Optically induced 'negative forces': Laser Tractor Beams

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Radiation pressure has fascinated scientists for centuries. In 1619, Johannes Kepler postulated the existence of radiation pressure to explain why comet tails always point away from the Sun. The idea behind this early proposal, which considered light to be composed of small particles, is in agreement with our current understanding of light forces; light carries both linear and angular momenta, and can transfer energy to atoms, molecules and particles. This fact allows radiation pressure to accelerate or push small particles in the direction of the light flow.

The idea of using optical beams to **attract** objects is much less trivial and has long been a dream of scientists and the public alike. Over the years, a number of proposals have attempted to bring this concept to life. Here we review the most recent progress in this emerging field, including new concepts for manipulating small objects using optically induced 'negative forces', achieved by tailoring the properties of the electromagnetic field, the environment or the particles themselves [1]. We will discuss the interplay between scattering asymmetry and optical forces [2] and, in particular, we will focus on the outstanding scattering angular distributions, with zero forward- or backward-scattered intensity, (i.e., the so-called Kerker conditions) recently observed for subwavelength dielectric particles both in the microwave [3] and visible [4,5] spectral regimes.

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