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Shot noise in the mesoscopic spin Hall effect RALITSA DRAGOMIROVA, University of Delaware, LIVIU ZÂRBO, Texas A&M University, BRANISLAV NIKOLIĆ, University of Delaware — The spin Hall effect has recently attracted a lot of attention as a promising all-electrical scheme to generate and manipulate pure spin currents by utilizing spin-orbit (SO) coupling in semiconductor nanostructures. Injection of unpolarized charge current through the longitudinal leads of a four-terminal two-dimensional electron gas (2DEG) with the Rashba SO coupling and/or SO-dependent scattering off extrinsic impurities is responsible not only for the pure spin Hall current in the transverse electrodes, maximized when the ballistic sample size is comparable to the *mesoscale* defined by the spin precession length, but also for random time-dependent current fluctuations. We extend the Landauer-Büttiker scattering formalism to calculate spin-resolved shot noise in multiterminal nanostructures for arbitrary polarization of the injected current and analyze the shot noise of transverse pure spin Hall current and zero charge current or transverse spin current and non-zero charge Hall current, driven by unpolarized or spin-polarized longitudinal charge current respectively. Since any spin-flip event (instantaneous or due to precession) within the 2DEG acts as an additional source of noise, we demonstrate that these spin and charge shot noises offer a unique tool to differentiate between intrinsic and extrinsic microscopic SO mechanisms behind the spin Hall and charge Hall effects in paramagnetic systems.

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