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Theory of optical spin orientation in silicon JINLUO CHENG, J. RIOUX, Department of Physics and Institute for Optical Sciences, University of Toronto, 60 St. George Street, Toronto, Ontario, Canada M5S 1A7, J. FABIAN, Institute for Theoretical Physics, University of Regensburg, 93040 Regensburg, Germany, J.E. SIPE, Department of Physics and Institute for Optical Sciences, University of Toronto, 60 St. George Street, Toronto, Ontario, Canada M5S 1A7 — Despite weak spin-orbit coupling and an indirect band gap, significant optical spin orientation is possible in silicon. We show this by performing full band-structure calculations of the phonon-assisted absorption of circularly polarized light in bulk silicon. At 4 K a maximum spin polarization of 25% is found at the band edge; at room temperature the polarization is still 15%. We present the selection rules and give the contributions from the individual phonon branches, valence bands, and conduction band valleys. Dominant are the TO/LO phonon-assisted transitions from the heavy-hole to the conduction band.

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