Magneto-optical Stern-Gerlach forces and non-reciprocal torques on small particles

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Shulamit Edelstein

R. M. Abraham Ekeroth[2;3], P. A. Serena[1], J. J. Sáenz[4;5], A. García-Martín[3], and M. I. Marqués[6]
[1]Instituto de Ciencia de Materiales de Madrid (ICMM-CSIC), Campus de Cantoblanco, 28049 Madrid, Spain

shulamit.edelstein@csic.es

We study the effect of optical forces [1] and torques on a spherical isotropic magneto-optical (MO) nanoparticle [2]. The force on the direction of the applied external magnetic field has two contributions: A first conservative component coming from the "Zeeman" coupling between the light spin density and the external magnetic field through the imaginary part of the MO polarizability, and a second component coming from the direct transfer of the helicity of the electromagnetic field to the particle through the real part of the MO polarizability. The torque also has two contributions: The usual one coming from the spin of the light field and another one depending only on the modulus of the electromagnetic field.

We explicitly show examples where these new contributions lead to: (i) An optical torque on an isotropic, spherical particle using a linearly polarized plane wave, (ii) the formation of a conservative optical lattice with non-interfering incoming fields and (iii) radiation pressure using electromagnetic fields with zero average value of the Poynting vector.

REFERENCES

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FIGURES

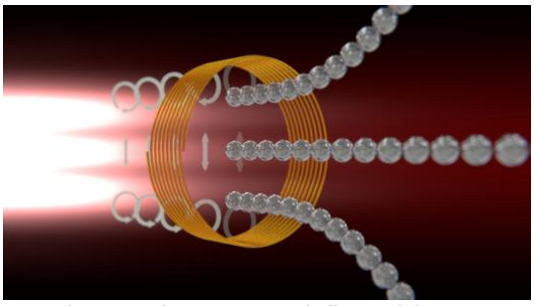

Figure 1: Optical Stern-Gerlach experiment: photons are deflected from a magneto-optical active particle up or down based on their spin angular momentum