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Title: **In vivo human brain imaging at 0.2 T with a whole body fast field-cycling system**

Authors: Gareth R. Davies[1], Lionel M. Broche[1], David J. Lurie[1], Kerrin J. Pine[2] and P. James Ross[1]

Institutions: [1]Aberdeen Biomedical Imaging Centre, University of Aberdeen (UK).
[2]Imaging Neuroscience, University College London (UK).

Abstract:

Purpose
Fast Field-Cycling (FFC) MRI systems obtain unique dispersive contrast through their ability to alter the main magnetic field strength B0 during the pulse sequence. In a typical pulse sequence, the field strength is changed from the polarization field, B0p, to the evolution field, B0e, at which relaxation effects of interest occur, before returning to the detection field, B0d. Switching the field requires novel magnets, power supplies and ancillary devices.

Methods
The literature contains several examples of FFC apparatus. In general they are home-built systems with dual-magnet designs, in which a stable and homogeneous field from one magnet (superconducting or resistive) providing B0d is offset by a secondary electromagnet to generate B0e. In contrast, this magnet follows a single-magnet design with rigorous requirements for field homogeneity and stability.
The magnet consists of three co-wound copper coils on a cylindrical former embedded in epoxy resin (Tesla Engineering Ltd, Storrington, UK). It is 2080 mm in length and 500 mm in bore, make it suitable for human subjects. A current of 650 A (in each of three circuits) generates a field strength of 0.2 T. This current is provided by a specially-made bank of high-power gradient amplifiers (International Electric Co. Oy, Helsinki, Finland) with a custom control system.

Results
We have obtained 64 x64 pixel transaxial spin-echo FFC images of the brain of a healthy volunteer using acquistion parameters:
field of view 300 mm , slice thickness 10 mm, TE 10 ms, TR 1500 ms, field ramp time 20 ms, polarization time 500 ms, $B_{0p} = B_{0e} = B_{0d} = 196$ mT (8.34 MHz proton frequency)

Outlook
We intend to demonstrate the novel contrast that can be obtained, in vivo, by selecting B0e values in a range of low 10's mT and ultra low sub mT regions.

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Corresponding Author: Gareth Davies

Contact Address: Universty of Aberdeen
Aberdeen Biomedical Imaging Centre
Biomedical Physics Building
Foresterhill
Aberdeen AB25 2ZD

Email: g.davies@abdn.ac.uk