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Versatile polarizer NMR spectrometer

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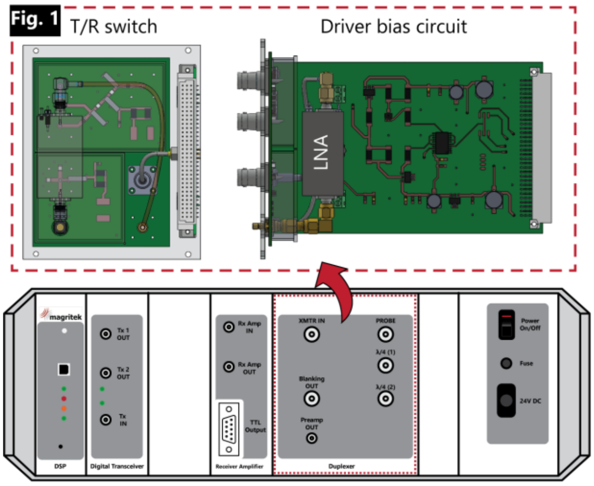
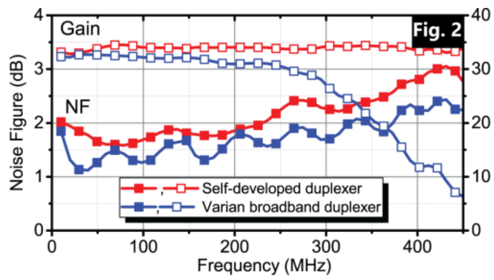
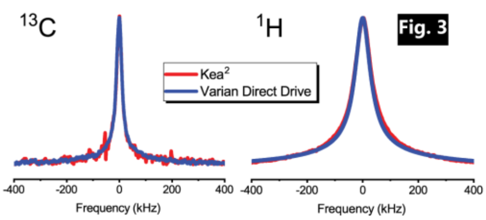
Hyperpolarization of nuclear spins using dissolution dynamic nuclear polarization (dDNP) lead to an increase of SNR in acquired NMR signals [1]. *In vivo* metabolic spectroscopy [2] and imaging [3] benefited from the boost in sensitivity leading to the development of commercial and home-built polarizer systems [4]. A basic spectrometer monitors the build-up of nuclear spin polarization prior to dissolution. These single purpose instruments are limited in SNR performance, bandwidth and transmitter frequency.

We herein propose an economical, dedicated polarizer spectrometer based on an integrated self-developed duplexer and the commercially available Magritek Kea^2 NMR benchtop console (Fig.1). The spectrometer operates between 10 MHz - 450 MHz and offers two transmitting and one reception channels thus enabling the use of advanced pulse sequences. The duplexer's T-R switch relies on PIN diodes and exchangeable λ/4 cables to provide a transmitter-LNA isolation less than +40 dB. An insertion loss less than 1.1 dB is observed during high power transmission (up to 300W using a Tomco TwinPulse 400 amplifier) and reception. High isolation and switching times 1-2 μs fulfil the hardware constraints needed for solid-state NMR. A Miteq AU-2A-150 LNA provides an average gain of 34.5 dB with a noise figure between 1.1 dB - 1.8 dB (Fig. 2).

The Kea^2 and a Varian Direct Drive spectrometer were used to acquire ^1H and ^{13}C NMR signals for a 4.5 M [13C]urea (5:4:1 glycerol-d_5, D_2O, H_2O & 40 mM TEMPOL) sample in a 6.7 T polarizer. The Kea^2 spectrometer achieved an SNR of 483.1 and 84.2 with the Varian Direct Drive spectrometer obtaining an SNR of 1636 and 144.9 for ^1H and ^{13}C, respectively (Fig. 3).







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