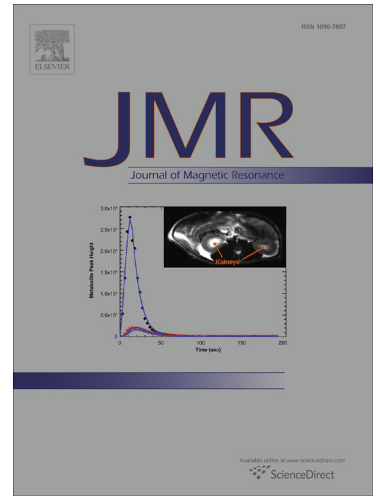
Accepted Manuscript



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S. Mandal, Y.-Q. Song

PII: S1090-7807(15)00070-1
DOI: http://dx.doi.org/10.1016/j.jmr.2015.03.008
Reference: YJMRE 5624

To appear in: *Journal of Magnetic Resonance*

Received Date: 12 February 2015
Revised Date: 15 March 2015

Heteronuclear J-coupling measurements in grossly inhomogeneous magnetic fields

S. Mandal[a,b,*], Y.-Q. Song[b]

[a] *Case Western Reserve University, Cleveland, OH 44106, USA*
[b] *Schlumberger-Doll Research, Cambridge, MA 02139, USA*

Abstract

It is difficult to measure chemical shifts in the small and inhomogeneous magnetic fields found in ex-situ and single-sided NMR systems, such as those used for well-logging. However, it is still possible to obtain chemical information from J-coupling constants, which are independent of static field strength and temperature. We describe and analyze ^{1}H-^{13}C double-resonance pulse sequences that are suitable for measuring heteronuclear J-coupling in grossly inhomogeneous fields. We also present preliminary experimental results from a low-frequency fringe-field system.

Keywords:
J-coupling, inhomogeneous fields, ultra-broadband electronics

1. Introduction

The indirect scalar coupling (J-coupling) constants between nearby nuclei are independent of field strength and temperature, and thus provide valuable chemical information even when the static magnetic field is too weak for chemical shifts to be measured [1, 2]. In addition, NMR spectroscopy at ultra-low field strengths (nT-μT) is of fundamental interest for understanding strongly-coupled spin networks; at very low fields, J-couplings can compete with the Zeeman interaction and even dominate the spectrum [3]. Such experiments require specialized instrumentation, including a pre-polarization system and detectors based on low-temperature superconducting quantum interference devices (SQUIDs) [4, 5].

Single-sided and inside-out NMR systems, such as those used for well-logging, have grossly inhomogeneous B_0 fields in the 5-50mT range [6, 7]. These fields are strong enough for Zeeman interactions to be dominant and for coils to be useful as detectors, but too weak and inhomogeneous for chemical shifts

*Corresponding author
Email addresses: sxm833@case.edu (S. Mandal), ysong@slb.com (Y.-Q. Song)