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Holographic Optical Tweezers

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Poster Presentation 10

HOLOGRAPHIC OPTICAL TWEEZERS

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Holographic Optical Tweezer arrays offer a new means of directing the assembly of nanoparticles into configurable structures. Previously, a generalized Lorentz-Mie scattering theory has been used to model *single* (non-holographic) optical traps. Here, we develop a simpler and more intuitive approach to examine the trapping potential as a function of particle size, the polarizability of the particle material as compared to that of the surrounding medium, the power of the laser used to trap the particles, and the angular divergence of the optics used for promoting assembly. For this calculation we incorporate an approximate form for the energy density of the laser beam - one that is appropriate both within and outside of the Rayleigh limit. We believe that our conclusions remain viable in the intermediate case, where the particles to be trapped have dimensions on the order of the wavelength of visible light; this regime is of particular interest in applications involving assembly of photonic bandgap materials and other photonically-active structures. As the first researchers to imbue computer-generated holograms with substance, we have produced the first complete implementation of the Holodeck: a laser beam which is passed through our computer-generated holograms forms a tailored array of "tractor beams" which causes nanoparticles to assemble into the desired form. We are also the first to address the key question regarding application of holographic optical tweezer arrays, namely the *number* of particles that can be simultaneously incorporated and manipulated.