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Hybrid Spin Noise Spectroscopy and the Spin Hall Effect VALERIY SLIPKO, Department of Physics and Technology, V.N. Karazin Kharkov National University, NIKOLAI SINITSYN, Theoretical Division, Los Alamos National Laboratory, YURIY PERSHIN, Department of Physics and Astronomy, University of South Carolina — The spin noise spectroscopy (SNS) is an emergent experimental technique that has been used to measure spin-related parameters of different materials and systems. In a typical semiconductor material, such as GaAs, the spin Hall effect is relatively weak. It cannot appreciably modify spin fluctuations observed by the standard optical SNS setup. In order to overcome this difficulty, we suggest a method of hybrid spin noise spectroscopy, which is based on a simultaneous analysis of spin and transverse voltage fluctuations [1]. By using this method, one can experimentally determine spin-transverse voltage and transverse voltage-transverse voltage correlation functions which are sensitive to the spin Hall coefficient. Opposite to the conventional Hall effect, the spin Hall effect in homogeneous systems is not accompanied by any transverse voltage on average. However, as we demonstrated, in the spin Hall regime the spin fluctuations are dressed by charge dipoles that are responsible for the transverse voltage fluctuations. Therefore, the transverse voltage fluctuations correlate with the spin fluctuations and their strength is proportional to the spin Hall coefficient. We anticipate that the proposed method find applications in studies of spin-charge coupling in semiconductors and other materials.

[1] V. A. Slipko, N. A. Sinitsyn, and Y. V. Pershin, Phys. Rev. B 88, 201102(R) (2013).

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