Electron Storage and Stretcher Ring, KSR

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An electron storage ring with the maximum energy of 300 MeV and critical wavelength from the dipole section of the 17 nm is under construction. It will also improve the duty factor of the electron beam with the energy of ~100 MeV attaining the average number of 10^{12} electrons per second with the fairly lower peak current of 0.3 μA, which is suitable for counter experiments.

Keywords: Storage Ring/ Synchrotron Radiation/ Insertion Device/ Pulse Stretcher/ Duty Factor

In order to provide a synchrotron light source in the wavelength of vacuum ultraviolet and soft X-ray region, an electron storage ring KSR with the maximum energy and the curvature radius of 300 MeV and 0.835 m, respectively has been under construction. The critical wave length of the synchrotron radiation from the dipole magnets is 17 nm, while the insertion device can provide radiation with an additional wavelength region. For example, superconducting wigler might generate the light with the wave length of several nm[1,2]. The detailed specification of the insertion device should be fixed after enough discussion on the research capabilities utilizing the light source. Further KSR has also such a role as enables the preparatory researches for experiments at the large research facility like Photon Factory at KEK or SPring-8 in Harima Science City.

The researches utilizing the 100 MeV electron beam of the linac[3] such as Parametric X-radiation from crystals [4] and transition radiation from multi-layers of thin foils are being carried out. Its small duty factor as 2×10^{-5}, however, causes a severe limitation on these experiments. The peak current of the linac must be reduced to 1mA to avoid the pile up of the signal pulses which results in the average number of electrons of the order of 10^9 per second. So the possibility to improve the duty factor of the electron beam to ~90 % with use of KSR is also studied. With this method, the average number of electrons per second is expected to increase to ~10^{12} keeping the peak current as low as 0.3 μA if the output beam from the linac with the peak current of 100 mA is injected and stretched at repetition rate of 10 Hz[5]. For this purpose, the electron beam is injected into the KSR by three-turn injection during 0.3μs. Then immediately after the injection, the beam emittance is increased with use of the transverse RF electric field which resonates with the horizontal betatron oscillation. The electrons which come to

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Scope of research

Particle and photon beams generated with accelerators and their instrumentations both for fundamental research and practical applications are studied. The following subjects are being studied: beam dynamics related to the space charge force in the accelerators: beam handling during the injection and extraction processes of the accelerator ring: radiation mechanism of photon by electrons in the magnetic field: interactions in the few-nucleon systems: R&D to realize a compact proton synchrotron dedicated for cancer therapy: and irradiation of materials with particle and photon beams.

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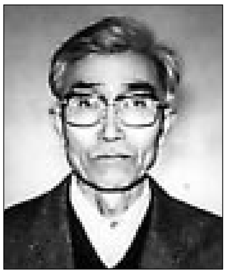

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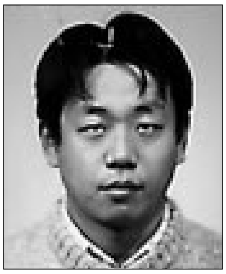

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the boundary of the separatrix will become unstable and jump into the electrostatic septum to be extracted out from the ring[6],[7]. The KSR ring has two long straight sections 6.2 m in length. One of them will be dedicated for an insertion device and the other should include both injection and extraction channels. Such configuration has a merit of utilizing common beam dump between the linac and the stretcher ring, KSR.

The magnets had been precisely aligned with the precision of better than ±0.1 mm in 1995 and this year the vacuum vessels have been installed into the magnets in two arcs. Evacuation of the arc part has already been started. These sections are considered to require longer aging time to realize good enough vacuum pressure because of the heating due to synchrotron radiation compared with the straight sections. The control and power feeding system of the magnets and vacuum has also been completed to prepare the beam circulation test. Detailed design of the insertion device and injection and extraction apparates is now under way.

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Table 1. Parameters of KSR

Beam Energy	
Storage Ring Mode	100~300 MeV
Stretcher Mode	~100 MeV
Circumference	25.689 m
Lattice Structure	Triple Bend Doubly Achromatic
Radius of Curvature	0.835 m
Bending Angle	60°
n-value	0
Edge Angle	0°
Length of the Long Straight Section	6.19 m
RF Frequency	116.7MHz
Harmonic Number	10
Number of Betatron Oscillations	
Horizontal Direction	2.75
Vertical Direction	1.25
Superperiodicity	
Storage Ring Mode	2
Stretcher Mode	1
Critical Wavelength (Dipole Section)	17 nm

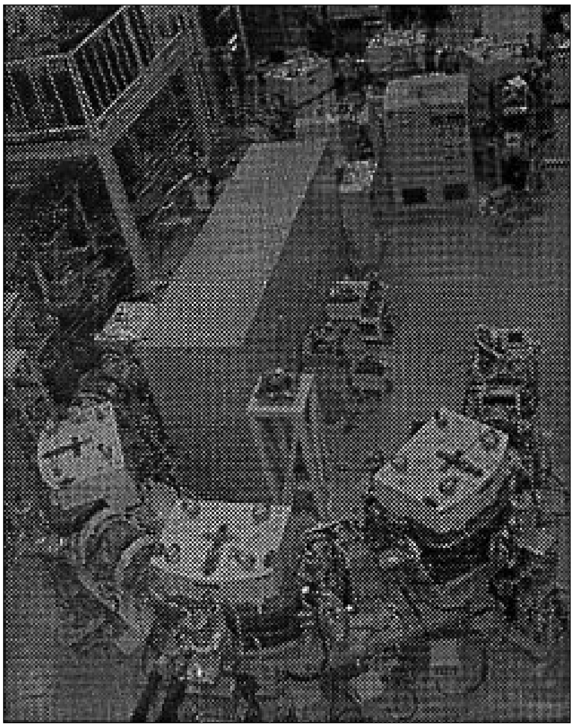

Figure 1. Overall View of the KSR.