Dr Mark Ainslie of the Bulk Superconductivity Group, in conjunction with a Japanese research team, has achieved a bulk superconductor magnetic field record.

The record-high trapped magnetic field of 1.1 T at 13 K in a magnesium diboride (MgB2) bulk superconductor using a practical, pulsed-field magnetisation technique comes on the heels of the Bulk Superconductivity Group’s previous 2014 world record result, where 17.6 T was achieved in a stack of two Gd-Ba-Cu-O high-temperature superconductors at 26 K using a slower and more expensive, field-cooling magnetisation technique. Field-cooling is commonly used for fundamental, high-field measurements and gives the best indication of the maximum trapped field capability of a sample.

The researchers were able to overcome issues relating to these flux jumps, which had frequently occurred in the MgB2 bulk when using a conventional solenoid coil magnetising technique.

Although the 1.1 T result has set a new record, there is still some work to do to improve pulsed-field magnetisation as MgB2 bulk materials are capable of trapping magnetic fields in excess of 5 T at temperatures below 20 K using the slower and more expensive magnetising technique that is commonly used for fundamental measurements on bulk materials.

Professor Fujishiro said of the result: "The idea of the use of the split coil for bulk superconductors came about from my previous experimental experience and the theoretical analysis of the trapped field and the effect of the soft iron yoke came from Dr Ainslie’s extensive experience with numerical simulations. I hope our collaboration, which combines extensive experiments and simulations, is very important in this field. We want to enhance practical trapped fields for MgB2 and..."
Gd-Ba-Cu-O bulks even further, and at the same time, we want to propose new pulsed-field techniques to enhance the trapped field and extend these techniques to practical applications."

According to the paper's authors, the work has important implications for practical applications of bulk superconductors:

*Although the critical temperature, Tc, for MgB2 is relatively low (39 K), requiring a lower operating temperature (15-20 K), the material is cheaper, lighter weight and has more homogeneous superconducting properties, and shows great promise as a trapped field magnet as an alternative to high-temperature bulk superconductors.*

Such a split-coil arrangement with an iron yoke could be incorporated into the design of a portable, high magnetic field source/magnet to enhance the available magnetic field or in an axial gap-type bulk superconducting electric machine, where iron can be incorporated into the stator windings to (1) improve the trapped field from the magnetization process, and (2) increase the effective air-gap magnetic field.

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The fruitful collaboration began in 2013 after Dr Ainslie spent six weeks on a research visit to various labs in Japan, funded by the Royal Academy of Engineering and an Institution of Engineering and Technology Travel Award. This included two weeks with Professor Fujishiro that has resulted in eight publications to date, seven of which were published in the field's leading superconductivity journal, *Superconductor Science and Technology*.

**More information:** H Fujishiro et al. Trapped field of 1.1 T without flux jumps in an MgBbulk during pulsed field magnetization using a split coil with a soft iron yoke, *Superconductor Science and Technology* (2016). DOI: