Overview of New SUBARU

New SUBARU Project Team

1 . Introduction

New SUBARU is a name of the project to construct an 1.5 GeV synchrotron light source ring in the SPring-8 site using the 1.0 GeV Linac as an injector. Laboratory of Advanced Science and Technology for Industry (LASTI) of Himeji Institute of Technology is in charge of construction collaborating with SPring-8. The project is supported by the local government, Hyogo prefecture. The first stage of the construction will be finished until the end of March 1998. The cost is about 50M$, including the housing of the ring and two beam lines. Fig.1 shows a flat view of the building, now under construction.

The ring covers the region from VUV to soft X-ray, and is capable of offering hard X-ray and IR using insertion devices. This energy region is suitable for industrial uses, such as X-ray micro lithography, LIGA for micromachining, material processings, etc. The ring is expected to stimulate industrial activities and supply seeds of new technology for industry in Hyogo, which was damaged by the terrible earth quake in 1995. The ring will be used not only to promote industrial activities but also to develop research works of future accelerator technology and play an important role in a big research complex including SPring-8.

The ring is designed to be comprehensive with the 8 GeV low emittance storage ring. It was not a low emittance ring, but having a high flexibility of operation and then to be convenient for R&D. Two main characteristics of the ring lattice are variable momentum compaction factor with invert dipoles and two free straight sections as long as 14 m each. A quasi-isochronism or controllable momentum compaction factor would be one of key techniques of future electron synchrotron. It would supply a short pulsed light in synchrotron light source rings, high gain of ring FEL, high luminosity for collider rings and low longitudinal emittance in damping rings. The long straight sections will be used for a development of insertion light sources such as Optical Klystron.

2. Ring Lattice

The storage ring is of a race track type with two fold symmetry. Table1 summarizes main storage ring parameters. It has 6 quasi-isochronus and achromatic bending cells and 6 dispersion free straight sections. Two short straight sections are used for an injection and RF acceleration and the other four are used for insertion light sources. A type of the bending cell is a modified DBA and one cell has two normal dipoles of 34 degrees in each and one inverse dipole of -8 degrees. The ring has 7 quadrupole families; two families in the dispersive sections are used to control al keeping the achromatism, the other five families in short and long dispersion free sections are used to control beta functions and betatron tunes. A number of sextupole families is five. Three families in the dispersive sections control two chromaticities and nonlinear momentum compaction factor (a2) independently. The other two families are used to extend the dynamic aperture of the ring.

Table. 1 Parameters of New SUBARU ring.

Injection Energy	1.0 GeV
Storage Energy	1.0 ~ 1.5GeV
Nominal current	500 mA (multi-bunch)
Circumference	118.71 6 m
Betatron tunes	6.21/2.17
α_1	-0.0012~ +0.0011
RF cavity	1
RF frequency	500 MHZ
RF voltage	250 kV
harmonic number	198
parameters at 1.5GeV	
Bending field m	1.55 T
critical photon energy	2.33 keV
Natural energy spread	0.072 %
Damping time τ_L	3.42 ms
τ_H, τ_V	6.56, 6.73 ms
synchrotron tune	0.0021 (α_1 = 0.0012)
bunch shortening limit	0.1 ps (0.03 mm)
Beam lifetime	10 hrs

3. Beam Lines

Four beam lines for insertions and another four for bending magnets will be constructed until the end of FY2000. Parameters of insertion light sources are summarized in Table2. Two of insertion light sources, short undulator and long undulators use permanent magnets and the other two use electric magnets. Especially a period of the undulator of the Optical Klystron is changeable. With all of them the ring covers very wide range of photon energy. Expected brilliance of photon beam is shown in Fig.2.

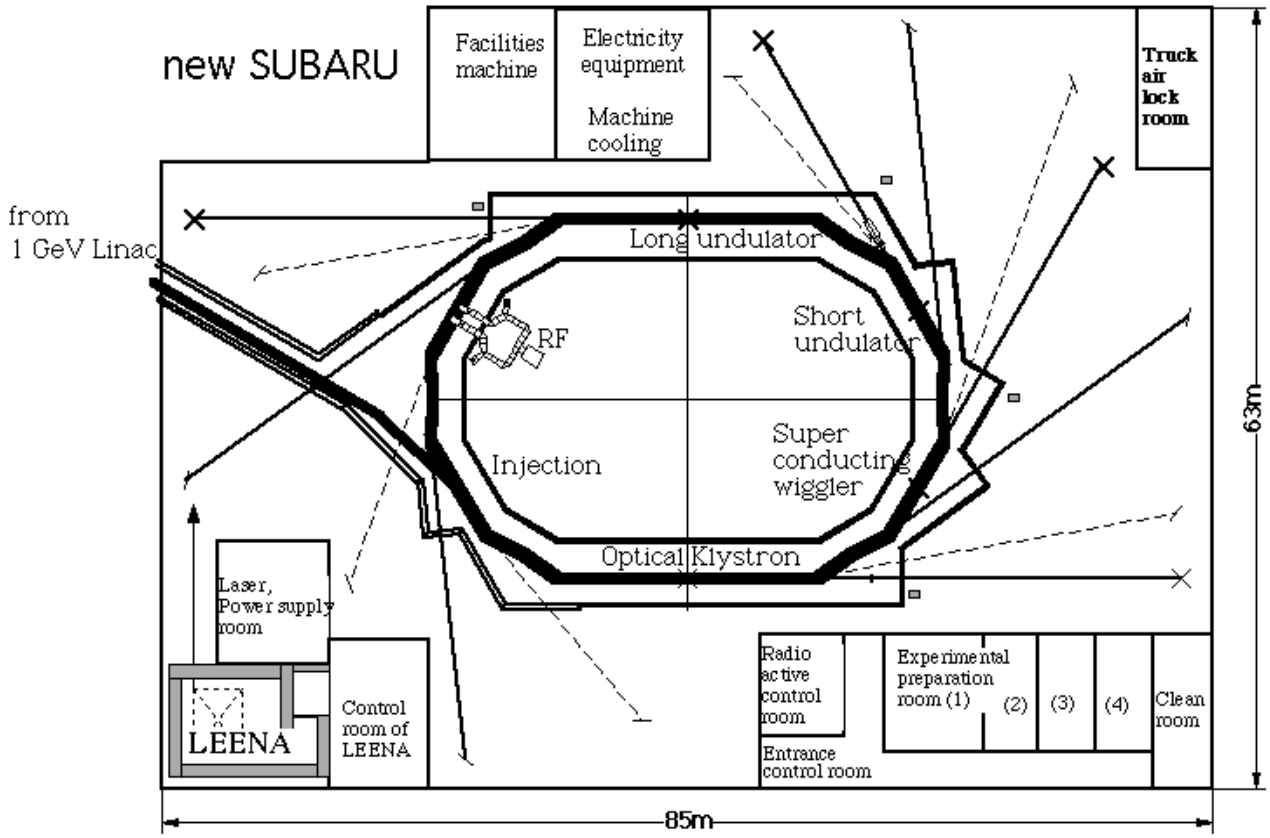

Fig.1: Flat view of the building including beam lines and the ring. Beam lines represented by solid lines are planned to be built and broken lines are future options. A 15MeV Linac (Laser Enhanced ElectroN Accelerator: LEENA) dedicated for IR-FE: occupies one corner.

Table. 2 Insertion light sources. Wave lengths for superconducting wiggler are those of critical energy.

Insertion device	Period (mm)	gap (mm)	K	No. of period	field (T)	wave length (nm) 0.5GeV	1.5GeV
Short undulator	80	23 ~ 59	6.3 ~ 1.6	30	0.85 ~ 0.21	220 ~ 23	97 ~ 10
Long undulator	60	31 ~ 48	2.3 ~ 0.95	200	0.41 ~ 0.17	28 ~ 11	13 ~ 5
S.C. wiggler	350	30	262	1	8	0.23	0.14
Optical Klystron	160	40	2.99	68	0.2	114	51
	320	40	4.48	34	0.15	461	205

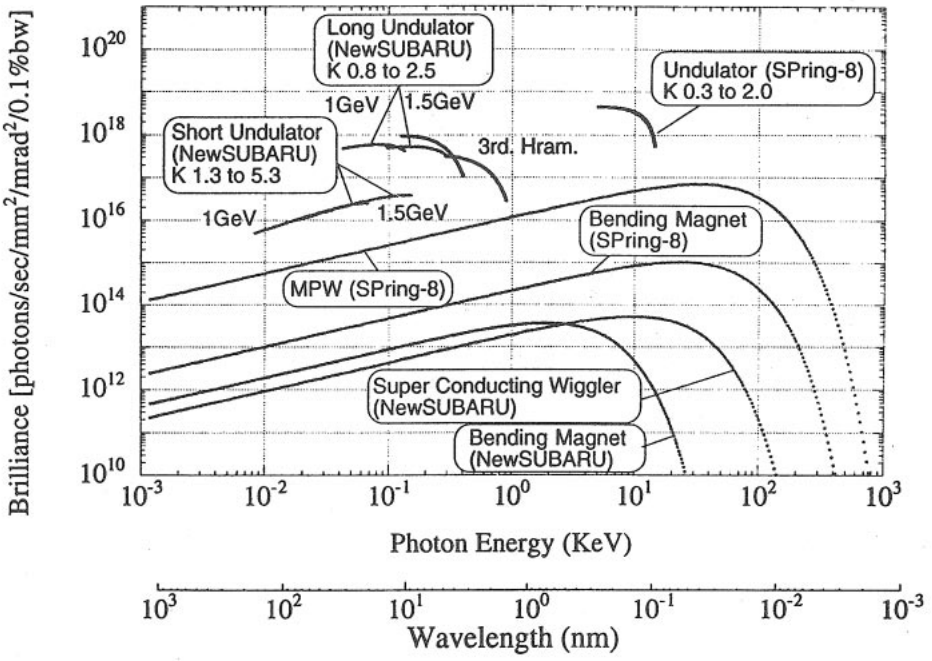

Fig.2 Brilliance of New SUBARU photon beam.