

Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Spin-orbit induced strong coupling of a single spin to a nanomechanical resonator PHILIPP STRUCK, University of Konstanz, ANDRAS PALYI, Eotvos University, Budapest, MARK RUDNER, Harvard University, Cambridge, KARSTEN FLENSBERG, Niels Bohr Institute, University of Copenhagen, GUIDO BURKARD, University of Konstanz — We theoretically investigate the coupling of an electron spin to vibrational motion due to curvature-induced spin-orbit coupling in suspended carbon nanotube quantum dots. Our estimates indicate that, with current capabilities, a quantum dot with an odd number of electrons can serve as a realization of the Jaynes-Cummings model of quantum electrodynamics in the strong-coupling regime. A quantized flexural mode of the suspended tube plays the role of the optical mode and we identify two distinct two-level subspaces, at small and large magnetic field, which can be used as qubits in this setup. The strong intrinsic spin-mechanical coupling allows for detection, as well as manipulation of the spin qubit, and may yield enhanced performance of nanotubes in sensing applications.

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Date submitted: 07 Nov 2011

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