

# The Nonlinear Optics of Graphene: Welcome to the Wild West!

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The nonlinear optics of graphene has been the subject of a host of studies, both experimental and theoretical. For more usual materials, a first description of such processes that is sometimes reasonably accurate can be constructed at a perturbative level by introducing a third-order nonlinear susceptibility, often within an independent particle approximation where relaxation processes are only treated in a phenomenological way. Even when such an approach fails, it often provides a benchmark for more sophisticated calculations, and by comparison with experiment can help identify the physics that it itself cannot describe. We present such an elementary approach to the nonlinear optical properties of graphene, illustrate how a series of confusions in the literature have arisen in its introduction, and compare with experiment where possible.

