Dissolution DNP Polarizer for In Vivo ^{13}C MRI/S

A. Smith[1], D. Downes[1], J. Collins[1], B. Lama[1], R. Balzan[2], A. Capozzi[2], A. Comment[2] and J. Long[1]

1. University of Florida; National High Magnetic Field Laboratory; 2. Ecole Polytechnique Fédérale de Lausanne (EPFL

Funding Grants: G.S. Boebinger (NSF DMR-1157490)

The inherent insensitivity of the NMR/MRI technique results from weak nuclear polarization and is well known. Dynamic nuclear polarization (DNP) has emerged as a promising technique for NMR signal enhancement. In DNP, the higher polarization of an unpaired electron is transferred to a nucleus of interest.

Dissolution DNP has been demonstrated as a powerful orthogonal technique for enhancing small molecule polarization by up to three orders of magnitude; typically a metabolite of interest is hyperpolarized in one instrument (the DNP polarizer) and then transferred to a second instrument (either a conventional NMR spectrometer or an MRI scanner) where the hyperpolarized metabolite can be injected to monitor metabolic flux in vivo.

We have recently implemented dissolution DNP technology in the AMRIS facility. Our system utilizes a 5 T magnet in which samples are cooled to <1.1 K [1]. With microwave irradiation, we achieve *70% polarization of ^{13}C nuclei* in the polarizer; *this translates to a >14,000 gain in SNR on dissolution and injection into our 4.7T MRI/S scanner.* The custom design of the polarizer enables the use of dissolution DNP to study metabolic flux *in vivo* using a variety of NMR – active nuclei as well as the study of fundamental mechanisms of polarization enhancement. *This polarizer is available to external users through the MagLab.*

1) Design and Performance of a DNP Prepolarizer Coupled to a Rodent MRI Scanner, A. Comment et al. Concept. Magn. Reson. B 31B: 255-269

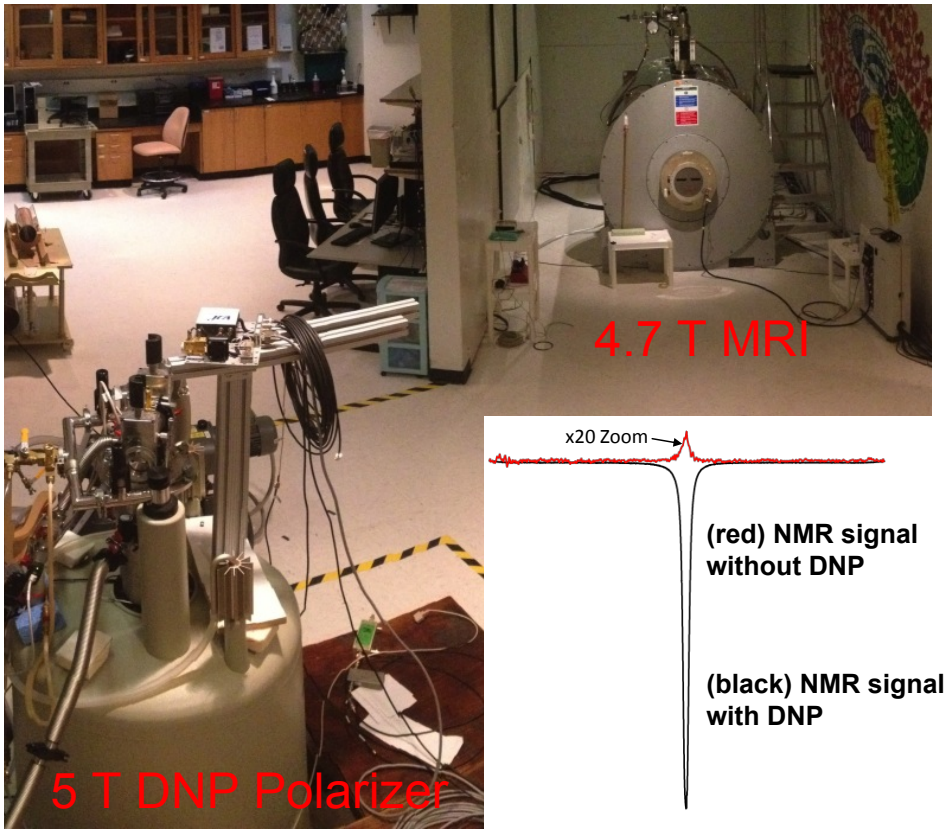

Figure 1: Photo showing location of dissolution DNP polarizer relative to 4.7T MRI/S system in the MagLab's AMRIS facility. The polarized substrate can be sent to either 4.7T or 11.1T MRI/S systems. **Inset:** Demonstration of DNP in the polarizer. Once polarization is maximal at 1.1K (up to 70% for ^{13}C), the sample is melted and sent to the MRI/S magnet. **Signal-to-noise enhancements of > 14,000 have been observed thus far.**

Facilities: AMRIS Facility 4.7T and 11.1 T MRI/S systems can use the DNP Polarizer