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**Feedback-driven tracking and trapping of a single fluorescent nanoparticle in a confocal microscope** LLOYD DAVIS, JAMES GERMANN, JASON KING, BRIAN CANFIELD, University of Tennessee Space Institute —
Improved techniques for recording the three-dimensional motion and spectroscopic dynamics of single fluorescent emitters with ever higher temporal and spatial resolution and for longer periods of observation will benefit future studies of molecular behavior and cellular mechanisms in biomedical research. Feedback-driven tracking and trapping, which relies on rapid determination of particle position followed by low latency application of motion to counteract Brownian diffusion, has been demonstrated by a number of techniques, each with their advantages and shortcommings. We have recently demonstrated a new method for tracking the motion of single emitters with diffusivities up to $\sim 12$ square-microns/second by use of a confocal fluorescence microscope with four slightly spatially offset temporally modulated laser foci for position determination and a 3D-piezo stage to counteract diffusion. Here, the instrument achieves single-molecule sensitivity but the update rate of the piezo stage limits the response of the tracking. Also, we have recently shown trapping of a single nanoparticle by use of astigmatic imaging for position determination and a simple four-electrode microfluidic device for applying electrokinetic motion in three dimensions. Here, the frame rate of the imaging limits the response of the trap. We discuss combining the advantages of each these methods and the projected capabilities.

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