The origin of intrinsic Gilbert damping[1] MARK C. HICKEY, JA-GADEESH S. MOODERA, MIT — The damping of magnetization, represented by the rate at which it relaxes to equilibrium, is successfully modeled as a phenomenological extension in the Landau-Lifschitz-Gilbert equation. This is the damping torque term known as Gilbert damping and its direction is given by the vector product of the magnetization and its time derivative. Here we derive the Gilbert term from first principles by a non-relativistic expansion of the Dirac equation. We find that the Gilbert term arises when one calculates the time evolution of the spin observable in the presence of the full spin-orbital coupling terms, while recognizing the relationship between the curl of the electric field and the time varying magnetic induction.

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