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Investigating the morphology of an optically trapped particle using Mie scattering

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Using optical tweezers, we trap microscopic polystyrene beads suspended in water and determine their diameter using Mie scattering theory. Using a near infrared laser, the optical trap is formed near the focus by a high numerical aperture lens. The particles have a higher refractive index than the surrounding medium and the focused light creates a strong gradient force which traps the transparent, dielectric particles.
The trapped particle is illuminated with broadband white light. Mie scattered light from the particle is collected in the epi direction by a microscope objective and measured on a spectrometer. Due to total internal reflection, specific wavelengths resonate within the spherical cavity. These resonances are commonly referred to as whispering gallery modes, or morphologically dependent resonances. These resonances can be identified on the spectrum of the Mie scattered light. By comparing the wavelength of these resonance peaks to that of theoretical simulations, we can precisely determine the diameter of the particle in the trap. Here, the analysis of these measurements will be discussed.
The system has been expanded to optically trap micron sized aerosol droplets in air using a counter propagating optical trap. The droplet is trapped in the overlap of the foci of the two counter propagating beams. Using a similar Mie scattering theory method as described above, the diameter of the trapped water droplet is to be determined. The system and preliminary trapping results will be discussed here.

Apply to be considered for a student ; award (Yes / No)?

yes

Level for award;(Hons, MSc, PhD, N/A)?

PhD

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