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Developing Optical Control of Levitated Particles in A Thermophoretic Trap[1] HUITING LIU, KELSEY GILCHRIST, University of Chicago, MICHELLE CHONG, Massachusetts Institute of Technology, CHENG CHIN, James Franck Institute, Enrico Fermi Institute, University of Chicago Department of Physics — We study the dynamics of levitated particles under illumination by a 405 nm wavelength laser. The particles are levitated and trapped using a thermophoretic force field generated in a vacuum chamber. Microspheres ranging from 5 to 50 μm in diameter are levitated at pressures between 4 and 15 Torr. Levitated microspheres exhibit different movements under illumination: movements in and opposite the direction of laser propagation (positive and negative photophoretic forces). To evaluate our experimental results vis-à-vis existing models of photophoresis, we report observations of the particle trajectories. We simulate the radiation field and temperature distribution of levitated spheres to understand the measurements quantitatively. This study of illumination-induced dynamics is a necessary first step towards use of the laser for optical control. With improved understanding of light forces, the laser can be used for novel measurements of the radial thermophoretic force and characterization of the thermophoretic potential. Optical control of levitated particles will widen the possibilities of our levitation scheme as a platform for studying micron-length dynamics and force fields in a microgravity environment.

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