THE 2 GEV POHANG LIGHT SOURCE

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At the Pohang Institute of Science and Technology (POSTECH) design studies for a 2 GeV synchrotron light source are in progress. It is fully funded by the Pohang Iron & Steel Company, Ltd (POSCO). The storage ring lattice has a 12 period TBA structure with separated function bending magnets. As a unique light source facility in Korea it is aimed at providing a wide range of radiation spectrum.

Introduction

A 2 GeV synchrotron light source project is in progress in Pohang, Korea. In April, 1988, 74 billion WON (≈US$110M) was donated by POSCO. Subsequently, the POSTECH formed a task force team to carry out design studies of a 2 GeV synchrotron light source. Construction is scheduled to be completed by the end of 1993.

The PLS system consists of a storage ring and a full energy electron linac. The storage ring is about 276 m in circumference and has a 12 period Triple Bend Achromat (TBA) structure with flat field bending magnets. Our initial design goal for the storage ring calls for 2 GeV in energy, 100 mA in current (for multibunch mode), and 10-70 nm rad in rms natural emittance. The storage ring should be able to supply synchrotron radiation continuously for no less than 5 hours. However, it is our wish to be able to upgrade the facility for a 2.5 GeV operation sometime in the future, and therefore many of the linac and storage ring parameters have been chosen to cope with these future requirements. Two beamlines per each bending magnet will be able to provide the users with total 72 beamlines for photoemission, SEXAFS, Diffraction Crystallography, EXAFS, SAXS experiments, etc.. At the center of the two straight sections, two insertion devices are planned to be installed for Diffraction, EXAFS, and Topography experiments.

Design studies for the injector linac is underway in collaboration with the Institute of High Energy Physics (IHEP) in Beijing, People's Republic of China.

In this paper, we introduce the overview of our PLS project. We describe parameters for the storage ring lattice, vacuum system, RF system, magnet power supply, control system, etc..

Storage Ring Lattice

Design parameters for the storage ring lattice are shown in Table I. The storage ring lattice has a TBA structure with 12 super-period. Total length of the ring is about 276 meters. Taking into account 2.5 GeV operation in the future, all the magnets are designed to provide adequate fields for operation between 2 and 2.5 GeV. A field of 1.21 Tesla was chosen for 2.5 GeV operation which resulted in a 1.2 m-long bending magnet. One noteworthy feature of the PLS TBA lattice is that it employs a separated function magnet. This is different from the conventional TBA lattice in which the bending magnet has a gradient to give vertical focusing and to reduce the natural emittance.

Fig. 1 shows the behavior of the lattice parameters. For a third-generation machine like the PLS storage ring, it is important to be able to provide a wide range of tuning capability. This need becomes especially pronounced when a storage ring is operated with insertion devices. The lattice shown in Fig. 1 enables us to control β functions and tunes without modifying beam emittance significantly.[1]

Table I Storage ring parameters

Tunes	$\nu_x = 14.28$, $\nu_y = 8.18$
Circumference	276.96 m
Natural emittance	13.6 nm·rad
rms beam size	$\sigma_x = 0.37$ mm, $\sigma_y = 0.16$ mm
Damping time	$\tau_x = 17.9$ msec, $\tau_E = 8.9$ msec
harmonic number	462
rms bucket height	2.4 %
chromaticity	$\xi_x = -22.8$, $\xi_y = -17.6$

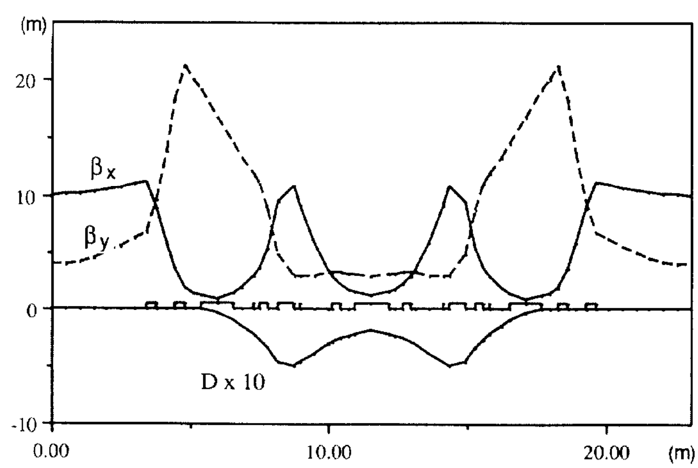

Fig. 1 Lattice functions for one cell

Magnet System

The storage ring magnet system consists of 36 bending magnets, 120 quadrupoles, 48 sextupoles, and some (possibly 4) skew quadrupoles, correction magnets, and injection magnets. A 1mm-thick ultra low carbon steel sheet made by POSCO will be used as a core material of the dipole magnet because of its high saturation induction, small hysteresis. and modest coercive force. Its magnetic and mechanical properties are under examination. The lamination sheet will be punched with

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a precision of 10 micron along the edge of the pole tips. The punching as well as the fabrication of the coil will be carried out by a local company in Korea which has experience in this field. Fig.2 shows the typical quadrupole magnet design.

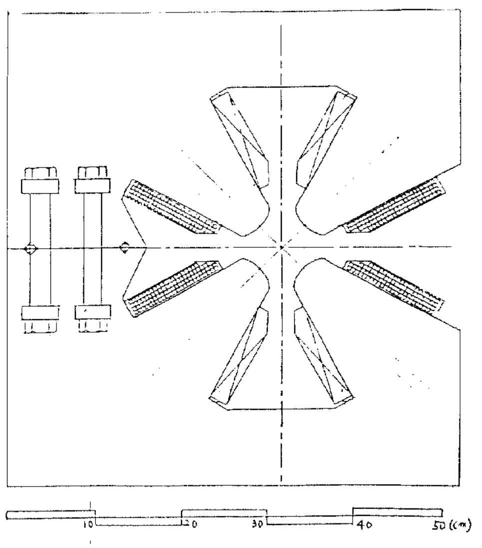

Fig. 2 Cross-section of the storage ring quadrupole

Vacuum System

Stainless steel 316 LN was chosen as the vacuum chamber material. This specific choice has been made because of its excellent vacuum and mechanical properties. Thermal issues may become an important consideration with stainless steel. Protection of the vacuum chamber from a misdirected photon beam produced in the insertion device region will be provided. A schematic diagram of a sector of the storage ring is shown in Fig. 3. This figure also shows the photon absorbers which will intercept most of the unused photons.The distribution of the bending magnet radiation power through one sector of the ring is shown in Fig. 4.

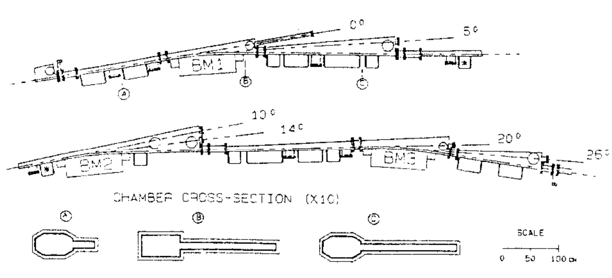

Fig. 3 Schematic diagram of vacuum chambers for one cell

Magnet Power Supply System

A stability of 50 ppm is the design goal for the PLS bending magnets and quadrupoles. The current stability includes effects due to normal power-line fluctuations, load variations, component drifts, and temperature coefficients over the range from 10^0C to 40^0C. All 36 bending magnets are electrically powered in series by a single power supply system consisting of a 12-pulse rectifier with an LC filter and a series transistor bank. Each quadrupole group located in the dispersive section

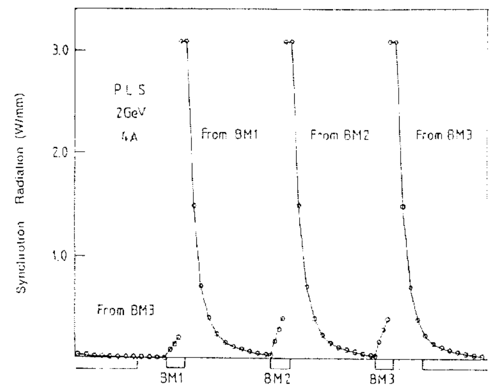

Fig. 4 Distribution of the bending magnet radiation on one sector of the vacuum chamber wall

is also powered by a single power supply. However, the remaining quadrupoles located in the non-dispersive section are individually powered by separate supplies. This is to allow easy control of the lattice functions, especially when insertion devices are placed in the straight section. At this time, it is our plan to have most of the power supplies manufactured by local companies under our technical support.

RF System

The RF system in a storage ring must supply enough voltage to cover various energy losses arising from bending magnet radiation, ID radiation, cavity ohmic loss, parasitic mode loss and some other miscellaneous higher mode loss. Also being considered during the initial design stage is the choice of RF frequency. At this point, 500.568 MHz has been selected as the accelerating frequency of the storage ring. For this frequency, there are several proven cavity designs, such as Daresbury, KEK, ALS, and BESSY. Studies on the difference in their designs in view of the PLS ring are in progress, and a final decision on the selection of the cavity type will be made shortly.

Control System

The host computer will serve as a machine control computer and also a general purpose computer. We will use a VAX 8550 for the host computer and the computing power 6 MIPS will be adequate to perform the off-line jobs while carrying out the routine control of the accelerator at the same time. The operating system of the host computer will be VMS. PLS will use a VAX station, SUN, and APPOLO workstations as a console computer which will feature 1-4 MIPS of CPU power, high resolution color graphics and a multi-window system. The operating system of the console computer will be VMS or some version of UNIX. All of the console computer will be connected to a host computer and process computers through ETHERNET. Four process computers will be engaged in executing most of the accelerator control programs written in C or Fortran during the operation. Three of them will be in charge of injection system, storage ring and beam line, and one will serve as the faculty backup and program development. DEC's MICRO VAX II will be used as process computer and VMS environment will help to maintain the software resource compatibility with the host computer. Fig. 5 shows the PLS control system network.

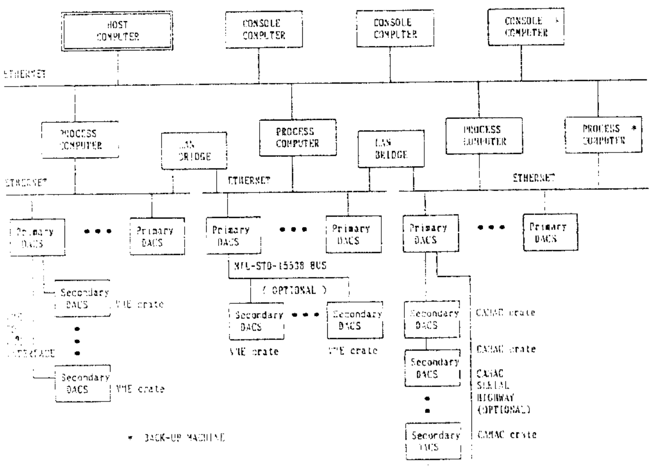

Fig. 5 PLS control system network

Injection System

We have considered two alternatives for the injection scheme: direct injection system from full energy linac versus conventional linac-booster synchrotron system. We have now decided to employ direct injection from full energy linac with technical collaboration from the IHEP group of the People's Republic of China. At the moment, design studies for a 2 GeV linac is underway. A 220 m-long space has been allocated for placement of the full-energy injector.

Summary

The PLS project is underway. It consists of a full energy linac and a storage ring. The linac is planned to be ready for operation by the end of 1992, and the design study is in progress. The storage ring is, at the moment, designed for a 2 GeV operation but will be capable of being upgraded to 2.5 GeV capacity in the future, without too much modification. PLS facility is intended to give an impetus not only to scientific research at the Pohang Institute of Science & Technology but also to the whole scientific community of Korea. When completed, this will be the first large scale science research facility ever built in Korea with the funds provided by a private company.

Acknowledgement

POSCO's commitment to Korea's scientific development made this project possible. We are grateful to all of the POSCO staff, especially Dr. T.-J. Park for his enthusiastic support of the project. We also acknowledge the great help and encouragement given by Dr. Hogil Kim, President of POSTECH.

Reference

[1] K.W. Nam et. al. in these proceedings