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Doping dependence of the inverse spin-Hall effect in n-GaAs near the metal-insulator transition CHAD GEPPERT, KEVIN CHRISTIE, MUN CHAN, University of Minnesota, SAHIL PATEL, CHRIS PALMSTRØM, University of California, Santa Barbara, PAUL CROWELL, University of Minnesota — We present measurements of the inverse spin-Hall effect in n-GaAs at various doping levels ranging from one to five times the Mott criterion ($n_c \approx 2 \times 10^{16}/\mathrm{cm}^3$). Spin currents are generated electrically (from either Fe or Co_2MnSi) which give rise to a Hanle effect in the local Hall voltage. The observed magnitude corresponds to a spin Hall angle of $\approx 10^{-3}$ in the regime of small electron polarization, yet exhibits a dramatic enhancement at low temperatures and/or high biases due to the presence of polarized nuclei. This enhancement is largest for intermediate dopings, reverses sign as the samples become more metallic, and exhibits an asymmetry with respect to the absolute sign of the polarization. These features are all indicative of conduction electrons resonantly scattering from localized states in the impurity band. Further confirmation of this picture is provided by quantitative modeling of the observed magnetic field dependence at oblique angles, where the Overhauser effect partially compensates the applied field. The resulting phenomenological form demonstrates that in addition to conventional spin-orbit effects, asymmetry in the spin-flip scattering may be directly mediated by the local nuclear spin system. Supported by NSF DMR-1104951.

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