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Low-frequency conductance fluctuations in Si:P and Ge:P δ-layers

SAQUIB SHAMIM, Department of Physics, Indian Institute of Science, Bangalore 560 012, India, SUDDHASATTA MAHAPATRA, GIORDANO SCAPPUCCI[1], W. M. KLESSE, MICHELLE Y. SIMMONS, Centre for Quantum Computation and Communication Technology, University of New South Wales, Sydney NSW 2052, Australia, ARINDAM GHOSH, Department of Physics, Indian Institute of Science, Bangalore 560 012, India — Delta doped Si:P and Ge:P devices offer a formidable platform for application towards quantum computation. The fabrication of single donor devices by STM-lithography takes us forward to address the solid state quantum bits. The atomic scale control however makes the devices extremely sensitive to fluctuations and disorder which affect their long term stability. Hence, a study of low frequency 1/f noise for these devices is desirable. We measure 1/f noise in Si:P and Ge:P δ-layers of varying doping density. Fluctuations in conductivity arise due to fluctuations in mobility and the Hooge parameter scales inversely with mobility as $1/\mu^3$ for all devices. For highly doped Ge:P δ-layer, the noise magnitude in a perpendicular magnetic field ($B_\perp$) reduces by factors of two at the phase breaking breaking field and the Zeeman field indicating universal conductance fluctuations (UCF). The phase breaking length l_ϕ^{UCF} extracted by fitting the $B_\perp$ dependence of noise to the crossover function matches well with l_ϕ^{WL} extracted from weak localization (WL) fits to magnetoconductivity indicating that both UCF and WL are governed by same scattering rates.

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