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Observing out-of-equilibrium quantum dynamics with a dipolar interacting spin ensemble in diamond[1] CHONG ZU, FRANCISCO MACHADO, BRYCE KOBRIN, THOMAS MITTIGA, SATCHER HSIEH, PRABUDHYA BHATTACHARYYA, TIM HOEHN, SOONWON CHOI, NORMAN YAO, Department of Physics, University of California, Berkeley — We introduce a novel platform, based upon P1 centers (substitutional nitrogen defects) in diamond, to simulate non-equilibrium quantum spin dynamics. In particular, we show the ability to directly control the disorder strength, the interaction Hamiltonian and the effective P1 density using a combination of static and driven fields. By preparing a low entropy initial state, we probe the nanoscale spin diffusion of P1 centers, ultimately observing the emergence of hydrodynamics. Finally, by implementing dynamical decoupling sequences in a diamond nano-pillar, we demonstrate the modification of interactions between P1 centers, providing evidence for the coherent nature of the spin dynamics.

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