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Optical trapping of small particles: The breakdown of the ray optics regime RACHAEL HARPER, ALEX LEVINE, University of California, Los Angeles — Laser trapping, or the manipulation small particles by a highly focused light beam, is now a ubiquitous experimental technique. The understanding of how forces on these particles are generated by their interaction with the light beam was developed by Ashkin in the context of geometric optics. However, recent experiments [1] on the laser trapping of dielectric particles having complex shapes and characteristic dimensions in the micron range suggest that the geometric optics based theory is inadequate. Solving the ray optics problem for a variety of complex particle shapes and comparing to the experiments of Ref. [1], we explore the limits of the ray optics based theory. Using a combination of numerics and analytic calculations in the physical optics regime, we extend the theory of optical trapping to the case where at least some of the dimensions of the particles are smaller than the wavelength of the light. By using these calculations, one can design particle shapes to program their dynamics in the light field, creating spinners and gliders, as well as particles that can and cannot be trapped. [1] JN Wilking, TG Mason, Europhys Lett, 81, 58005 (2008).

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