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Mechanical effects of light: Radiation pressure, photon momentum and the Lorentz force law

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The rays of light carry energy as well as linear and angular momentum. The latter properties are exploited in solar sails, optical tweezers, and micro/nano opto-mechanical motors and actuators. A fundamental characteristic of photons, their momentum in the presence of material media, has been the subject of debate and controversy for more than a century. The so-called Abraham-Minkowski controversy involves theoretical arguments in conjunction with experimental tests to determine whether the vacuum photon momentum must be divided or multiplied by the refractive index of the host medium. Also, momentum conservation is intimately tied to the force law that specifies the rate of exchange of electromagnetic and mechanical momentum between light and matter. In this presentation the author will discuss the foundational postulates of the Maxwell-Lorentz theory of electrodynamics that clarify the prevailing ambiguities and resolve the reigning controversies.

Biography

Masud Mansuripur (PhD, 1981, Electrical Engineering, Stanford University) is Professor and Chair of Optical Data Storage at the College of Optical Sciences of the University of Arizona in Tucson. He is the author of "Introduction to Information Theory" (Prentice-Hall, 1987), "The Physical Principles of Magneto-Optical Recording" (Cambridge University Press, 1995), "Classical Optics and its Applications," (Cambridge University Press, 2002, second edition 2009, Japanese translation 2006 and 2012), and "Field, Force, Energy and Momentum in Classical Electrodynamics," (Bentham e-books, 2011). A Fellow of OSA and SPIE, he is the author or co-author of more than 250 technical papers in the areas of optical data recording, magneto-optics, optical materials fabrication/ characterization, thin film optics, diffraction theory, macromolecular data storage, and problems associated with radiation pressure and photon momentum.

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