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Giant Spin-Hall Effect and Nonlocal Transport in Graphene DMITRY ABANIN, Princeton, K.S. NOVOSELOV, A.K. GEIM, Manchester, L.S. LEVITOV, MIT — Graphene provides a unique opportunity to explore quantum-relativistic phenomena in a condensed matter laboratory. Interesting phenomena associated with the parity anomaly, including quantum Hall effect in the absence of magnetic field and quantum spin-Hall effect in quantizing magnetic fields, have been theoretically proposed, but could not be observed so far largely due to disorder and density inhonogeneity. We show that weak magnetic field induces large bulk non-quantized spin-Hall effect in graphene. The effect occurs due to Zeeman spin splitting which generates the imbalance of the Hall resistivities of the two spin species. The spin-Hall effect is robust in the presence of disorder and interactions. It will manifest itself in large nonlocal transport mediated by long-lived spin currents, as well as in spin injection and spin accumulation experiments. The effect peaks at the Dirac point, and can serve as a hallmark of the relativistic character of carriers in graphene and other Dirac materials.

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