Optical non-reciprocity in magnetic Weyl semimetals

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Résumé

In an optical reflective experiment, we shed light an a material from a source, and we measure the intensity of reflected electromagnetic modes using a detector. This measure is said to be reciprocal if it remains unchanged under the swapping of the source and the detector. Optical non-reciprocity has been proposed as a possible route to improve the efficiency of energy conversion devices, from solar cells to passive heat coolers. In this talk, we will explore the optical non-reciprocity of magnetic Weyl materials.
Weyl semi-metals are topological materials that exhibit a linear dispersion near their electronic band crossings. Because such materials break time-reversal symmetry and display an anomalous transverse current when applied an external electric field, Weyl-semimetals-based devices are excellent candidates to investigate optical non-reciprocity. We focus on identifying the physical origin of non-reciprocity in Weyl materials heterostructures.
Our investigations showed that optical non-reciprocity can be attributed to dissipation through plasmon-polariton modes. The analog Lorentz force acts differently on these modes depending on their direction of propagation: it either facilitates or frustrates the transverse displacement of electronic charges. Therefore an accurate description of the optical non-reciprocity of magnetic Weyl materials requires the understanding of the optical conductivity around the plasma frequency. We will discuss an efficient numerical method to characterize it, based on the Kernel polynomial method, and the associated results allowing to optimiize non-reciprocity of these materials.

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