Chiral Fields in Achiral Systems

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Chirality – the absence of mirror symmetry – is an integral component of our world. The handedness of a given chiral substance can only be detected by interactions with other chiral objects. The strength of the chiral interaction between electromagnetic fields and a chiral molecule can be quantified by the so-called optical chirality [1]. It has been shown that fields with high optical chirality can arise near plasmonic nanostructures with strong planar or three-dimensional geometrical chirality [2].

We demonstrate numerically that geometrical chirality is not a necessary prerequisite for obtaining chiral near-fields: Even a highly symmetric linear plasmonic rod antenna illuminated with linearly polarized light under normal incidence generates chiral electromagnetic fields [3].

We use a simple dipole model to explain this behavior qualitatively. This model is further utilized to analyze and compare different incident polarizations. We show that the chiral near-field patterns generated by circularly polarized incident light are still dominated by the distribution found for the linear polarization.

The handedness of the chiral fields near a square structure can be flipped locally by changing the polarization angle of the incident light. Based on these findings, we propose a novel method for enantiomer sensing using linearly polarized light. This technique is confirmed by full-field simulations using a Fourier Modal Method solver that has been extended to support chiral materials.

[1] Y. Tang and A. E. Cohen, Science **332**, 333 (2011).
[2] M. Schäferling et al., Phys. Rev. X **2**, 031010 (2012).
[3] M. Schäferling, X. Yin, and H. Giessen, Opt. Express **20**, 26326 (2012).