Confinement engineering of s-d exchange interactions in GaMnAs quantum wells

N.P. STERN, R.C. MYERS, M. POGGIO, A.C. GOSSARD, D.D. AWSCHALOM, Center for Spintronics and Quantum Computation, University of California, Santa Barbara, CA 93106 — Recent measurements of coherent electron spin dynamics have observed antiferromagnetic s-d exchange coupling between conduction band electrons and electrons localized on Mn$^{2+}$ impurities in GaMnAs quantum wells. Here we discuss systematic measurements of the s-d exchange interaction in Ga$_{1-x}$Mn$_x$As/Al$_y$Ga$_{1-y}$As quantum wells with different confinement potentials using time-resolved Kerr rotation spectroscopy. Extending previous investigations of the well width dependence of the s-d exchange, $N_0\alpha$, we find that the magnitude of the exchange parameter, $N_0\alpha$, varies as a function of both well width and well depth ($y$). Both phenomena reduce to a general dependence on confinement energy, which is well-fit to a model taking into account the effect of kinetic exchange and band mixing on the exchange parameters.

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