Progress in Field Measurements of SPring-8 Storage Ring Magnets

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The SPring-8 storage ring consists of 88 dipoles, 480 quadrupoles and 336 sextupoles. Presently, 95% of total number 904 have been delivered in the site and 90% have been finished in field measurements. The field measurements are being done for total magnets to verify their field quality and to measure the magnetic center precisely for quadrupoles and sextupoles.

The long flip coil is used for dipole measurements [1]. Reproducibility of the measurement is better than 5×10^{-5} in the measurement term of longer than one year. The dispersion of magnetic lengths of 72 dipoles was measured 3.2×10^{-4} in rms and small enough compared with the allowable value of 5×10^{-4}.

Figure 1 shows the harmonic coil used for the quadrupole and the sextupole measurements. The measurement probe cylinder made of glass-fiber reinforced epoxy resin is fixed with bearings at the both sides and can be pulled out from the bearing in the exchange of sample magnets. The measurement principle and the configuration of measurement coils in the probe cylinder are described in reference [2]. Measurement items are magnetic length, multipole components and magnetic center.

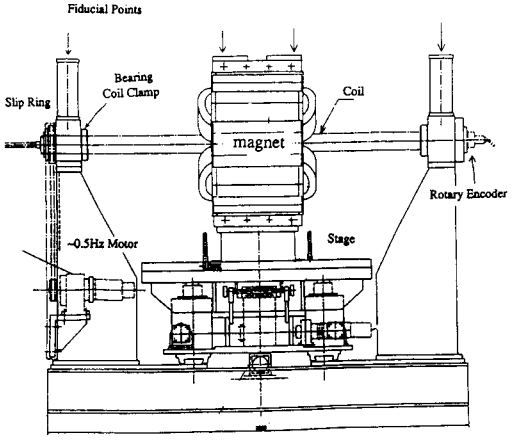

Fig. 1. A side view of the harmonic coil. A sample magnet placed on a motor driven table is measured with the coil supported on the bearings at the both sides.

Measured reproducibility of the magnetic length has been obtained less than 1×10^{-4} by decreasing the influence due to the coil deformation during the re-clamping using series connected twin coils [2]. The dispersion of the magnetic length was measured about 5×10^{-4} in rms for 298 quadrupoles and 1×10^{-3} for the 184 sextupoles and these values are tolerable.

All the quadrupoles and the sextupoles have fiducial points on the upper yokes machined in manufacturing. Their position accuracy is about ±40~100 μm for the specified dimensions from the mechanical magnet centers. Since, however, the requirement for our magnet alignment is very strict, we needed to re-measure the position of the fiducial points in the magnetic measurement. We plan to align all the magnets according to the recorded positions measured with the accuracy of 10 μm.

Measuring procedure of the magnetic center with the harmonic coil is as follows. Adjust magnet position with a movable table as the magnetic center coincides with the rotating center of the harmonic coil. Measure the two fiducial points of the magnet and two points right above the bearings of the harmonic coil. The position measurement is done using the accuracy of several micro meters with the newly developed laser beam and CCD camera position measurement system [3].

Table 1 indicates the measurement results of the positions of the magnet fiducial points. X indicates horizontal direction and Y vertical direction. These values include both errors due to the measurement and the manufacturing. Reproducibility of the measurement has been verified better than 10 μm by measurements of the reference magnet once two weeks.

Table 1. Measurement results on the position errors of the fiducial references for the quadrupoles and the sextupoles.

Magnet Type	No.	Xave.	Xrms	Yave.	Yrms	
QMA	18	-0.026	0.038	-0.080	0.015	[mm]
QMC	44	-0.022	0.026	-0.065	0.022	[mm]
SMB	55	0.027	0.036	-0.071	0.020	[mm]
SMC	14	0.059	0.051	-0.070	0.032	[mm]

The measurements of quadrupoles and sextupoles are being continued five or six magnets a day and will be completed for all the magnets in this June though the placement and the alignment is planned to start partially in this April.

References

[1] J. Ohnishi and M. Kawakami, RIKEN Accel. Prog. Rep., 27, 145 (1993).

[2] J. Ohnishi and N. Kumagai, RIKEN Accel. Prog. Rep., 27, 146 (1993).

[3] Y. Chida et al., This report.