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Chiral charge pumping in graphene deposited on a magnetic insulator

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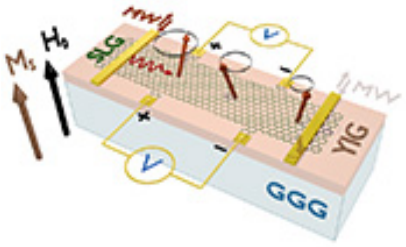

Magnetic insulator Yttrium Iron Garnet (YIG) is one of the mostly studied magnonic materials due to its extraordinary small magnetic damping. We have observed a symmetry breaking in YIG film resulting in unidirectional magnetic anisotropy, which is demonstrated experimentally by exciting ferromagnetic resonance (FMR) in an out-of-plane magnetized YIG-film. Surprisingly, the FMR field at a given value of the excitation frequency varies under the inversion of the applied magnetic field. Since the crystallographic structure of YIG corresponds to cubic lattice, the effect has to originate in a broken symmetry mediated by the surface.

To support this claim we attached a monolayer of graphene to the YIG layer and excited propagating spin waves in the same geometry of the out-of-plane field. Experimentally we observe an induced dc voltage in the graphene layer, which changes its sign when the orientation of the static magnetization is inversed. The voltage is pumped in graphene by magnetic precession in YIG, clearly indicates the broken spatial inversion symmetry in the studied system equivalent to that found for bare YIG film. A theoretical model is proposed, which connects the observed chiral symmetry breaking to screw dislocations in YIG. The measured dc voltage shows a non-monotonous dependence on the spin-wave frequency, in agreement with the proposed theoretical model.

[1] M.Evelt, H.Ochoa, O.Dzyapko, V.E.Demidov, A.Yurgens, J.Sun, Y.Tserkovnyak, V.Bessonov, A.B.Rinkevich and S.O.Demokritov, arXiv:1609.01613 [cond-mat.mes-hall]