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Optical Trapping and Manipulation in the Single- and Many-Body Limits

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Analysis of optical dipole/scattering forces can be done at a variety of levels, some of which are appropriate to the undergraduate curriculum. The addition of simple holographic techniques has extended the basic capabilities of optical tweezing, making it a more viable tool for the assembly of micro-systems and organization of specimens into user-defined structures. In 2D, we have demonstrated an approach that allows optical forces alone to assemble microparticles over macroscopic areas. 3D structures pose greater challenges, but also significant opportunities. Our early efforts at filling a 3D lattice of optical traps led to an appreciation for the dynamics of injected microparticle streams, which yield a surprisingly successful method of sorting or re- routing within microfludic environments. We will discuss the status of efforts using optical trapping to create static many-body structures (both simple and complex), as well as recent results on dynamic interactions. At the same time, some of these techniques have clear pedagogical value, as will be emphasized.