of steering magnets at the beam transport line.
- Change from shunt resistors to DCCT used as the sensor of power sources.
- Divide of the RF cooling water system from the main cooling water system.
- Upgrade of the Cryosorption pump system and its cooling water system.

In near future, the stored current will be 350mA mode from 200mA mode. And the time opened for users will be expanded to 24 hours from about 10 hours. But it is impossible to operate stably in the present machine condition. Then we are getting ready for upgrade of the main cavity and install of the Landau cavity. The operating system used now[3,7] has no capacity to operate more devices then replace of the operating system is prepared with help of operating system crews at Spring-8.

5 REFERENCES

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