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High-Resolution Correlation Spectroscopy of ^{13}C Spins Near a Nitrogen-Vacancy Center in Diamond[1] CARLOS MERILES, ABDELGHANI LARAOUI, City College of New York - CUNY, FLORIAN DOLDE, JOERG WRACTHRUP, FRIEDEMANN REINHARD, CHRISTIAN BURK, 3rd Physics Institute, University of Stuttgart — We use a pulse protocol to monitor the time evolution of the 13C ensemble in the vicinity of a NV center. We observe time correlations in the nuclear spin dynamics that extend over several milliseconds exceeding the color center coherence lifetime by more than an order of magnitude. Upon Fourier transform, we separate 13C spins exhibiting differing coupling constants with a frequency resolution inversely proportional to the NV spin-lattice relaxation time. Further, we use the nuclear spin of the host nitrogen as a quantum register during the correlation interval and demonstrate that hyperfine-shifted resonances in this spectrum can be separated from the bare carbon peak upon proper initialization of the NV. Intriguingly, we find that the amplitude of the correlation signal exhibits a sharp dependence on the applied magnetic field, virtually disappearing below a critical field common to all centers. The value of this transition field can be 'tuned' by properly adjusting the timing within our correlation scheme. We discuss these observations in the context of the 'quantum-to-classical' transition proposed recently to explain the combined dynamics of the NV spin and the 13C bath at variable magnetic field.

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