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Charge-Hall effect driven by spin force: reciprocal of the spin-Hall effect PING ZHANG, QIAN NIU, Department of Physics, The University of Texas at Austin, Austin, TX 78712, THEORETICAL CONDENSED MATTER GROUP AT UT TEAM — A new kind of charge-Hall effect is shown in spin-orbit coupled semiconductor systems. Unlike in the ordinary Hall effect, the driving force in the longitudinal direction is a spin force, which may originate from the gradient of a Zeeman field or a spin-dependent chemical potential. A nontrivial exact Onsager relation is established between this effect and the electric field-induced spin-Hall effect. Surprisingly, we find that this Onsager relation cannot readily be established; only when the spin current is modified by including a torque dipole term, is the spin-Hall conductivity in response to an electric field found to correspond to our charge-Hall conductivity in response to a spin force. Remarkably, it is this modified spin current that is responsible for spin accumulation at a sample boundary as shown recently based on the spin continuity equation in a semiclassical theory. Our finding on the Onsager relation further points to the importance of this modified spin current. Spin-Hall current or accumulation can thus be tested through the Onsager relation by a measurement of our charge Hall effect in response to a spin force.

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