Chiroptical effects from plasmonic nanostructures with optical Second Harmonic Generation (SHG)

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Chiral nano/meta-materials could enable key applications such as negative refractive index and large optical activity, which can lead to nano-levitation and frictionless nano-motors. Additionally, chiral metamaterials can reduce the helical pitch of circularly polarized light thereby achieving superchiral light. Just as plasmonic local field enhancements can be used to increase the interaction of light with molecules (up to 10^{14} in the case of Raman scattering), superchiral light can increase the interaction within chiroptical (chiral optical) effects.

Strong (SHG) chiroptical effects result from the interaction of light with chiral plasmonic nanostructures (Fig. 1). Due to the favorable power-law scaling of near-field enhancements, the nonlinear optical properties of chiral plasmonic nano- and metasurfaces are of prime fundamental and practical importance. Recently, these optical properties have attracted considerable interest [1]. We report on a surprising direct relationship between superchiral light and SHG [2]. By varying the dimensions of nanostructures, superchiral light can be tuned to optimize material dimensions for enhanced nonlinear chiroptical response. The use of superchiral elements as building blocks opens very interesting possibilities in both 2D and 3D nanomaterials.

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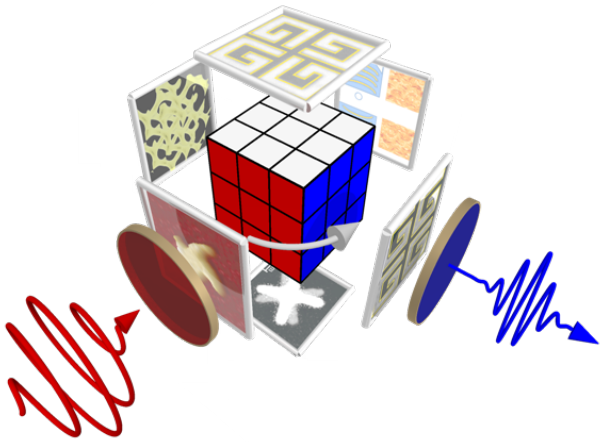

Fig. 1: *The nonlinear chiroptical behavior arises from the nonlinear susceptibility tensor. For second harmonic generation, in the dipole approximation, this tensor has 3 by 3 by 3 elements and can be represented by the familiar Rubik's cube.*

[1] V. K. Valev, J. J. Baumberg, C. Sibilia, T. Verbiest, Adv. Mater. 25, 2508-2628 (2013).
[2] V. K. Valev, J. J. Baumberg, B. De Clercq, N. Braz, X. Zheng, E. J. Osley, S. Vandendriessche, M. Hojeij, C. Blejean, J. Mertens, C. G. Biris, V. Volskiy, M. Ameloot, Y. Ekinci, G. A. E. Vandenbosch, P. A. Warburton, V. V. Moshchalkov, N. C. Panoiu, T. Verbiest, Adv. Mater. 26, 4074-4081 (2014).