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**Transport Equations and Spin-Charge Propagating Mode in a Two Dimensional Hole Gas with Spin-Orbit Coupling** TAYLOR HUGHES, ANDREI BERNEVIG, Stanford University, YAROSLAW BAZALIY, IBM Almaden Research Center, SHOU-CHENG ZHANG, Stanford University — We find that the spin-charge motion in a strongly confined two-dimensional hole gas (2DHG) supports a propagating mode with cubic dispersion apart from the diffusive mode due to momentum scattering. Propagating modes seem to be a generic property of systems with spin-orbit coupling. Through a rigorous Keldysh approach, we obtain the transport equations for any system with spin-orbit coupling that can be represented using spin-  $1/2$  matrices. We specialize to the 2DHG and analyze the behavior of the hole spin relaxation time, diffusion coefficients, and spin-charge coupled motion. We also confirm the value of the spin Hall conductivity in the ballistic regime and discuss the viability of the propagating mode.

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