Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Spin polarization and spatial texture in quantum dots GARNETT BRYANT, National Institute of Standards and Technology — Spins in semiconductor quantum dots (QD) are promising qubits. Zeeman-split states form two-level systems with pseudo spin 1/2. Rotations of these qubits typically use magnetic fields B. However, this pseudo spin is not the physical spin of the state. Due to confinement, strain and strong spin-orbit coupling, the physical spin can be strongly mixed and spatially varying in the QD. We use atomistic tight-binding theory for strained InAs/GaAs and strain-free GaAs/AlAs QDs to investigate the influence of strain, QD geometry and magnetic field orientation on spin polarization and spatial texturing. For electrons, with weak spin-orbit coupling, spin is almost fully polarized and nearly aligned with B. For holes, with strong spin-orbit coupling, there can be incomplete spin polarization and spin locked to the QD axis, rather than B, even for B far off the QD axis. Spatial spin texturing occurs on the atomic scale with spin flipping between nearby atoms. In the Voigt configuration, hole spin remains nearly locked locally to the QD axis, but with opposite orientation on opposite sides of the dot, creating a spin-dipole. The influence of this spin polarization and spatial texturing on spin manipulation, exchange interaction and decoherence will be discussed.

Garnett Bryant
National Institute of Standards and Technology

Date submitted: 30 Oct 2015 Electronic form version 1.4