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Coherent Optical Control of Spin-Spin Interaction in Doped Semiconductors CARLO PIERMAROCCHI, GUILLERMO QUINTEIRO, Michigan State University — We provide a theory of laser-induced interaction between spins localized by impurity centers in a semiconductor host. By solving exactly the problem of two localized spins interacting with one itinerant exciton, we study the light-induced spin-spin interaction as a function of the spin separation, laser energy, and intensity. We apply the theory to shallow neutral donors (Si) and deep rare-earth magnetic impurities (Yb) in III-V semiconductors. When the photon energy approaches a resonance related to excitons bound to the impurities, the coupling between the localized spins increases, and may change from ferromagnetic to antiferromagnetic. This light-controlled spin interaction provides a mechanism for the quantum control of spins in semiconductors for quantum information processing; it suggests the realization of spin systems whose magnetic properties can be controlled by changing the strength and the sign of the spin-spin interaction.

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