Construction and Tuning of an APPLE-2 Type Variable Polarizing Undulator in the SPring-8 Storage Ring

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Abstract

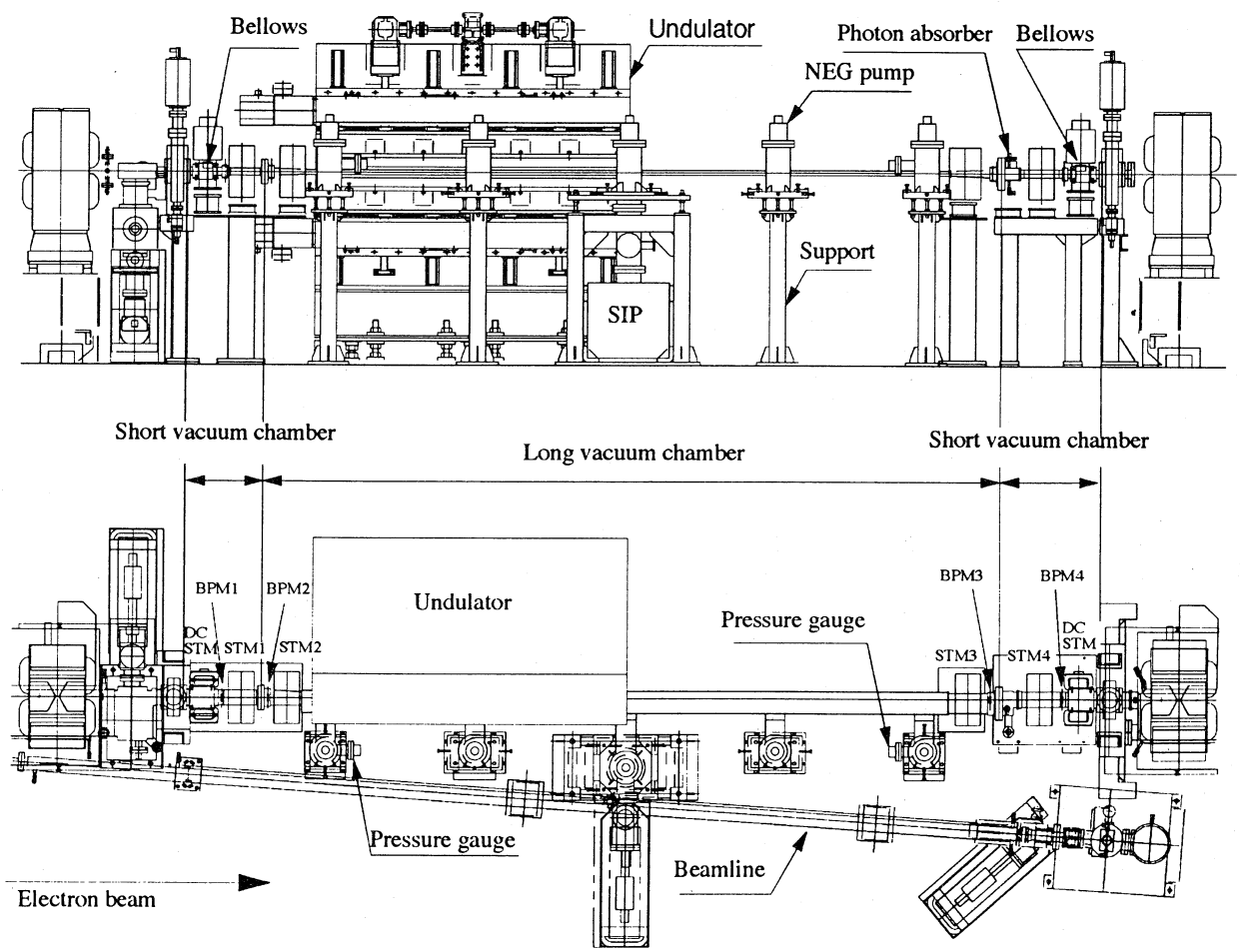
This report presents the status of construction and tuning of an APPLE-2 Type Variable Polarizing Undulator for soft X-ray beamline in the SPring-8 Storage Ring. The required rate to switch right and left circularly polarized radiation is 0.5Hz.

1 Introduction

An APPLE-2 type variable polarizing undulator (ID23) as the light source of the soft X-ray beamline (BL23SU)[1] has installed into the storage ring in 1998 after the fabrication and the magnetic field measurement[2]. The ID23 generates a linearly (horizontal or vertical plane), an elliptically or a circularly polarized radiation by shifting the phase position of the magnet rows of the undulator. The most important performance of the ID23 is switching of right and left circularly polarized radiation at 0.5Hz by periodic phase driving of the magnet rows[3]. This feature is expected to promote a study of circular dichroism in spectroscopic research fields. Main parameters of the ID23 are shown in Table 1.

Table 1: Design parameters of the ID23

Device type	APPLE-2
Period length	120 mm
Period number	16
Available gap range	20~300 mm
Available phase shift range	-120~+120 mm
Switching rate (right~left~right)	0.5 Hz
Peak field for horizontal polarization	By=0.55 T
Peak field for vertical polarization	Bx=0.55 T
Peak field for circular polarization	By=Bx=0.39 T



In order to minimize the closed orbit distortion induced by residual errors of the integral field, which vary with the gap or phase shift motion[2], we must tune the current set of some correction magnets for the ID23 as the function of the gap and phase position dynamically.

2 Status of ID23 System

The outline of the ID23 system is shown in Figure 1. The ID23 system is consist of an APPLE-2 type undulator[2][3], a vacuum system[4], correction magnets[5], beam position monitors[6] and a control system[7][8]. The ID23 system is installed at the straight section of the cell23 in the storage ring.

The degree of vacuum in the chamber of the ID23 section is kept about $3X10^{-8}$ Pa in the ordinary beam operation (stored current~70mA) with five NEG pumps and one SIP. This is satisfactory for in the beam operation.

Two correcting magnets (STMs in Fig.1) are installed at the upstream and the downstream of the undulator respectively. In addition a long coil correcting magnets are attached to the vacuum chamber inserted in the gap of the undulator. Each magnet can generate By and Bx and is air core one for fast (100Hz) control. We can minimize the closed orbit distortion induced by residual errors of the integral field of the undulator and adjust the direction of the X-ray radiation with using these magnets independent of other cells.

The control system operates correction magnets at 100Hz (this is design value, in actual ~30Hz) to compensate by local bump method the residual errors of the integral field which vary with the gap or 0.5Hz phase shift motion.

3 Status of Tuning

As the ID23 is available for beamline users, it is indispensable to complete the local bump (the orbit distortion $< 0.1\sigma$ at every point of the storage ring) and to keep the direction of the radiation (the direction variation $< 0.1\sigma$ at the end of beamline) during gap or 0.5Hz phase shift motion.

We have tried at the first stage to compensate statically the residual errors of the integral field with only long coils. We have scanned the excitation current of the long coil to get the current set (we call "correction table") to minimize the closed orbit distortion at every gap or phase position by a single kick model. The amplitude of the residual closed orbit distortion in a single kick model is $<10\mu m$ for X and $<5\mu m$ for Y using this table. One of roots of the residual distortion is the errors of the secondary integral field of the undulator witch are not be able to be corrected by one correction magnet. So we are tuning the current set of two correction magnets (upstream and downstream of the undulator) to complete the local bump orbit at every gap or phase position statically.

By the way, we must control the correction magnets as the function of the gap and phase position at 0.5Hz dynamically. The control system is ready[7][8]. We are trying these control system soon. Because the interval of the COD measurement is about 30 sec in the storage ring , we are using other system to measure the distortion of the closed orbit with the 0.5Hz phase shift motion. We are confirming to complete the local bump correction by measuring the variation of the direction of the X-ray radiation from other insertion device or the variation of a rf-BPM output signal synchronizing the phase shift motion of the ID23.

References

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