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Magnetic noise spectroscopy as a probe of hydrodynamic transport in graphene KARTIEK AGARWAL, Princeton University, RICHARD SCHMIDT, BERTRAND HALPERIN, Harvard University, VADIM OGANESYAN, City University of New York, GERGELY ZARAND, Budapest University of Technology and Economics, MIKHAIL LUKIN, EUGENE DEMLER, Harvard University

— We develop the theoretical framework for calculating magnetic noise from conducting two dimensional (2D) materials. We describe how local measurements of this noise can directly probe the wave-vector dependent transport properties of the material over a broad range of length scales, thus providing new insight into a range of correlated phenomena in 2D electronic systems. As an example, we demonstrate how transport in the hydrodynamic regime in an electronic system exhibits a unique signature in the magnetic noise profile that distinguishes it from diffusive and ballistic transport and how it can be used to measure the viscosity of the electronic fluid. We employ a Boltzmann approach in a two-time relaxation-time approximation to compute the conductivity of graphene and quantitatively illustrate these transport regimes and the experimental feasibility of observing them. We also discuss signatures of isolated impurities lodged inside the conducting 2D material. The noise near an impurity is found to be suppressed compared to the background by an amount that is directly proportional to the cross-section of electrons/holes scattering off of the impurity. We use these results to outline an experimental proposal to measure the temperature dependent scattering properties of the impurity

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