Testing Pick-up Coils for Calibrating Wuhan Pulsed Magnets

Z. Zhu, C. Mielke, N. Harrison (NHMFL-PFF, LANL)

Introduction

How to accurately calibrate high magnetic field is a challenge, especially for pulsed magnetic field. Normally, in pulsed magnetic field, the value of magnetic field is integrated from a coil by multiplying a factor coming from cross section of the coil. But this method would have an error on the factor leading to the uncertainty of the field value.

NHMFL-PFF, LANL established a standard method to calibrate the magnetic field by de Haas-van Alphen frequency (dHvA) from copper which is 59.5 T. The Wuhan National Magnetic Field Center (WHMFC) is a newly developed scientific laboratory. The WHMFC has built several pulsed magnets. But those magnets need to be carefully calibrated. So the dHvA of the pick-up coils is ideal for the calibration.

Experimental

We wound four pick-up coils which are almost identical. Each of them has 670 turns inner coil and 245 turns outer coil in reversed direction with gauge AWG 50 copper wire. The coil has 0.5mm hole inside. We deliberately compensated the pick-up coils by removing or add turn of the outer coil. Before sending the pick-up coils to the WNMFC, we tested the four coils in 65ms short pulsed magnet up to 60 T at 1.5 K.

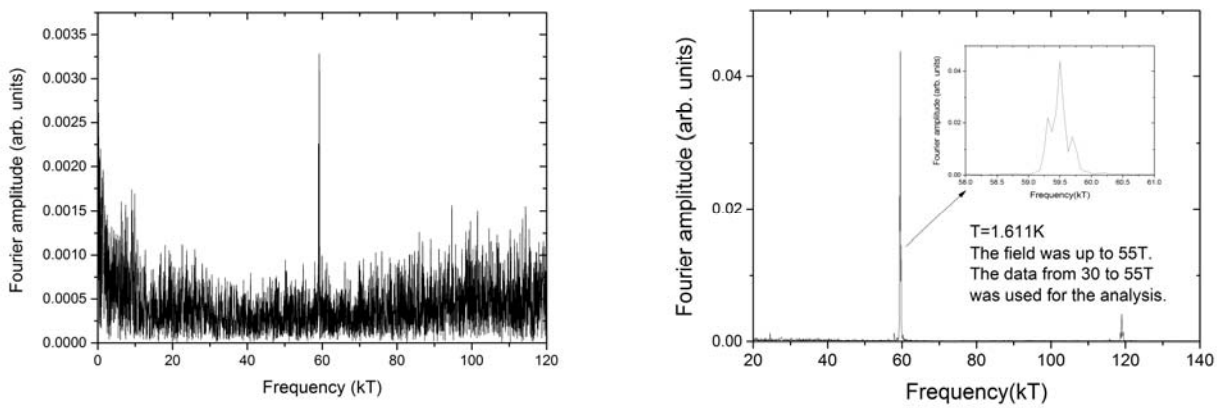

Fig. 1 left: The Fourier transform frequency of dHvA from copper tested in NHMFL-PFF, LANL in one of the coil at 1.5 K up to 60 T. Right: The dHvA result from same coil in WHMFC.

Results and Discussion

Except one of the coils which was connected to a coaxial line showed no feature. The other three coils showed pronounced peak from dHvA effect by Fourier transform of signal (Fig. 1 left panel). After the test, we brought four coils to WHMFC where they tested one of the coils in a pulsed magnet which is up to 55 T at 1.611 K and successfully repeated the results. By adjust factor of integration, making the oscillation frequency locate in 59.5 T, the accurate value of the magnetic field was achieved for the magnet in WHMFC.

Conclusions

Using dHvA effect from pick-up coils to calibrate field is proved to an efficient and successful method in pulsed field.

Acknowledgements

We acknowledge funding support from NHMFL-PFF. the National High Magnetic Field Laboratory, which is supported by National Science Foundation Cooperative Agreement No. DMR-1157490, the State of Florida, and the U.S. Department of Energy. Z.Z acknowledges LANL director's funding,