Abstract Submitted
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Theoretical Analysis for the Optical Shaping of Emulsion Droplets[1] DAVID TAPP, Department of Mathematical Sciences, Durham University, UK, JONATHAN TAYLOR, School of Physics and Astronomy, University of Glasgow, UK, ALEX LUBANKSY, School of Engineering, Edith Cowan University, Australia, COLIN BAIN, Department of Chemistry, Durham University, UK, BUDDHAPRIYA CHAKRABARTI, Department of Mathematical Sciences, Durham University, UK — Motivated by recent experimental observations, I discuss a theoretical framework to predict the three-dimensional shapes of optically deformed micron-sized emulsion droplets with ultra-low interfacial tension. The resulting shape and size of the droplet arises out of a balance between the interfacial tension and optical forces. Using an approximation of the laser field as a Gaussian beam, working within the Rayleigh-Gans regime and beyond, and assuming isotropic surface energy at the oil-water interface, the resulting shape equations are numerically solved to elucidate the three-dimensional droplet geometry. A plethora of shapes as a function of the number of optical tweezers, their laser powers and positions, surface tension, initial droplet size and geometry are obtained. Experimentally, two-dimensional emulsion droplet silhouettes have been imaged from above, but their full side-on view has not been observed and reported for current optical configurations. This experimental limitation points to ambiguity in differentiating between droplets having the same two-dimensional projection but with disparate three-dimensional shapes. The model I present elucidates and quantifies this difference for the first time.

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