PRESENT STATUS OF INSERTION DEVICES AT THE BEPC

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Abstract

The paper brief introduces the insertion devices was operated in Beijing Electron Positron Collider (BEPC) and two new multipole wigglers of hybrid type are planned to construct as part of the BEPC upgrade project. The magnetic and mechanical design of two new wigglers are described in this paper. Also given is the characteristics of the wigglers radiation.

1 Introduction

Beijing Electron Positron Collider (BEPC) is a facility which is mainly for high energy physics experiments (operation under parasitic mode), while partially for the application of synchrotron radiation (operation under the dedicated mode with electron energy of 2.2 GeV, beam current of 120 mA).

Table 1. Main parameters of the BEPC

Designation	Parasitic Mode	Dedicated Mode
Energy (GeV)	1.6 - 2.2	2.2
Luminosity ($cm^{-2}s^{-1}$)	$(2 - 7) \times 10^{30}$	
Current (mA)	2×26	50 - 120
Horizontal emittance (nm.rad)	390	76.0
Vertical emittance (nm.rad)	26	7.6
Beam lifetime (hr)	7	20

2 Insertion Devices operated in BEPC

There are two wigglers operated in BEPC up-to-now. One is a single period conventional electromagnetic wiggler 4W1 (Wavelength shifter)[1], while the other is multipole permanent magnet wiggler 3W1[2]. (see Fig. 1 ,2). The main parameters of these wigglers are as follows:

Table 2: Main Parameters of 4W1 and 3W1

Wigglers	4W1	3W1
Period Number	1	5
Period (cm)	135	30
Total Length (m)	1.78	1.75
Full Aperture Height of the Vacuum Chamber	56(mm)	31(mm)
Operation Gap g (mm)	66	43
Range of Gap Variation (mm)		39~220
Magnetic Field @ Oper. Gap B (T)	1.8	1.42@gap=43mm
Deflection Parameter K Value	228	40
Critical Energy (KeV)	5.79 @ E=2.2 GeV	4.57 @ E=2.2 GeV
Brilliance ($Ph/s.mm^2.mr^2.0.1\%BW$)	$\sim 8 \times 10^{12}$	$\sim 6 \times 10^{13}$

Figure 1: single period electromagnetic wiggler 4W1

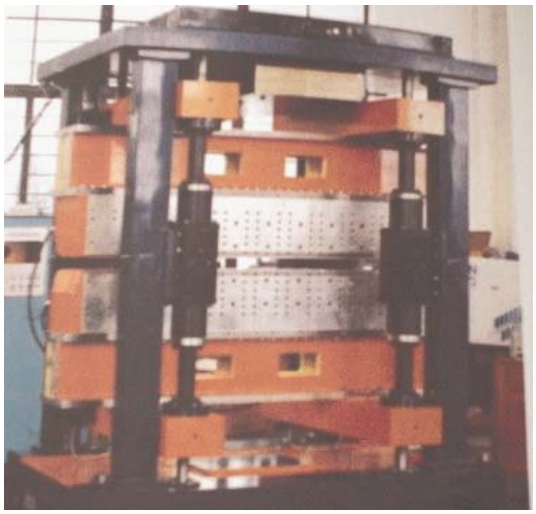

Figure 2: multipole permanent magnet wiggler 3W1

3 BEPC Upgrade Program

BEPC will be upgraded to BEPC II in the near future. The brightness for high-energy physics experiments will increase one order, and the electron energy for Synchrotron Radiation Dedicated Mode will be upgraded to (2.5 GeV, 300 mA) or (2.8 GeV, 200 mA). During the period of the BSRF upgrade project, two new multipole permanent magnet insertion devices are planned to constructed. To enhance the photon brightness and photon energy of synchrotron radiation, one (1W1) is a out-of-vacuum wiggler which will be installed in the 1st quadrant, and from which two beamlines for XAFS and Diffusion Scattering station, respectively, will be elicited; the other (4W2) is primarily designed as a In-Vacuum Wiggler[3,4,5], which will be installed in the straight line in the 4th quadrant of the storage ring, and from which one beamline for high pressure diffraction station will be elicited (see Fig. 3).

4 Magnetic and mechanical Design

These two new insertion devices will be hybrid multipole C-type structure wigglers[6,7]. The peak magnetic field specified for the 1W1 is 1.4 Tesla at 39mm gap, and the 4W2 is 1.8 Tesla when 12mm minimum gap.

The wigglers magnetic field calculation has been finished with Pandira 2D and the approximate analytical expressions of 3-dimensions[8,9]. The magnetic field distributions at the midplane for two wigglers are illustrated in Fig. 4 and 5. The specification for the new wigglers is given in Table 3. The 3D mechanical structure from two wigglers are illustrated in Figure 6 and 7.

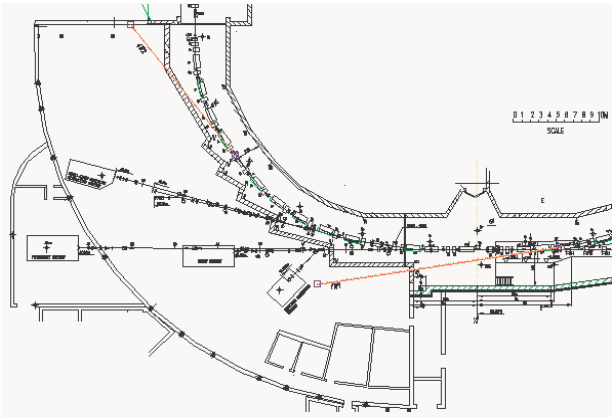

Figure 3: layout of new wigglers in BEPC

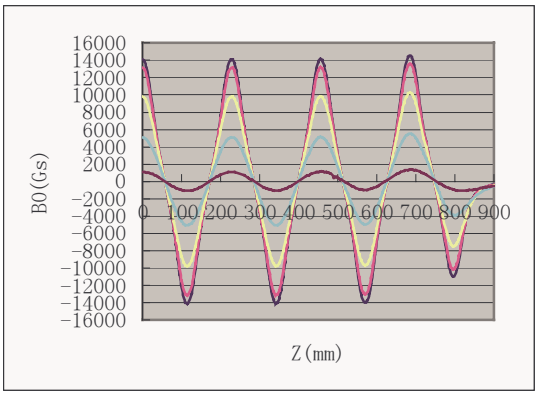

Figure 4: The magnetic field distributions at the midplane of 1W1

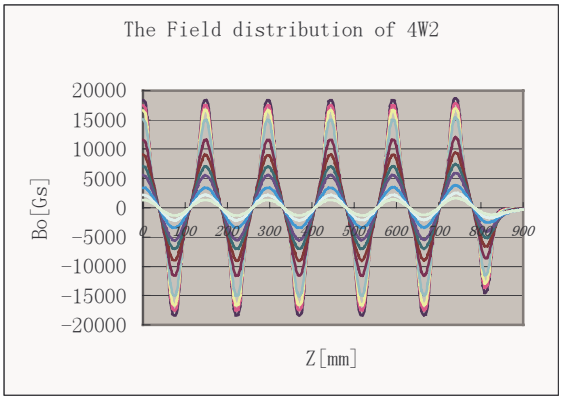

Figure 5: The magnetic field distributions at the midplane of 4W2

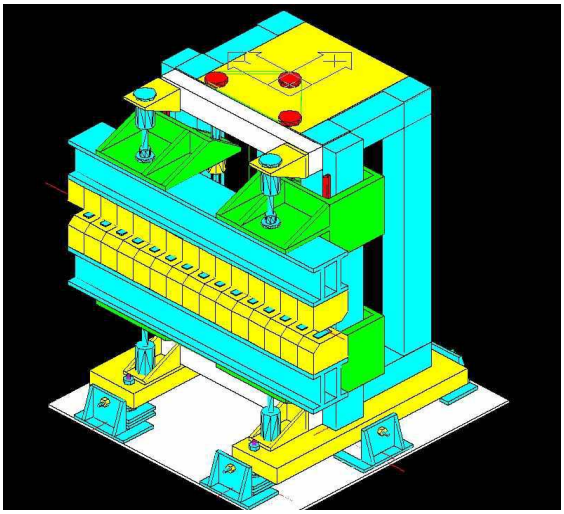

Figure 6: The 3D sketch map of 1W1

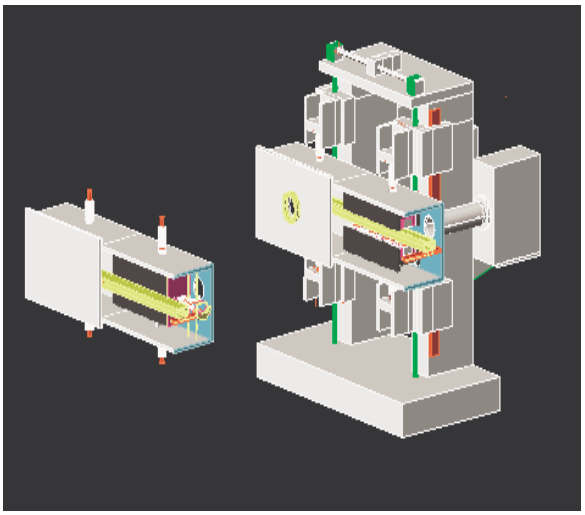

Figure 7: The 3D sketch map of in-vacuum wiggler(4W2)

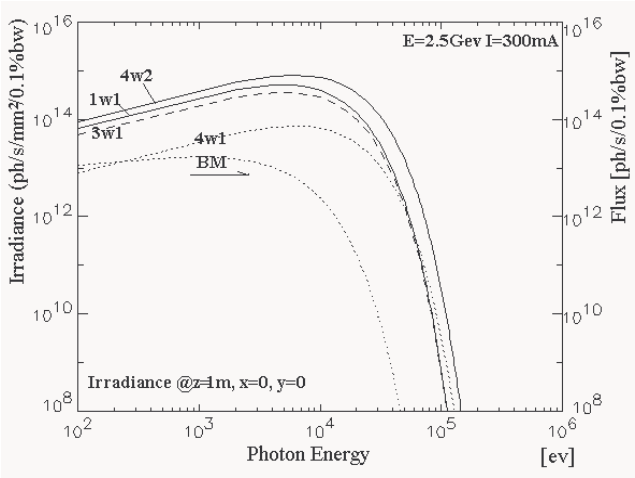

Figure 8: Irradiance calculated from wigglers at BEPC

Table 3: The specification of the 1W1 and 4W2

Wigglers	1W1	4W2
Type	Out-of-Vacuum	In-Vacuum
Number of Periods	7	11
Period length (mm)	228	150
Straight Line Length (m)	1.8	2.2
Range of Gap Variation (mm)	30~200	12~120
Operation Gap (mm)	39	12
Magnetic Field @Oper. Gap (T)	1.4	1.8
Deflection Parameter K Value	30	25
Critical Energy (KeV)	5.8@ E=2.5 GeV; 7.3 @ E=2.8 GeV	7.48@E=2.5 GeV 9.38@E=2.8 GeV

5 Performances of the synchrotron radiation for the wigglers at BEPC

The flux and irradiance of the X ray radiation from four wigglers at BEPC are calculated as shown in figure 8. We can find that the characteristics of the synchrotron radiation for the designed two wigglers is superior.

6 References

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