Derivation of effective spin-orbit Hamiltonians and spin lifetimes†
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A general approach is derived for constructing an effective spin-orbit Hamiltonian for nonmagnetic materials, which is useful for calculating spin-dependent properties near an arbitrary point in momentum space with pseudospin degeneracy. The formalism is verified through comparisons with other approaches for III-V semiconductors, and its general applicability is illustrated by deriving the spin-orbit interaction and predicting spin lifetimes for strained SrTiO₃ and a two-dimensional electron gas in SrTiO₃ (such as at the LaAlO₃/SrTiO₃ interface). These results suggest robust spin coherence and spin transport properties in SrTiO₃-based materials at room temperature.

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