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Spin relaxation via exchange with donor impurity-bound electrons[1]

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In the Bir-Aronov-Pikus depolarization process affecting conduction electrons in p-type cubic semiconductors, spin relaxation is driven by exchange with short-lived valence band hole states. We have identified an analogous spin relaxation mechanism in nominally undoped silicon at low temperatures, when many electrons are bound to dilute dopant ion potentials. Inelastic scattering with externally injected conduction electrons accelerated by electric fields can excite transitions into highly spin-orbit-mixed bound excited states, driving strong spin relaxation of the conduction electrons via exchange interaction. We reveal the consequences of this spin depolarization mechanism both below and above the impact ionization threshold, where conventional charge and spin transport are restored.

[1]Based upon: Lan Qing, Jing Li, Ian Appelbaum, and Hanan Dery, Phys. Rev. B **91**, 241405(R) (2015). We acknowledge support from NSF, DTRA, and ONR.