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Nuclear spin-lattice relaxation in n-GaAs close to the metal-insulator transition W.G. MOULTON, JUN LU, M.J.R. HOCH, P.L. KUHNS, National High Magnetic Field Laboratory — Dynamic nuclear polarization is of considerable interest in semiconductors particularly in GaAs. Nuclear spin-lattice relaxation interactions are important in the polarization process. The coupling of electron and nuclear spins in n-GaAs close to the metal-insulator (MI) transition changes significantly as the dopant concentration n increases through the MI critical concentration n_C=1.2x10^{16} cm^{-3}. The changes correspond to the evolution of localized donor states into itinerant states close to the bottom of the conduction band. Measurements of the ^{71}Ga relaxation rates ^{71}W made as a function of magnetic field (1 – 13 T) and temperature (1.5 – 300 K) for n-GaAs samples with n = 5.9x10^{15}, 7x10^{16} and 2x10^{18} cm^{-3} show marked changes in the relaxation behavior with n. Korringa-like relaxation is found in the metallic samples for T <30 K and power law dependence at lower n. For $T > 30$ K phonon-induced nuclear quadrupolar relaxation is dominant. Knight shift measurements made on the 2x$10^{18}$$cm^{-3}$ sample using magic-angle spinning, confirm a small value for the hyperfine coupling constant and permit comparison of the Korringa product with predictions. At lower n, local moments play an important role in relaxation producing striking changes in the H dependence of ^{71}W. A model will be presented.

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