Measuring anisotropic spin relaxation in graphene

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We compare different methods to measure the anisotropy of the spin-lifetime in graphene. In addition to experiments of B. Raes et al. [1,2] and N. Tombros et al. [3] we present a Hanle experiment where the electron spins precess around either a magnetic field perpendicular to the graphene plane or around an in plane field. We use exfoliated graphene on SiO₂ in a non-local geometry with Co electrodes and MgO tunnel barriers. We reproduce Raes’s experiment [1], in which the magnetic field is applied at an angle β to the injector electrode (see Fig. 1). This data is consistent with isotropic spin relaxation, as in [1]. In our new experiment, we apply the magnetic field in two distinct direction, out of plane (Bₜ) and in plane (Bₜ∥) as shown in Fig. 1. For this geometry we see a small difference in width and slope of the Hanle traces, displayed in Fig. 3. Although we include anisotropies of spin-lifetimes for arbitrary magnetic field directions the in plane Hanle trace cannot be well fitted. Potential reasons for this behaviour will be discussed.

References
Figure 3: Comparison of Hanle curves with magnetic field perpendicular to the graphene plane (black) and in the graphene plane (red).