Theory of plasmon-magnon coupling in 2D honeycomb magnets

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Two-dimensional (2D) materials have been investigated for almost two decades [1] and have been the source of truly spectacular discoveries [2]. Magnetic 2D materials, in particular, have been recently discovered [3,4] and are currently representing a very active and interesting research field[5]. In particular, two-dimensional honeycomb ferromagnets offer the unprecedented opportunity to study interactions between collective modes that in standard bulk ferromagnets do not cross paths. Indeed, when doped with free carriers, they also host the typical gapless plasmonic mode of 2D itinerant electron/hole systems. Moreover, they display an optical spin-wave branch which disperses weakly near the Brillouin zone centre. The plasmon branch, eventually, meets the optical spin-wave branch at a certain energy and momentum, paving the way for interactions between the charge and spin sector. In this talk we present a microscopic theory of such plasmon-magnon interactions, which is based on a double random phase approximation[6]. We show that plasmon-magnon interactions do not require spin-orbit coupling to exist, and they naturally arise from the exchange interaction between the itinerant carrier and the localized magnetic moments. We will also discuss on the possibility to unveil this physics in recently isolated 2D honeycomb magnets such as Cr2Ge2Te6[7].

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