PA25

A DESIGN OF THE INJECTION SCHEME AND A CONSTRUCTION OF MODEL KICKER MAGNET FOR THE HIGH BRILLIANCE LATTICE OF THE PHOTON FACTORY

Toshiyuki MITSUHASHI, Masahiro KATOH, and Akira UEDA

Photon Factory, National Laboratory for High Energy Physics, Oho,Tsukuba,Ibaraki, 305 Japan

Abstract

New injection schemes for the three kind of low emittance lattices of the photon factory was designed. A traveling wave type kicker magnet is applied to make a injection pulse bump. A model kicker magnet was also designed and constructed. The magnet is traveling wave kicker magnet and the impedance of the test magnet was designed to 6.25Ω. The experimental measurement of properties of the magnet will be mentioned.

1. Introduction

In recent few years, the third generation high brilliant synchrotron radiation facilities are constructed and to start the operation. At the photon Factory, we are studied to design new high brilliant lattices those gives a small emittances near to the third generation synchrotron radiation source[1)2)]. In this paper, it is described that a design of the injection system for the high brilliant lattices of the Photon Factory and a construction of a test model of the kicker magnet.

2. Design of injection system

The design of the injection system consists of the four kicker magnets and the two septum magnets. Hence the injection point is just same position as in the previous lattice[3)], these pulse magnets are located almostly same place as in the previous arrangement[3)]. In the present new design, a fast injection bump(faster than the revolution time 624nsec) is applied to obtain an enough wide aperture for the first few turns of the injected beam. The present existing septum magnets are used again in the new system. Under these conditions, we optimized the design of the injection pulse bump for three set of high brilliant lattices. The phase advance of the lattices are 90degree, 105degree, and 135degree[1)2)]. In table 1, the parameters of the injection bumps and the positions and angles of the injected beam at the injection point are listed.

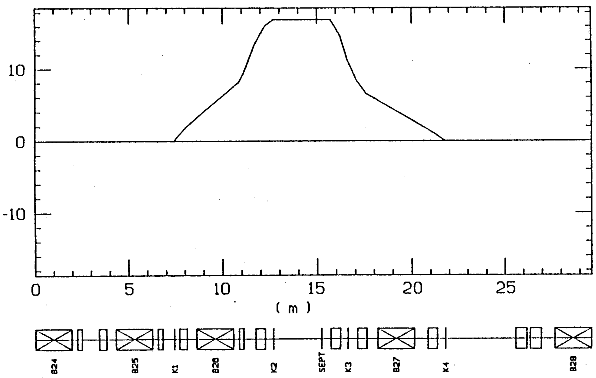
Table 1
injection parameters

	pulse bump (mm,mrad)	position and angle of injection beam (mm,mrad)
90° lattice	(17,0.0)	(27.5,1.5)
105° lattice	(17,0.0)	(27.5,1.5)
135° lattice	(17,0.0)	(27.5,2.0)

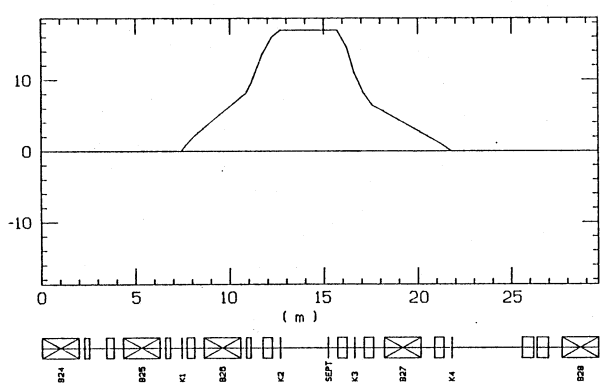
The design of the injection bumps are shown in Fig.1. The position and the angle of the injected beam are set 27.5mm and 1.5mrad or 2mrad. The magnitude and angle of the injection bump are set 17mm and 0mrad. The steering angles of the kicker magnets are listed in table 2.

Table 2
steering angles of the kicker magnets

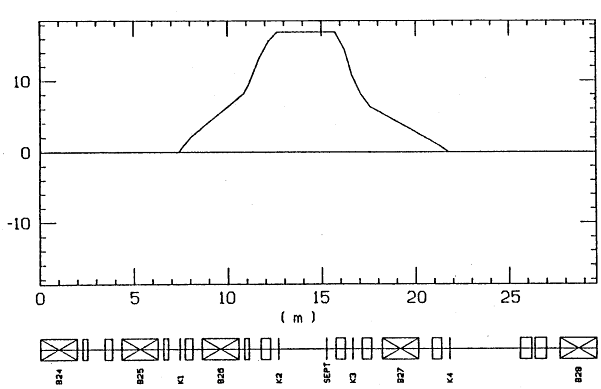
	90° lattice	105° lattice	135° lattice
K1	3.20 mrad	3.30 mrad	3.50 mrad
K2	-2.24 mrad	-2.30 mrad	-2.71 mrad
K3	3.14 mrad	3.43 mrad	3.91 mrad
K4	1.79 mrad	1.78 mrad	1.71 mrad



(a) bump design for the 90deg. lattice



(b)bump design for the 105deg. lattice



(c) bump design for the 135deg. lattice
Fig.1 design of the injection bumps

3. Construction of a model 6.25Ω-kicker magnet

As mentioned in previous section, a fast injection bump(faster than the revolution time 624nsec) is applied to obtain an enough wide aperture for the first few turns of the injected beam. To realize the fast injection bump, the traveling wave magnet is chosen as the kicker magnet. This magnet is divides the C-shaped ferrite core into discrete sections to form a uniform impedance transmission line[4)5)]. The sections are capacitively coupled to the return conductor through a discrete capacitors. To obtain intense magnetic field with limited space of the kicker magnet, the smaller characteristic impedance of the magnet is better. Recently, a 6.25Ω traveling wave magnet was developed by J.Dinkel et al. at the Fermilab[6)]. We also designed 6.25Ω traveling wave magnet, and to construct a test-model of the kicker magnet. The design parameters of the magnet are listed in Table 3.

Table 3
magnet design parameters

Magnetic length	360mm
Gap height	60mm
Gap width	170mm
Peak field	942Gauss(at 4500 A)
Characterristic impedance	6.25Ω
Field propagation time	187nsec
Number of cell	30cell
Imductance per 1cell	38.9nH
Capacitance per 1cell	996pF

A schematic drawing of the designed magnet is shown in Fig. 2. In this construction of the test-model, poll viniliden fluorite(PVdF)was used as a dielectric of the capacitor to obtain the capacitance of 996pF.

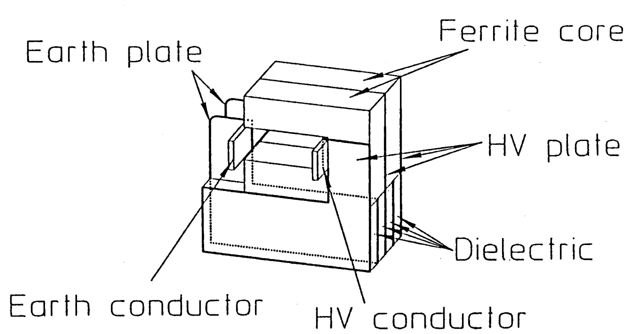


Fig.2 A schematic drawing of the magnet

A general view of the constructed test-model magnet is shown in Fig.3.

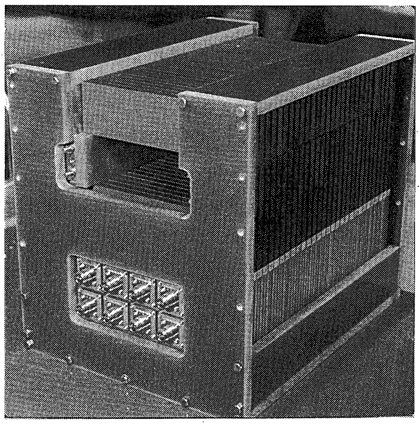


Fig.3 A general view of the test-model magnet

4.Capacitance and Inductance measurements of the test-model magnet

The 29-cell magnet's total capacitance and inductance were measured using an HP4284A Precision LCR Meter. Results of the capacitance and inductance measurements are shown in figures 4 and 5 respectively.

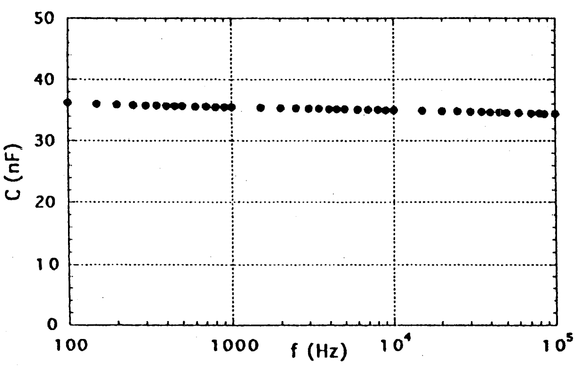


Fig.4 measured capasitance of the magnet

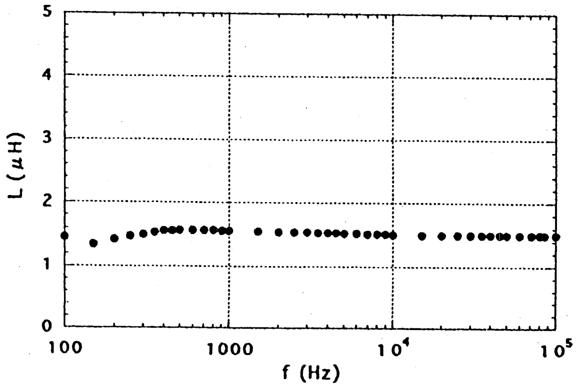


Fig.5 measured inductance of the magnet

In the frequency region from 1kHz to 100kHz,the measured capacitance is almost constant value 37.5 nF and the measured inductance is 1.6μH. By these values of capacitance and inductance, the characteristic impedance of the magnet conclude to be 6.5 Ω. A discrepancy between the calculated value of the characteristic impedance of 6.25Ω and measured value of 6.5Ω is considered to error in the inductance measurement and fringing effect from the edges in the capacitance measurement. The return connection between the conductors produce additional inductance.

references

1)Edited by M.Katoh and Y. Hori,"report of the design study on a high brilliance configuration of the PF storage ring" ,KEK report 92-20, (1993).
2)M.Katoh et al., some where of this proceedings.
3)T.Mitsuhashi,M.Katoh,T.Katsura,Y.Satoh, M.Kobayashi,S.Ohsawa,T.Urano,A.Enomoto, A.Asami,and T.Yamakawa,Particle Accelerators, Vol.33,87,(1990).
4)D.Finder, "Hardware for Full Aperture Kicker System for the CPS"CERN/MPS/SR71-5.
5)D.E.Anderson and L.X.Schneider, "Proc. of the 1993 Particle Accelerator conference", 1354,(1993).
6)J.Dinckel,B.Hanna,C.Jensen,D.Qunell and R.Reilly,"Proc. of the 1993 Particle Accelerator conference",1357,(1993).