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Spin-dependent 8x8 k.p Hamiltonian in silicon[1] PENGKE LI, HANAN DERY, University of Rochester — Silicon is a promising material choice in spintronics devices due to its long electron spin lifetime and dominant technology. We present a theory that describes the spin properties of conduction electrons in different valleys in silicon. Using the method of invariants, we have developed an 8×8 Hamiltonian with spin-orbit interaction that captures the symmetry of the zone edge states and their spin dependent parameters. We derive analytical results of the energy bands, and more important, of the spin mixing of states. Both are in perfect agreement with the numerical results of an empirical pseudopotential method with spin orbit interaction. The new theory is capable of filling a dominant role in studying spin properties of electrons silicon similar to the way that the Kane model in being used in direct band-gap semiconductors.

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