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Spin-Resolved Quantum Interference in Graphene[1]

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Graphene's spin transport properties have attracted a great deal of attention, due in part to the potential for long spin lifetimes, and to the unusual spin structures that are predicted to exist at the edge of a graphene flake. The ability to measure spin polarized electrical currents is an important step toward testing these predictions, and toward achieving coherent spin control in graphene. Here, we resolve spin transport directly from conductance features that are caused by quantum interference. These features split visibly in an in-plane magnetic field, similar to Zeeman splitting in atomic and quantum dot systems. Graphene's g-factor and density of states can be determined to high precision from the magnitude of the splitting. These spin-polarized conductance features may, in the future, lead to the development of graphene devices incorporating interference-based spin filters. It has been shown by numerous imaging techniques that exfoliated graphene flakes are modulated by nanometer-scale ripples. The in-plane magnetic field used to spin-split conductance fluctuations also generates a random vector potential due to the rippled topography. This random vector potential leads to anisotropic momentum scattering and an effective dephasing rate, both of which can be clearly observed in transport. Based on these measurements, the ripple geometry can be extracted from graphene's in-plane magnetoresistance.

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