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Generating Entanglement and Squeezed States of Nuclear Spins in Quantum Dots MARK RUDNER, Harvard University, LIEVEN VANDERSYPEN, TU Delft, VLADAN VULETIC, LEONID LEVITOV, MIT — Entanglement generation and detection are two of the most sought-after goals in the field of quantum control. Besides offering a means to probe some of the most peculiar and fundamental aspects of quantum mechanics, entanglement in many-body systems can be used as a tool to reduce fluctuations below the standard quantum limit. For spins, or spin-like systems, such a reduction of fluctuations can be realized with so-called squeezed states [1]. Here we present a scheme for achieving coherent spin squeezing of nuclear spin states in single electron quantum dots [2]. This work represents a major shift from earlier studies, which have explored classical "narrowing" of the nuclear polarization distribution through feedback involving stochastic spin flips. In contrast, we use the nuclear-polarization-dependence of the electron spin resonance (ESR) line to provide a non-linearity which generates a non-trivial, area-preserving, "twisting" dynamics which squeezes and stretches the nuclear spin Wigner distribution without the need for nuclear spin flips.

[1] M. Kitagawa, M. Ueda, Phys. Rev. A 47, 5138 (1993).
[2] M. S. Rudner, L. V. M. Vandersypen, V. Vuletic, L. S. Levitov, to be published.

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