Optically detected counter-rotating spin waves in ferromagnetic layers: the key role of the optical phase shift

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We excite perpendicular standing spin waves by a laser pulse in a (Ga,Mn)(As,P) ferromagnetic semiconductor layer and detect them using time-resolved magneto-optical effects. The full trajectory of the magnetization vector can be reconstructed using two magneto-optical effects, the polar Kerr effect and the Voigt effect. Quite counter-intuitively, we find that the first two excited modes are of opposite chirality. We show that this is an optical illusion that can perfectly be explained by taking into account absorption and optical phase shift inside the layer [1]. These results provide a correct identification of spin waves modes, enabling a trustworthy estimation of their respective amplitudes as well as an unambiguous determination of the spin stiffness parameter.

References:

[1] S. Shihab, L. Thevenard, A. Lemaître, C. Gourdon. https://hal.archives-ouvertes.fr/hal-01490261