STATUS REPORT OF HIROSHIMA SYNCHROTRON RADIATION CENTER HIROSHIMA UNIVERSITY*

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Abstract

The Hiroshima Synchrotron Radiation Center (HSRC) at Hiroshima University was established in 1996 for the research of solid state physics. The HSRC equips a 700 MeV electron storage ring nicknamed HiSOR. Recently, we are considering upgrade of the instrumentation beamline for the optical monitoring. In this paper, we report the present status of HSRC.

OUTLINE OF HISOR

Figure 1 shows the appearance of HiSOR storage ring. The HiSOR storage ring is a compact racetrack-type with a circumference of 21.95 m [1]. The electron beam is injected by a microtron with the energy of 150 MeV. After injection, the beam is accelerated up to 700 MeV and natural emittance is 400 π nmrad. Since bending field of 2.7 T is relatively strong in normal conducting magnets, soft x-ray photons can be generated. Main parameters of HiSOR ring are shown in Table 1. The APPELE-II type quasi-periodic undulator [2] and the linear undulator have been installed the straight sections. The main parameters of undulators are shown in Table 2. The APPELE-II type undulator is capable of select between quasi-periodic type and normal type by exchanging a part of the magnet, and is currently operated in normal type.

At present, there are 13 beamlines and nine beamlines are opened for users. Figure 2 shows photon energy spectra of the synchrotron radiation from HiSOR. Some subjects of beam lines were as follows; polarization dependent angle resolved photoemission spectroscopy(ARPES), spin-resolved ARPES, circular dichroism of biomaterials, soft x-ray magnetic circular dichroism.

Figure 1: Bird's-eyes view of HiSOR.

Table 1: Main Parameters of HiSOR

Circumference	21.95 m
Beam energy at Injection at Storage	150 MeV 700 MeV
Magnetic field at Injection at Storage	0.6 T 2.7 T
RF frequency	191.244 MHz
Harmonic number	14
RF voltage	200 kV
Maximum stored current	350 mA
Natural emittance	~400 π nmrad
Beam life time	~10 hours @ 200 mA
Critical wavelength	1.42 nm (880 eV)

Table 2: Parameters of Undulators

Linear undulator (BL-1)	
Total length	2354.2 mm
Periodic length	57 mm
Periodic number	41
Pole gap	30-200 mm
Maximum magnetic field	0.41 T
Magnetic material	Nd-Fe-B (NEOMAX-44H)
Quasi-periodic APPLE-II undulator (BL-9)	
Total length	1845 m
Periodic length	78 mm
Periodic number	23
Pole gap	22-200 mm
Maximum magnetic field	0.86 T (horizontal mode)
	0.59 T (vertical mode)
	0.50 T (helical mode)
Magnetic material	Nd-Fe-B (NEOMAX-46CH)

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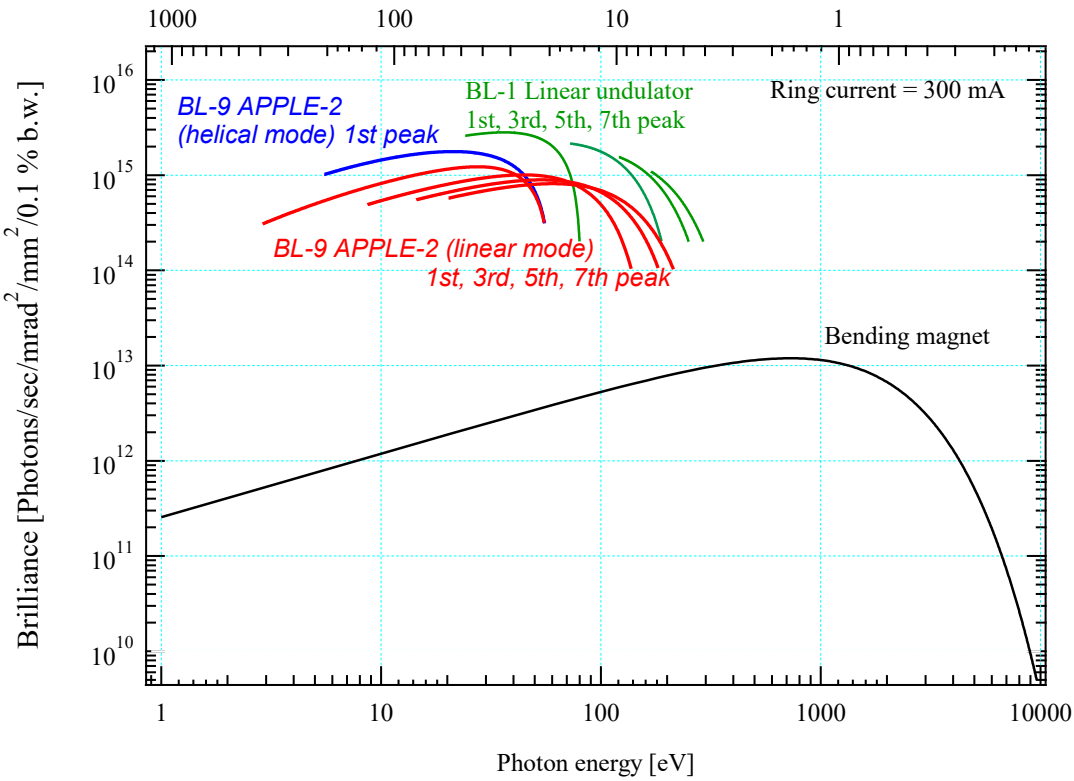

Figure 2: Photon energy spectra of the SR from HiSOR.

OPERATION

In a fiscal year, user operation is scheduled except summer shutdown of August and September. In this operational period, synchrotron radiation is supplied for user between Tuesday to Friday. A daily operational time is about 11 hours including injection and reinjection procedures. Monday and a month in the summer shutdown period were operated for machine tuning. Figure 3 shows the operational time in recent six fiscal years. From 2012, user run decrease by a water leakage from beam dumper for bending region. Exchange of beam dumper has completed in 2015, therefore operational time for users was recovered its 2011 level. As a result, 1546 hours of user operation was performed in 2016 fiscal year. According to the time of user run, the number of users also recovered. The number of users in each fiscal year are shown in Figure 4.

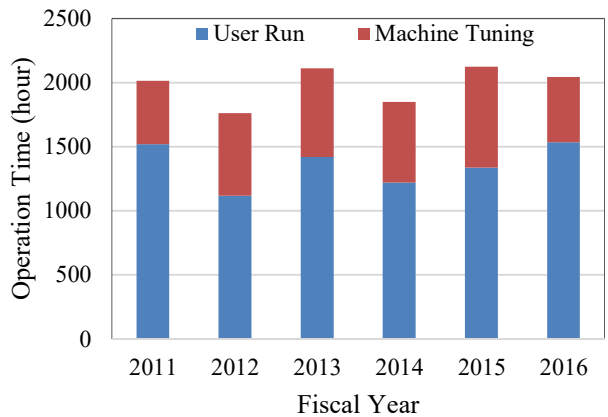

Figure 3: Operation time of storage ring.

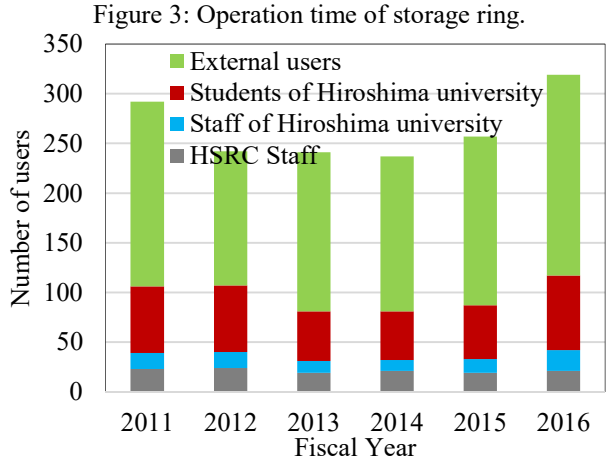

Figure 4: Number of users.

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INSTRUMENTATION BEAM LINE

One of the beamlines was prepared for developments of the instrumentations by using synchrotron radiation. In this beamline, a wire monitor, ccd cameras and a streak camera are equipped. In recent years, the beamline has been used for educational purposes. We plan to install an interferometer for bunch length measurements [3].

FUTURE

Since the HiSOR ring was compact race-track type accelerator, its emittance is one or more orders of magnitude larger than other same size rings. Therefore, construction of new storage ring is planned [4, 5].

REFERENCES

[1] K. Yoshida *et al.*, in *Proc.* APAC'98, Tsukuba, Japan, 1998, p. 653.

[2] S. Sasaki *et al.*, in *Proc.* IPAC'12, New Orleans, Louisiana, USA, 2012, paper MOPPP072, p.729.

[3] Y. Miyamoto *et al.*, *Opt. Lett.*, vol. 18, p. 900, 1993.

[4] A. Miyamoto *et al.,* in *Proc.* IPAC'10, Kyoto, Japan, 2010, paper WEPEA029, p. 2546.

[5] A. Miyamoto and S. Sasaki, in *Proc.* IPAC'15, Richmond, VA, USA, 2015, paper TUPWA060, p. 1560.