Onsager relations in a two-dimensional electron gas with spin-orbit coupling

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Theory predicts for the two-dimensional electrons gas with only Rashba spin-orbit interaction a vanishing spin Hall conductivity and at the same time a finite inverse spin Hall effect. We show how these seemingly contradictory results are compatible with the Onsager relations: the latter do hold for spin and particle (charge) currents in the two-dimensional electron gas, although (i) their form depends on the experimental setup and (ii) a vanishing bulk spin Hall conductivity does not necessarily imply a vanishing spin Hall effect. We also discuss the situation in which extrinsic spin orbit from impurities is present and the bulk spin Hall conductivity can be different from zero.

[1] C. Gorini, R. Raimondi, P. Schwab, arXiv:1207.1289