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Spin Relaxation Theory in Amorphous Silicon and Germanium[1]
NICHOLAS HARMON, MICHAEL E. FLATTÉ, University of Iowa — Research into spintronic devices using amorphous inorganic semiconductors has seen little attention despite the surge of interest in amorphous organic spintronics. In many ways the two materials are similar - for instance hopping transport is observed in both for certain regimes. Amorphous semiconductors such as silicon and germanium offer advantages such as the ability to greatly reduce and control hyperfine field effects by the process of hydrogenation, and considerably higher mobilities. We present a theory of spin relaxation in amorphous semiconductors based on the theory of a continuous-time random walk, and obtain analytic results in several regimes. We also calculate the spin relaxation with a Monte Carlo simulation. We find that the spin-orbit coupling is the primary limit to long spin lifetimes in amorphous silicon and germanium. The theory we introduce is very general and can also be applied to amorphous organic semiconductors. We compare our results for amorphous inorganic and amorphous organic materials.

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