HARMONIC MEASUREMENT FOR KEK B-FACTORY STEERING MAGNETS

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Abstract

Total of 920 steering magnets for KEK B-Factory have been measured by the microcomputer controlled measurement system at IHEP. It took more than two years. During this period, two reference magnets were measured many times. The reproducibility for the reference magnets is better than 8×10^{-4}.This system was used to measure magnets for BEPC (Beijing Electron Positron Collider) ten years ago. But it has been improved and updated to meet the new requirements. This paper will cover the details of the measurement system devices, method as well as results.

1 INTRODUCTION

The measurement system has been improved to measure the steering magnets for KEK B-Factory at IHEP. According to the field measurement requirement for KEK B-Factory steering magnets, we measured 920 KEK B-Factory steering magnets. We started this work in February 1996 and finished it in July 1998. These magnets are divided into four types according to their different field strength. We use the same measurement system but different magnet power supplies. The requirements of measurement specification are as follows:

- Multiple contents at the reference radius of 50 mm
- The integral field distribution along the vertical direction
- Excitation curve of the integral field

2 HARMONIC MEASUREMENT SYSTEM

The measurement system is based on the harmonic coil method. The block diagram of rotating long coil measurement system is shown in Fig.1. It consists of rotating long coil, AC motor and data acquisition system.

- Rotating long coil: It was used to measure magnets for BEPC ten years ago. The measurement system was updated for KEKB magnets.
- Switch box: It was used to improve the bucking ratio by precise potentiometer. For these measurements, we used the unbucked method.
- Amplifier and 14 bit Analog and Digital Converter.
- Angular encoder: 5VN271DZ, 1024 cycles per turn with index signal.
- AC Motor: 11turns per second by decelerator.
- Computer: The computer controls the measurement procedures and performs the data process. The software is written in Quick BASIC language.
- Magnet power supply: It is controlled by the computer. The current stability is better than 1×10^{-4}.

The resolution of the measurement coil and data acquisition system is the order of 10^{-5} .The relative precision of the rotating measurement system is better than 2×10^{-4}. The absolute precision is better than 5×10^{-4}.

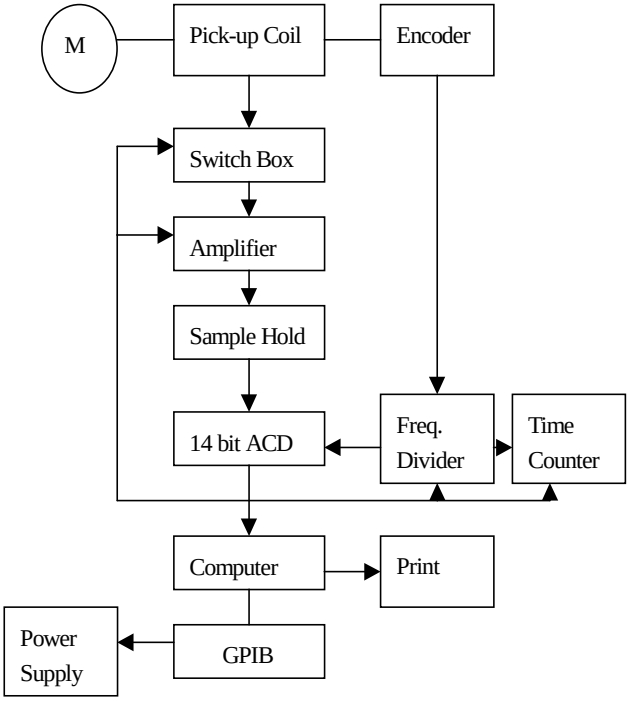

Fig.1 Block Diagram of the measurement system

3 FIELD MEASUREMENT RESULTS

- Quality of magnetic field

The field measurements include multiple contents, integral field distribution and excitation cure of the integral field. The excitation curve of KEK-HER-400 is shown in Fig.2. The average values of integral field for 400 KEKB-HER-STV magnets and 420 KEKB-LER-STV magnets are 22317.5 Gs-cm and 14174.05 Gs-cm respectively. The integral field dispersion of 400 KEKB-HER-STV magnets at 3A is shown in Fig.3 and 420 KEKB-LER-STV magnets in Fig.4. Their Standard Deviations are 8.36×10^{-4} and 1.54×10^{-3}.

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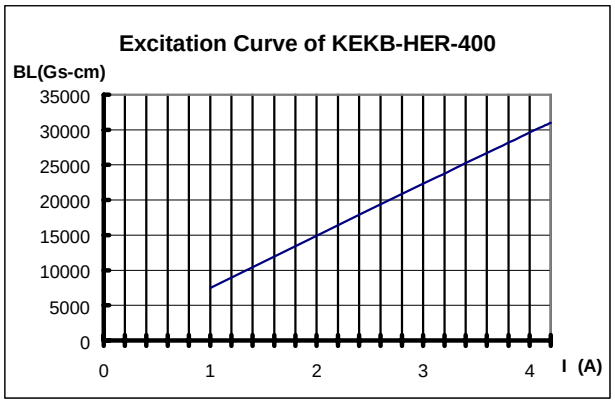

Fig.2 Excitation Curve of KEK-HER-400

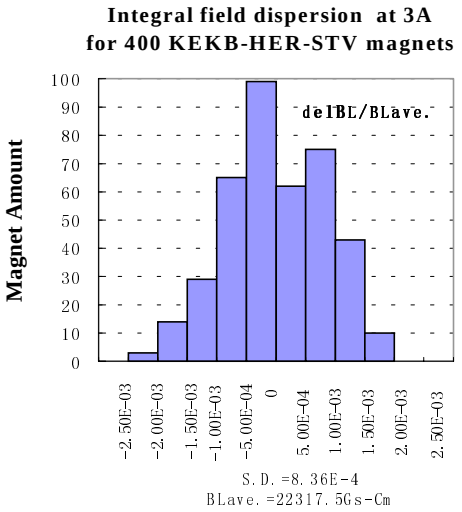

Fig.3 Integral field dispersion at 3A for 400 KEKB-HER-STV magnets

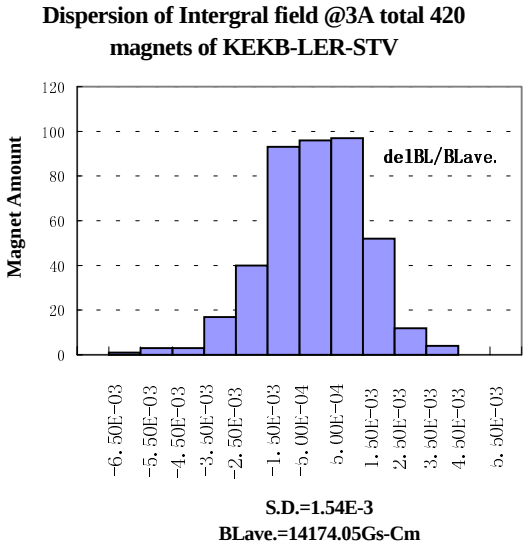

Fig.4 Integral field dispersion at 3A for 420 KEKB-LER-STV magnets

The field distribution for 400 KEKB-HER-STV magnets is shown in Fig.5, 420 KEKB-LER-STV magnets in Fig.6 . These magnets are C type, their left sides are opened.

Position	S.D. (HER)	S.D. (LER)
-5	8.06E-04	9.24E-04
-4.5	6.84E-04	7.76E-04
-4	5.92E-04	6.68E-04
-3.5	5.08E-04	5.71E-04
-3	4.29E-04	4.80E-04
-2.5	3.53E-04	3.94E-04
-2	2.80E-04	3.11E-04
-1.5	2.09E-04	2.30E-04
-1	1.39E-04	1.52E-04
-0.5	6.91E-05	7.54E-05
0	0	0
0.5	6.91E-05	7.44E-05
1	1.38E-04	1.48E-04
1.5	2.08E-04	2.22E-04
2	2.79E-04	2.95E-04
2.5	3.51E-04	3.69E-04
3	4.24E-04	4.44E-04
3.5	4.99E-04	5.21E-04
4	5.77E-04	6.01E-04
4.5	6.61E-04	6.90E-04
5	7.66E-04	8.19E-04

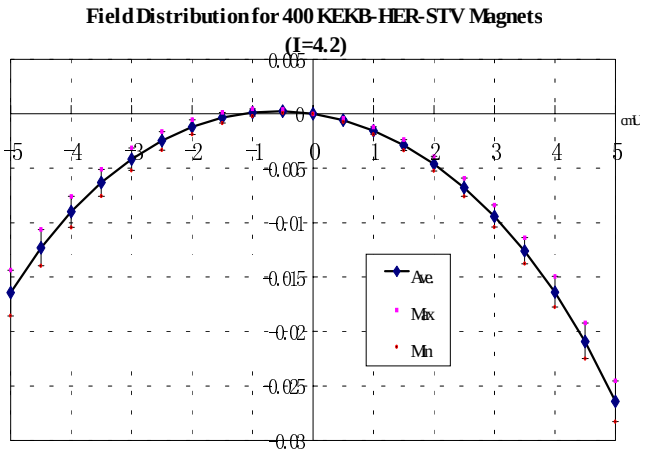

Fig.5 Field distribution for 400 KEK-HER-STV magnets

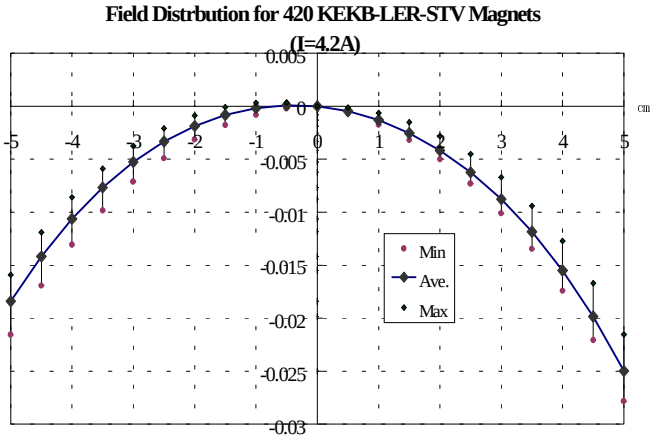

Fig.6 Field distribution for 420 KEK-LER-STV magnets

- Reproducibility of measurement

We regarded KEKB-LER-400 and KEKB-HER-400 as reference magnets. We monitored the stability of measurement system by measuring the reference magnets. We measured two reference magnets 29 times during this period. The reproducibility of the integral dipole field is better than 8×10^{-4}. The integral field dispersion $\Delta \int Bdl/(\int Bdl)$ave. of KEKB-LER-400 magnet at 2A is shown in Fig.7, and that of KEKB-HER-400 magnet is shown in Fig.8

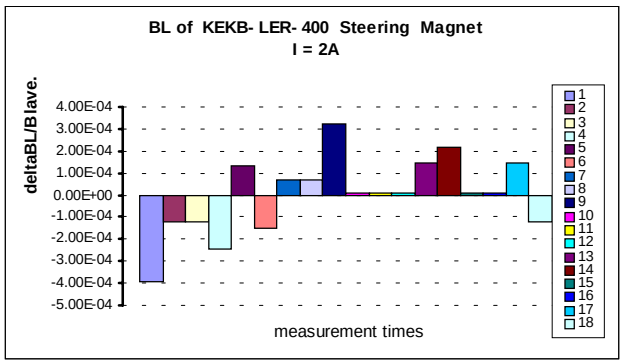

Fig.7 The integral field dispersion of KEKB-LER-400 at different measurement times

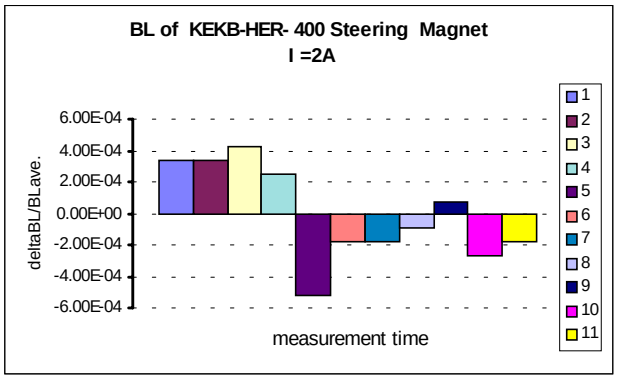

Fig.8 The integral field dispersion of KEKB-HER-400 at different times

4 CONCLUSION

The field performance of the magnets satisfies the KEK B-Factory specification requirements. From the measurement results, it is concluded that the harmonic measurement system has the performance with high resolution and repeatability.

5 ACKNOWLEDGEMENT

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6 REFERENCES

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