Radiation of Single Emitters Near Topological insulators

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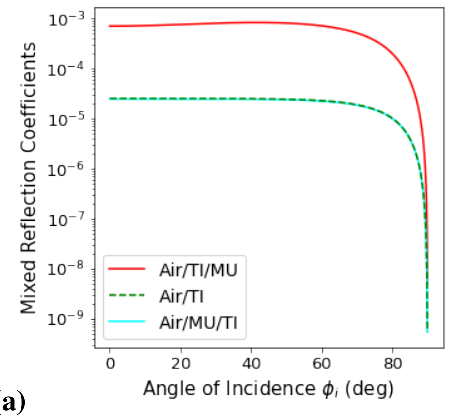
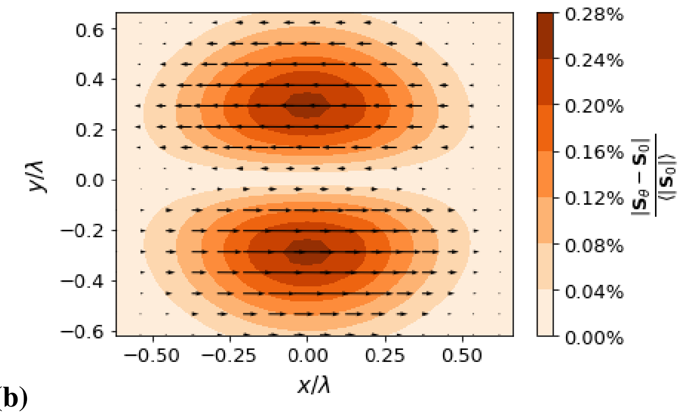
We consider the transmission and reflection coefficients of light in systems composed of topological insulators (TI) [1]. Due to the electro-magnetic coupling in TIs, new mixing coefficients emerge leading to new components of the electromagnetic fields of propagating waves. Efforts in optically characterizing TIs seek to measure the Faraday rotation of a transmitted ray, as it should be quantized by the fine structure constant α. However, this effect is very small, and the conditions for it to be purely topological are such that requires very strong magnetic fields, low temperatures, and high-frequency emissions [2]. This effect can be amplified by complex material configurations, which pushed us to find an alternative simpler method. Our theoretical estimations indicate that a third mu-metal sub-layer causes a 100-fold amplification of the effect caused by mixing reflection coefficients. Such effect increase with the TI's wave impedance. We also predict a transverse deviation of the Poynting vector due to these mixed coefficients contributing to the radiative electromagnetic field of an electric dipole. Given an optimal configuration of the collection lens-dipole-TI system, this deviation could amount to 0.28% of the Poynting vector due to emission near not topological materials, making this effect detectable. Our method of optical characterization could significantly contribute to the realization of low energy consumption of electronic devices based on TIs.



(a)



(b)

Figure 1: (a) Mixed reflective Fresnel's coefficients for the three different possible configurations and (b) Vector plot of the Poynting vector's deviation for an $\hat{x}$ oriented dipole over a TI's surface.

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References

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