Light spin forces, polarization structuring and the trapping of small particles with optical tweezers

Ignacio Iglesias[1] and Juan José Sáenz[2]

[1]Departmento de Física, Universidad de Murcia, Campus de Espinardo, E-30100, Murcia, Spain
[2]Departmento de Física de la Materia Condensada, Universidad Autónoma de Madrid, E-28049, Madrid, Spain

iic@um.es

The force generated by the light spin on Rayleigh particles in optical tweezers increases with the numerical aperture of the microscope altering the trapping potential structure [1]. As happen with the radiation pressure, the spatial distribution of the spin force deeply changes when the polarization of the incident beam is modified. For certain polarizations, the spin force can be comparable in magnitude with the radiation pressure.

To improve the trapping efficiency of metallic particles [2] by minimizing the scattering forces, it has been proposed the use of radial polarized beams [3, 4]. The reason is that the radial pupil plane polarization generates an intensity distribution around the focal point whereas the axial component of the radiation pressure surrounds the optical axis. Thanks to that, it is assumed that the stability region generated by the gradient forces becomes free from scattering.

In this presentation we will describe the different forces acting in a high numerical aperture optical trap for different polarization structures and how, if the spin forces are considered, radial polarization does not reduce the scattering on small metallic particles [5] although it may have other advantages.

References

[1] I. Iglesias and J. J. Sáenz, Opt. Comm. 284, 2430-2436 (2011).
[2] K. Svoboda and S. M. Block, Opt. Lett. 19, 930-932 (1994).
[3] Q. Zhan, Opt. Express 12, 3377-3382 (2004).
[4] Q. Zhan, Adv. Opt. Photon. 1, 1-57 (2009).
[5] I. Iglesias and J. J. Sáenz, Opt. Express 20, 2832-2834 (2012).