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Measuring colloid interactions and dynamics with digital holographic microscopy and multi-particle scattering theory JEROME FUNG, DAVID KAZ, RYAN MCGORTY, GUANGNAN MENG, Dept. of Physics, Harvard University, K. ERIC MARTIN, Dept. of Physics, UC Santa Barbara, VINOTHAN N. MANOHARAN, Dept. of Physics and SEAS, Harvard University — We describe an *in situ*, nonperturbative optical technique for measuring the pair potential between two colloidal particles in bulk suspension. We image clusters of colloidal spheres at or near contact with digital holographic microscopy and fit the resulting holograms to the exact numerical solution for electromagnetic scattering from the clusters. We measure the depletion interaction between two 1 μm polystyrene spheres in a bulk suspension by studying the thermal fluctuations of their $\sim$ 50 nm separation distance with $\sim$ 5 nm spatial resolution. Our method does not require the use of optical tweezers and thus may be useful for studying interactions between colloids that are too small or too nearly index-matched to be optically trapped. We also use our methods for recording and fitting holograms to simultaneously measure the 3D translational and rotational Brownian motion of sphere clusters.

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