Theory of thermal transport via photons within media

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It is well known that photons can cause thermal transport between *isolated* bodies, i.e., via near- and far-field thermal radiation. In contrast, thermal transport *within* media by photons is hardly explored, as it is typically exceeded by other mechanisms, such as electronic or phononic contributions. Furthermore, theoretically determining photonic energy transport in dissipative media has been found challenging, as it, among other things, requires careful treatment of Poynting's theorem. In this contribution, we derive an exact mesoscopic formalism for thermal transport within dissipative media, circumventing Poynting's theorem [1]. We discuss cases where photonic contributions can be dominant such as an interface that supports traveling surface waves. We compare to recent experiments as well as to approximate approaches, e.g., using the Boltzman transport equation.

[1] M Krüger, K Asheichyk, M Kardar, R Golestanian, Phys. Rev. Lett. 132 (10), 106903 (2024)