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The Zoomin' HOTs: Dynamic Holographic Optical Tweezing

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THE ZOOMIN' HOTs: DYNAMIC HOLOGRAPHIC OPTICAL TWEEZING

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A new experimental technique, Holographic Optical Tweezing (H.O.T.), has been developed through a collaboration between our group at IWU and researchers at the University of Chicago.[1] Our addition of diffractive optics to earlier techniques for optical trapping significantly enhances the ability to control the assembly of biological cells or microscopic dielectric particles. In this new work, we describe original designs for optical systems using static holograms that nevertheless allow dynamic control over the number of traps in an assembly, their configuration/disorder (via spatial filtering), and even their spacings (via carefully designed zoom optics), as well as the strength of the traps (via the laser intensity). Although there are many possible applications for this new technology, as physicists our first interest is in exploring collective effects in optical binding, and in creating model systems that afford us many tunable parameters with which to explore many-body interactions. We are also interested in the onset of symmetry-breaking behavior (e.g., avalanches and the possibility of self-organized criticality, and the microscopic mechanisms underlying phase transitions in two and three dimensions).

[1]Eric R. Dufresne, Gabriel C. Spalding, Matthew T. Dearing, Steven A. Sheets, David G. Grier, Review of Scientific Instruments 72, 1810 (2001).