Photonic forces with random fields. From optics of partially coherent light to Van der Waals and Casimir interactions

Manuel Nieto-Vesperinas and Juan Miguel Auñón

Instituto de Ciencia de Materiales de Madrid,
Consejo Superior de Investigaciones Científicas.
Campus de Cantoblanco, Madrid, 28049, Spain
mnieto@icmm.csic.es

We describe the consequences of the mechanical action on matter of electromagnetic fields emitted by three-dimensional randomly fluctuating, statistically homogeneous, and isotropic sources. At the selected wavelengths, (visible and near-infrared), the Planck energy is equivalent to that of the vacuum fluctuations. This has important consequences: employing a quasi-monochromatic optical source, the photonic forces on nanoparticles may be tailored at will. In particular, one may create with light forces equivalent to those of Casimir-Polder and Van der Waals interactions. Thus allowing a control studying these forces and beyond them.

We shall discuss the different contributions (electric, magnetic and interference) of the forces, showing how this scenary is ruled by the interplay of the evanescent (conservative) and propagating (non-conservative) modes of both the random field emitted by the fluctuating source and of the wavefields radiated by the electric and magnetic dipoles randomly induced on particles.

In particular, the asymptotic behavior of these stochastic forces close to the source, assesses and goes beyond the current approximations taken in previous studies of Casimir interactions and their relatives.

References

[1] J.M. Auñón, C.W. Qiu and M. Nieto-Vesperinas. “Tailoring photonic forces on a magnetodielectric nanoparticle with a fluctuating optical source”. Phys. Rev. A, **88**, 043817 (2013).

[2] A. García-Etxarri *et al*. “Strong magnetic response of submicron Silicon particles in the infrared”. Optics Express, **19**, 4815 (2011).

[3] M. Nieto-Vesperinas *et al*. “Angle-suppressed scattering and optical forces on submicrometer dielectric particles”. Journal of the Optical Society of America A, **28**, 54 (2011).

[4] A. Novitsky *et al*. “Single Gradientless Light Beam Drags Particles as Tractor Beams”. Physical Review Letters, **107**, 203601 (2011).