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Lateral optical binding forces between two colloidal Mie particles
MING-TZO WEI, Lehigh University, JACK NG, C.T. CHAN, Hong Kong University of Science and Technology, H. DANIEL OU-YANG, Lehigh University — Micro particles in an intense optical field can self-organize into an array with well defined structure. This phenomenon, first reported by Burns et al., as optical binding, was believed to be caused by the optical gradient force. In spite of many attempts to calculate the binding forces and the colloidal structures, there has been a lack of experiments directly measuring the forces between the particles. Positioning two micron-sized polystyrene particles, each held by a tightly focused laser beam from a single coherence laser source, we found the lateral optical binding force oscillates with the inter particle separation, as well as the relative phase between the beams due to retardation. By independently changing the polarization directions at each optical trap, we examined the periodicity and magnitude of the forces. Our research indicates the forces under such conditions require a model beyond dipole approximation. In addition, an accurate calculation based on Mie theory with consideration of high focusing compare well with our experimental findings.

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