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Spin injection and detection in silicon IGOR ZUTIC, STEVEN ERWIN, Center for Computational Materials Science, Naval Research Lab, JAROSLAV FABIAN, Karl-Franzens University, Graz, Austria — Silicon has long spin-relaxation and spin-decoherence times, properties which make it very attractive for spintronics and quantum-information applications [1]. Unfortunately, the underlying origin of these properties—indirect band gap and weak spin-orbit coupling—preclude conventional optical methods of spin injection and detection in semiconductors. We propose two schemes to overcome these difficulties and realize robust spin injection and detection in silicon: one using magnetic semiconductors, and one using direct-gap conventional semiconductors, both in a heterojunction geometry [2]. To analyze the operation of these schemes, we develop an analytical model for spin-polarized transport across a heterojunction. Under realistic operating assumptions, we find that the symmetry properties of charge current with respect to the reversal of equilibrium and nonequilibrium spin polarization can be used to detect spin injection in silicon. [1] I. Zutic, J. Fabian, and S. Das Sarma, Rev. Mod. Phys. 76, 323 (2004). [2] I. Zutic, J. Fabian, and S. C. Erwin, preprint cond- mat/0412580.

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