Design of HiSOR-2

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Keywords: Synchrotron light source, electron storage ring.

HiSOR, a low energy and compact synchrotron light source in Hiroshima University, has been operational since the middle of 1990's. It equipped with two undulators which produce high-brightness light in the vacuum ultraviolet range. It has two normal conducting bending magnets with high field strength of 2.7 T, which produce synchrotron radiation in a wide range including tender X-rays even with the low electron energy, 700MeV. On the other hand, the emittance is 400 nm, which is larger by two orders of magnitudes than the 3rd generation sources and results in the low brightness. This large emittance is caused by the simple lattice structure which consists of two 180 degree bending magnets. To make the beam injection system simple and compact, the injection is made at the energy of 150 MeV. Consequently, the ring cannot be operated in the top-up mode, which has become a standard operation mode in modern light sources. Since the HiSOR electron storage ring has a rational design without redundancy, it is difficult to make a major modification to improve the performance or introduce new technologies. This is in contrast with other light sources in Japan, such as Photon Factory [1], UVSOR [2] and SPring-8 [3], which already made or is planning major upgrades.

For the future plan of HiSOR, we designed a completely new ring, HiSOR-2 [4]. The circumference is about 50 m, the electron energy 500 MeV and the emittance around 10nm. It has six straight sections and four of them can be used for undulators. The small emittance gives much higher brightness of undulator radiation by two orders of magnitudes than the present one. It would have a new full energy injector to realize the top-up operation, which consists of a linear accelerator and a booster synchrotron. Such a completely new facility is ideal for further developing the researches based on the high brightness undulator radiation in the vacuum ultraviolet range. However, we have to prepare responding flexibly to changes in the environment surrounding synchrotron radiation science in Japan. As leaving this plan as one candidate, we have started designing alternative plan, which is more compact and hopefully can be realized with less budget [5].

An example of the design is shown in Fig. 1. The circumference is about 30 m and the electron energy is 500 MeV. The emittance is 17 nm. The ring has six 2.2 m straight sections, four of which can be used for undulators. To realize such a simple lattice, we have to develop combined function multipole magnets. Another example has similar lattice structure as in Ref. [4] but is more compact with the circumference of about 40m and the emittance of about 10 nm. An example of the accelerator layout with this second design is shown in Fig. 2, which requires construction of a new building for the storage ring and experimental hall but the full-energy booster synchrotron would be constructed in the present injector room.

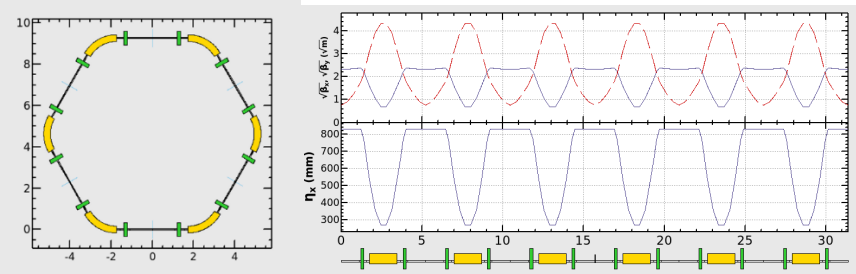

FIGURE 1. Magnetic lattice (left) and optical functions (right) of the new lattice design for HiSOR-2.

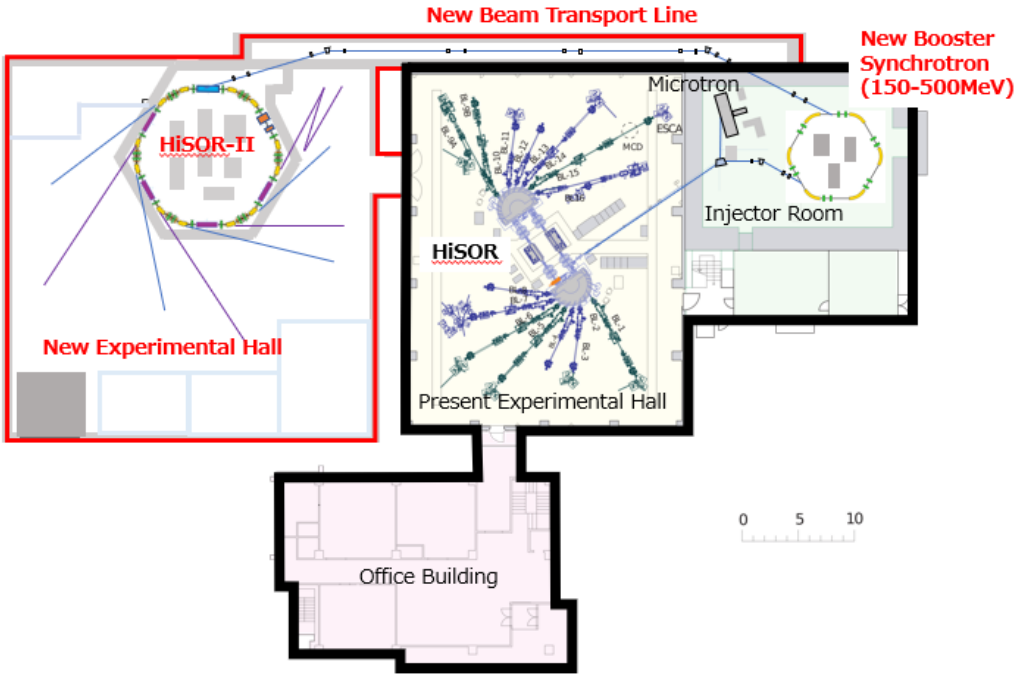

FIGURE 2. An example of the layout of the facility with a design of HiSOR-2 storage ring with 40 m circumference.

It should be noted that, in HiSOR-2, the bending magnets will be normal conducting and have ordinary field strengths such as around 1 T. In addition, the electron energy is lower than the present HiSOR. The bending radiation will not cover the X-ray range. This may strongly limit the application fields of new facility. The accelerator layout shown in Fig. 2 enables us to operate the present HiSOR even after the construction of HiSOR-2.

REFERENCES

1. M. Katoh *et al*., *J. SYNCHROTRON RAD.* 5(3) 366 - 368 (1998).
2. M. Katoh *et al*., *Nucl. Instr. Meth. A*. 467, 68 - 71 (2001).
3. http://rsc.riken.jp/pdf/SPring-8-II.pdf.
4. S. Matsuba *et al., J. Phys. Conf. Ser*. 1350 012015-1~5 (2019).
5. Y. Lu *et al*., in these proceedings