Design of Magnet System for a Local Bump Feedback at Variably Polarizing Undulator Section

Teruhiko BIZEN, Taihei SHIMADA, Masaru TAKAO, Yoichi HIRAMATSU and Yoshikazu MIYAHARA

SPring-8, Kamigori, Ako-gun, Hyogo 678-12, Japan

1. Introduction

A local bump feedback system is under construction to correct the orbit distortion caused by magnetic field errors of a double array undulator which generates linear and circular polarization of light for a soft X-ray beamline. This feedback system is composed of a beam position monitoring system (BPM system) and a magnet system. The BPM system measures the beam position and calculates the local bump orbit to be formed. The local bump orbit is created by a magnet system which is composed of a several-turns long coil and four steering magnets. These magnets are controlled from the VME system which also controls the undulator and BPM system.

2. Design of magnet system

2-1 Magnet

The layout of the magnet system is shown in Fig.1. The long coil is attached to the stainless steel vacuum chamber inserted in the gap of the undulator. The coils for vertical magnetic fields is 2m long two turns coil. The horizontal coils are divided into two sets of four coils to avoid the interference with the vacuum pump port. The long coil is designed not to interference with the undulator jaws when the gap distance is closed to 20mm. These coils are capable to take away when the vacuum chamber is baked out. The steering magnets are located at both ends of this undulator section. The system of four steering magnets is possible to control both position and angle of a local bump orbit. Both long coil and steering magnet are composed of horizontal plane coils and vertical plane coils which is able to excite separately, so the local bump orbits on the horizontal and vertical plane are created independently. These coils are air cored coil made of solid copper conductor for its fast response.

Maximum field strength of the long coil is 500×10^{-6}Tm which is enough for canceling the magnetic errors caused by the undulator. The kick angle of the long coil is determined as a function of the gap distance and the array phase of the undulator. This function has been made by the interpolation of the magnetic fields data measured at the factory. These data will be correct on the table displayed on the operator console during the machine study period. The value of the gap distance and the array phase of the undulator is measured by the rotary encoder and the linear scale encoder and fed into the VME-bus CPU (HP9000-743rt/64). The CPU calculate the kick angle of the long coil using this function and control the magnet power supply. The fluctuation of the magnetic errors caused by the gap distance and the array phase of the undulator is very slow so the control frequency of the long coil is DC like.

The steering magnets are excited to eliminate fast and residual orbit distortion which cannot be corrected by the long coil. Figure 2 shows the calculated longitudinal distribution of horizontal and vertical magnetic fields of

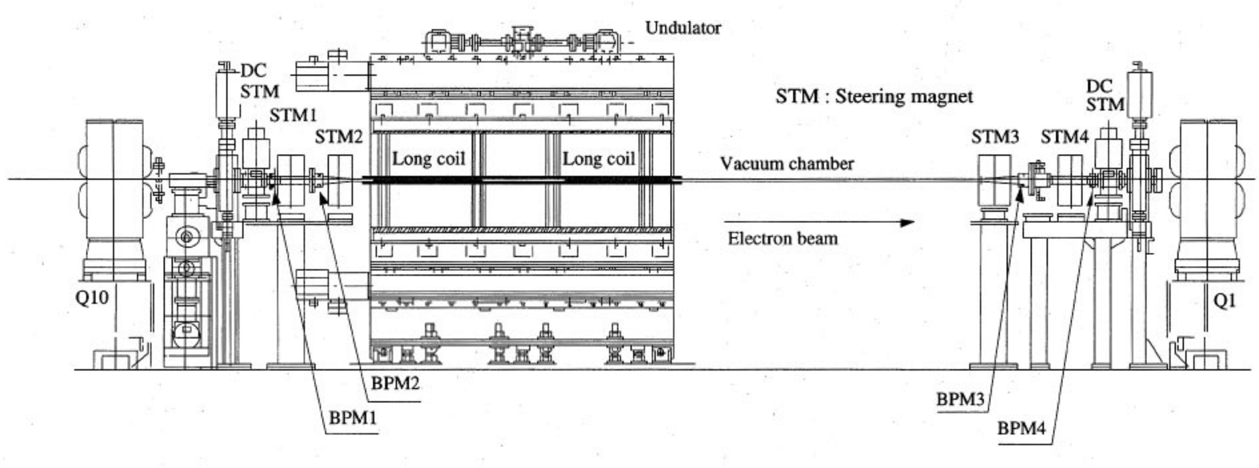

Fig.1 Layout of the magnet system

the steering magnet. Maximum field strength is 200×10^{-6}Tm for horizontal and 240×10^{-6}Tm for vertical. This field strength is capable to correct ±20μm and ±1μradian distortion of the beam at the first beam position monitor (BPM) of this section. A local bump orbit to decrease the COD and stabilize the photon beam from the undulator is calculated by the BPM system, and the VME-bus CPU control the kick angles of four steering magnets.

2-2 Power supply

The same type of magnet power supply is adopted for the long coil and steering magnets in this system. The polarity is a bipolar and the maximum supply current is ±15A. The maximum variable speed of current is 1A/msec and the maximum delay time of the output is less than 5msec. All power supplies are linked to a VME system by RIO (Remote I/O) so ten sets of coils are excited sequentially. The total time to excite all magnets will be 7msec, so this feedback is performed at a rate of 100Hz.

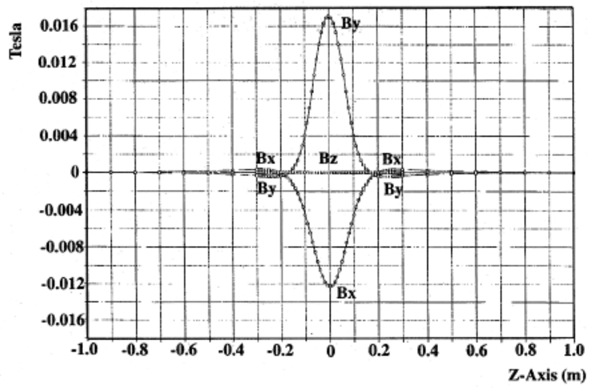

Fig.2 Calculated distribution of horizontal and vertical magnetic fields