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Microwave frequency modulation for improving polarization transfer in DNP experiments[1] MALLORY GUY, CHANDRASEKHAR RAMANATHAN, Department of Physics and Astronomy, Dartmouth College — Dynamic nuclear polarization (DNP) is a driven process that transfers the inherently high electron polarization to surrounding nuclear spins via microwave irradiation at or near the electron Larmor frequency. In a typical DNP experiment, the amplitude and frequency of the applied microwaves are constant. However, by adding time dependence in the form of frequency modulation, the electron excitation bandwidth is increased, thereby increasing the number of electron spins active in the polarization transfer process and improving overall efficiency. Both triangular and sinusoidal modulation show a 3 fold improvement over monochromatic irradiation. In the present study, we compare the nuclear spin polarization after DNP experiments with no modulation of the applied microwaves, triangular and sinusoidal modulation, and modulation schemes derived from the sample's ESR spectrum. We characterize the polarization as a function of the modulation amplitude and frequency and compare the optimal results from each modulation scheme. Working at a field of 3.34 T and at a temperature of 4 K, we show that by using a modulation scheme tailored to the electronic environment of the sample, polarization transfer is improved over other modulation schemes. Small-scale simulations of the spin system are developed to gain further insight into the dynamics of this driven open system. This understanding could enable the design of modulation schemes to achieve even higher polarization transfer efficiencies.

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