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Measuring mesoscopic spin currents by spin-to-charge conversion

PHILIPPE JACQUOD, PETER STANO, Physics Department, University of Arizona, 1118 E 4th Street, Tucson, Arizona 85721, USA — A number of theoretical investigations show that spin currents can be magneto-electrically generated by passing electric currents through spin-orbit coupled quantum dots. Measuring these currents has however not been achieved to date. In this talk, we present a theoretical proposal for measuring such mesoscopic spin currents with a voltage probe connected to the quantum dot via a single channel quantum point contact. We demonstrate that a spin current flowing through the quantum point contact results in an odd dependence of the charge current I_{qpc} on an externally applied Zeeman field, while this response is even in the absence of the spin current. The magnitude of the spin current is proportional to the zero field derivative of I_{qpc} , with a constant of proportionality depending weakly on the geometry of the point contact. Numerical estimates suggest that in this way, mesoscopic spin currents can successfully be measured in GaAs quantum dots.

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