Synchrotron

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Introduction

The booster synchrotron for SPring-8 was designed to accelerate electron or positron beam from 1 GeV to 8 GeV with the repetition cycle of 1 Hz. The construction of the synchrotron was started in 1993. To confirm the specification of the main components, some instruments were fabricated in advance and tested. One bending, one quadrupole and one sextupole magnet were made and the magnetic field-distributions were measured. One bump, one kicker and two septum magnets for the beam extraction were made. Following the field measurement, a few improvements were made. For each magnet, the magnetic field-distribution and the wave form of the magnetic field in the pulsed-operation were measured. All results of the measurements confirmed that they conformed to their specification.The high-power test of the first RF-cavity was completed successfully. The calibration test of the beam-position monitor with the button-type electrodes and the signal processing circuits is now started.

Magnets

The synchrotron magnets comprise 64 dipole magnets, 80 quadrupole magnets, 60 sextupole magnets and 80 correction magnets. The core of each magnet is stacked with 0.5 mm thick, silicon steel laminations. The dipole magnet has a C-type core with a pole width of 140 mm and is curved with parallel end plates. The pole length is 2,870 mm. The maximum field-strength of the dipole magnet is 0.9 T. The bore radius and the length of the quadrupole magnets are 70 mm and 0.57 m respectively. Corresponding figures for the sextupole magnets are 100 mm and 0.15 m. The quadrupole and sextupole magnets are constructed with a two-piece core-structure. The maximum field strengths of these magnets are 15 T/m and 200 T/m^2, respectively.

RF Cavity

The synchrotron uses 508.58 MHz RF-system, which is the frequency that is delivered from the same oscillator in the storage ring. The total RF-power requirement is 1.69 MW. Two 1-MW KEK-type klystrons are used as the power source and provide the power for 8 five-cell cavities. The RF power from a klystron is divided equally into the four cavities using three magic-T splitters. The required RF-voltage is increased linearly from 8 MV to 18.7 MV during the acceleration. The effective RF-voltage is changed by controlling the phases of the RF power between the two klystrons, keeping the output power of the klystrons constant. The phase difference between the two klystrons, 131 and zero degrees, corresponds to the total RF-voltages, 8 and 18.7 MV, respectively, at the constant-klystron output-power of 845 kW.

Beam Position Monitor

The beam position is measured at every quadrupole magnet, thereby giving a total of 80 measuring-positions around the circumference of the synchrotron. Each beam-position monitor (BPM) consists of a set of four button electrodes mounted on the wall of the vacuum vessel. The signals from each BPM are transmitted through low-loss, high-frequency cables to the detector circuits via fast pin-diode switches. For real-time measurements of beam position during ramping, 4 detector circuits are used for 80-BPMs.