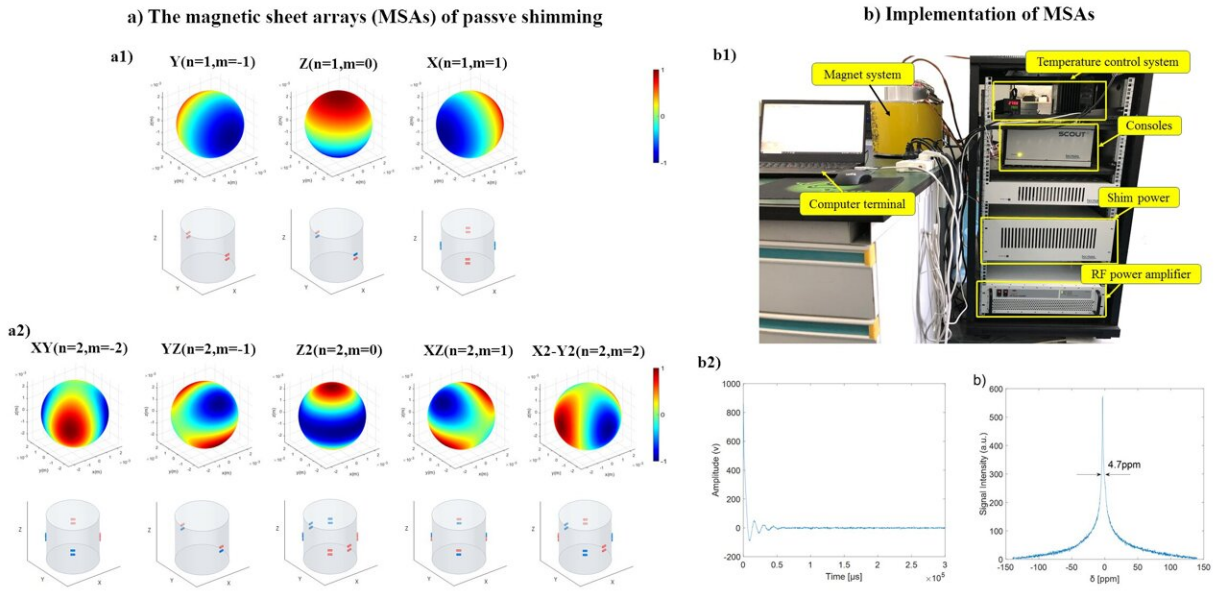
Researchers propose passive shimming method for Halbach magnets

April 20 2022



Passive shimming research based on magnetic sheet array. a) Magnetic sheet array; b) Implementation platform and results. Credit: SIBET

Benchtop Nuclear Magnetic Resonance (NMR) instruments have huge application scenarios in the fields of food safety; on-line rapid component analysis in pharmaceutical, biological, and chemical laboratories; drug detection, education and teaching.

The dipolar cylindrical Halbach magnet as a high-performance magnet

structure has become the main magnet structure for benchtop NMR spectroscopy equipment because of its high material utilization and magnetic field homogeneity. However, due to its complex structure, various errors in processing leads to poor magnetic field homogeneity, which seriously affects the signal quality of magnetic resonance and limits the development of benchtop magnetic resonance spectrometer equipment based on Halbach magnets in China.

The Benchtop Magnetic Resonance Spectroscopy Group led by Yang Xiaodong from the Suzhou Institute of Biomedical Engineering and Technology (SIBET) of the Chinese Academy of Sciences has recently proposed a passive shimming method for Halbach magnets. Results were published in the *Journal of Magnetic Resonance*.

Based on the decomposition and construction of spherical harmonic function, the researchers designed the shimming magnetic sheet array generating each harmonic within the 3rd order and constructed the field diagram analysis of shimming array with different sizes and positions to achieve fast magnetic field compensation.

They also described the practical operation and test results of this method on Halbach magnets.

"In the 0.5T-Halbach passive shimming experiment, the magnetic field homogeneity was improved by two orders of magnitude compared with the initial field, and the homogeneity was improved to 4.7 ppm," said Yang.

In another set of 0.93T-Halbach magnets, the homogeneity was also improved by an order of magnitude, verifying the effectiveness and repeatability of the proposed method to improve the magnetic field homogeneity.

The passive shimming magnetic sheet array proposed in this work achieves efficient compensation of the magnetic field homogeneity of Halbach magnets.

"The results provide strong support for the independent development of high-resolution permanent magnetic resonance spectrometer in China," said Yu Yingcong, president of Wenzhou People's Hospital and also a corresponding author of the study.

The team has built a high-resolution magnetic resonance platform based on the 0.5T-Halbach magnet after passive shimming. "We will conduct experiments for related applications next to promote the development of the research results in relevant applications," said Wang Ya, first author of the study.

More information: Ya Wang et al, A passive shimming method for Halbach magnet based on magnetic sheet arrays, *Journal of Magnetic Resonance* (2022). DOI: 10.1016/j.jmr.2022.107210

Provided by Chinese Academy of Sciences