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Phase-Sensitive Probes of Nuclear Polarization in Spin-Blockaded Quantum Dots MARK RUDNER, IZHAR NEDER, Harvard, LEONID LEVITOV, MIT, BERTRAND HALPERIN, Harvard — Semiconducting quantum dots provide a platform for investigating the quantum many-body dynamics of coupled electron and nuclear spins. The phenomenon of spin blockade, wherein the Pauli exclusion principle requires electrons to flip their spins in order to pass through the system [1], is an invaluable tool in this pursuit. We describe a new regime of coupled electron and nuclear spin dynamics in spin-blockaded quantum dots where the hyperfine coupling to nuclear spins competes with a purely electronic spin-flip mechanism, such as the spin-orbit interaction or coupling to an inhomogeneous Zeeman field [M. S. Rudner et al., arXiv:0909.0060]. We show that the long-lived coherence of the nuclear spin bath plays a crucial role and leads to a range of new surprising phenomena. In particular, a purely electrical detection of coherent nuclear precession can be realized. Recent results of Foletti et al. [arXiv:0801.3613] suggest that this interesting new regime is now within experimental reach. [1] K. Ono et al. Science 297, 1313 (2002).

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