

Abstract Submitted  
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**Non-classical spin baths in diamond** LINH PHAM, Harvard University, NIR BAR-GILL, Harvard University, Harvard-Smithsonian Center for Astrophysics, CHINMAY BELTHANGADY, Harvard-Smithsonian Center for Astrophysics, KEIGO ARAI, Massachusetts Institute of Technology, DAVID LE SAGE, Harvard-Smithsonian Center for Astrophysics, STEPHEN DEVIENCE, Harvard University, RONALD WALSWORTH, Harvard University, Harvard-Smithsonian Center for Astrophysics — We study the non-classical dynamics of a controlled quantum system coupled to a spin bath, using an NV center in diamond interacting with its surrounding  $^{13}\text{C}$  nuclear spins as a unique paradigm. We measure samples with varying concentrations of nuclear spins and characterize the dynamics of the spin bath using a coherent spectroscopic technique based on multi-pulse sequences. Finally, through concurrent control of both the central NV spin and the nuclear spins in the bath, we explore polarization transfer to the spin bath. Such polarization transfer forms the basis for cooling of the bath and allows a systematic study of this process, its scaling, and its relation to the third law of thermodynamics.

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