

SURVEY AND ALIGNMENT FOR SSRF

Xin Ouyang, Kaixi Huang, Chenghao Yu

Shanghai National Synchrotron Radiation Center, Shanghai, China

Abstract

The Shanghai Synchrotron Radiation Facility (SSRF) is a third generation synchrotron X-ray source, consists of a 300MeV Linac, 3.5GeV Booster and Storage Ring. The R&D of SSRF has been approved by the Science and Technology group of the Government, started early of 1999. This paper will describe the design of survey and alignment for the SSRF, including the control network, survey measurements.

1 INTRODUCTION

The Shanghai Synchrotron Radiation Facility (SSRF) is a third generation light source designed to produce high brightness and flux soft X-ray and hard X-ray in the energy region of 0.1~40keV. One of the most important factors in the successful operation of the machine is the alignment quality, which ensures the stability of the particle beams. The primary goal of the survey and alignment of the SSRF is to precisely align the magnets within 150 μ m of their designed position. To accomplish tasks a network of monuments is established and their positions are measured with respect to one another. Using the monuments as reference points, positions of magnets and other beam components are measured and alignment.

Uneven drop will occur in the storage ring floor due to different floor loading, ground moisture variations and seasonal variations. Therefore, monument positions and the magnet positions will have different changes.

The monument measurements and coordinate value calculations should be carried out periodically and the magnet locations surveyed and aligned at regular intervals.

2 ALIGNMENT TOLERANCES

In order to achieve a successful startup of the SSRF, the following relative alignment tolerances are defined by each of the ring managers.

Table 1: Maximum tolerable displacement for synchrotron magnets relative to adjacent beam components

	Dipole	Quadruple	Sextuple
In Beam Direction(ΔZ)	0.5mm	2mm	2mm
Horizontal(ΔX)	0.3mm	0.2mm	0.2mm
Vertical(ΔY)	0.5mm	0.2mm	0.2mm
Roll($\Delta\theta_z$)	0.2mrad	0.5mrad	1.0mrad
Pitch($\Delta\theta_y$)	0.5mrad	0.2mrad	0.5mrad

Table 2: Maximum tolerable displacement for storage ring magnets relative to adjacent beam components

	Dipole	Quadruple	Sextuple	Injecting magnets
Horizontal (ΔX)	0.5mm	0.15mm	0.15mm	1.0mm
Vertical (ΔY)	0.5mm	0.15mm	0.15mm	1.0mm
In Beam Direction (ΔZ)	2.0mm	0.5mm	0.5mm	2.0mm
Roll Angle($\Delta\theta$)	0.2mrad	0.5mrad	0.5mrad	1.0mrad

3 SSRF COORDINATE SYSTEM

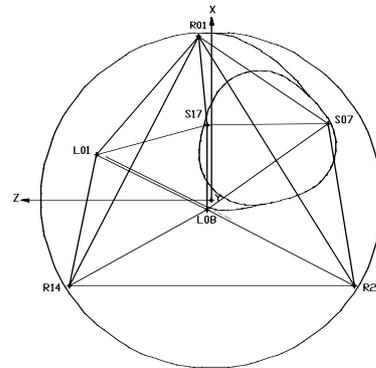


Fig. 1: SSRF coordinate system and the sketch of the surface network

The absolute coordinate system (Fig. 1) is a right hand system originating at the center of the storage ring represented by O and with X-axis orientation paralleled to the direction through origin and the injector point, Z-axis is perpendicular to X-axis, Y-axis is parallel to the opposite gravity vector at O.

As the origin O is located under the LINAC tunnel, it's impossible for us to set up a monument on it.

The local beam following system describes the orientation z at any point. It remains tangent to the beam trajectory s.

The magnets, vacuum chambers and BPM which are put on the same girder will be prealignment in a preparation room, shown in fig. 5. With the work being done in a preparation room rather than in the tunnel, it can be carried out more efficiently, with higher quality installed and aligned in tunnel in a rather short period of time, thereby speeding up installation program of the storage ring

5.2 Mark the beam line on the floor

The position of Bending magnet and magnets on the end of each girder are derived from tunnel network control points using LTD500.

5.3 Rough setting Girder

Each prealigned girder is brought into the ring tunnel and roughly positioned by using the location marks. Then it is leveled using Wild N3. Tilt is controlled with a bubble level. A tolerance within $\pm 2\text{mm}$ in relation to the

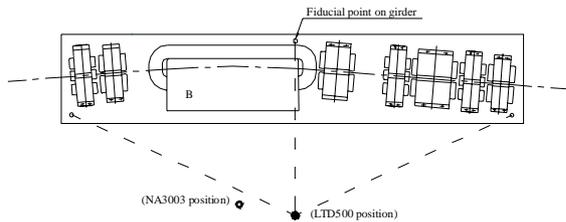


Fig.5 Prealignment for quadruples, sextuple and Bending magnets

neighboring reference points is expected.

5.4 Fine positioning girder

Magnet positions on each end of the girder are measured and then adjusted to a rms 0.15mm of the designed position with respect to neighboring reference points utilizing LTD500. After that the girder will be locked.

5.5 Smoothing alignment

After girder realignment, a confirmation survey is carried out to determine whether the magnets are within the required tolerances. The survey is independent on the tunnel monuments, constituted from ring-quadruple itself. If the magnets are found to exceed the required tolerance the process is repeated.

5.6 Alignment of the LINAC

The Linac consists of electric gun, accelerating sections, the solenoids, the quadrupole triplets, etc.. These components mounted on each girder will be assembled, prealigned and fixed in the preparation room. The entire assembly will be removed into the linac tunnel and positioned roughly on marks on the floor. Finally by using LTD500 and linac tunnel monuments alignment system, the linac components will be aligned to the required accuracy.

6 ACKNOWLEDGEMENT

The authors would like to thank several colleagues from the mechanic group of SSRC for their co-operation. We also wish to thank Chao Zhang from SPring8, F.Q. Wei from SLS for their comments on the SSRC alignment concept. Our thanks also goes to Prof. Li Guangyun and Jin Rongyao of their suggestions and discussions.

REFERENCE

- [1] Survey and Alignment at the Advanced light source, Gary F.Kvebs, Lawrence Berkeley Laboratory
- [2] Positioning the Spring8 Magnets with the Laser Tracker, C.Zhang, S.Matsui, J.Ohnishi, Spring8
- [3] The Alignment of the Advanced Photon Source at Argonne National Laboratory, Horst Friedsam, Argonne National Laboratory