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Neutral currents probed by non-local transport in graphene with 5 *d* metal adatoms[1] YILIN WANG, XINGHAN CAI, SHUDONG XIAO, WENZHONG BAO, JANICE REUTT-ROBEY, University of Maryland, College Park, MICHAEL FUHRER, School of Physics, Monash University, Victoria, Australia —

Adsorption of adatoms on graphene has been theoretically proposed as an effective means to enhance spin-orbit coupling in graphene. Here we use the non-local measurement geometry to detect neutral currents (spin, valley, energy) through their Hall and inverse Hall effects. Single-layer graphene devices are probed *in-situ* in ultra-high vacuum while depositing 5d heavy metal atoms (Ir, Au) at a temperature of 7 K. Surprisingly, we detect a non-local signal in pristine devices as well as metal-atom modified devices, with a consistent dependence of the signal on length and gate voltage for several devices. Changes in the non-local signal upon deposition of 5d metal atoms appear governed by charge carrier mobility (reduced with increasing metal atom concentration) and are difficult to understand with spin Hall/inverse spin Hall effects alone due to increased spin-orbit coupling in graphene. We will discuss other possible origins of the non-local signal.

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