Photonic Hall-effect for a single nanoparticle

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Quantum Hall effect arises when electrons are subject to a large magnetic field due to the fact that electrons experience a Lorentz force as they are charged. Despite the absence of photonic charge, it has been observed that a similar effect, a photonic Hall-effect, appears when light is subject as well to a magnetic field, although the origin of the effect is very different.

This photonic Hall-effect, or magneto-transverse anisotropy, in light scattering, is of actual interest and is the basis of interesting phenomena [1,2]. The Hall effect of a single scatter is important by itself. In particular, Hall effect for a Mie sphere has been addressed long before [3]. In these studies it was argued that in the small particle regime (the so called Rayleigh scattering regime) there were no net magneto-transverse scattering effects [3].

Radiative corrections have shown to be important to analyze magneto-optic properties of small nanoparticles [4]. As we will show, Optical Hall-effect in small dipolar particles does exist, arising as a consequence of the radiative corrections to the polarizability.

References

[1] Z. Wang, Y. Chong, J.D. Hoannopoulos & M. Soljacic, Nature **461**, 772 (2009)
[2] F.D. Haldane, S. Raghu, Phys. Rev. Lett., **100**, 013904 (2008)
[3] D. Lacoste, B.A. van Tiggelen, G.L.K.A. Rikken, A. Sparanberg, J. Opt. Soc. Am., **15**, 1636 (1998)
[4] S. Albaladejo et al., Opt. Express **18**, 3556 (2010).