

RESOLVING MOLECULAR MOTOR STEPPING INSIDE LIVING CELLS

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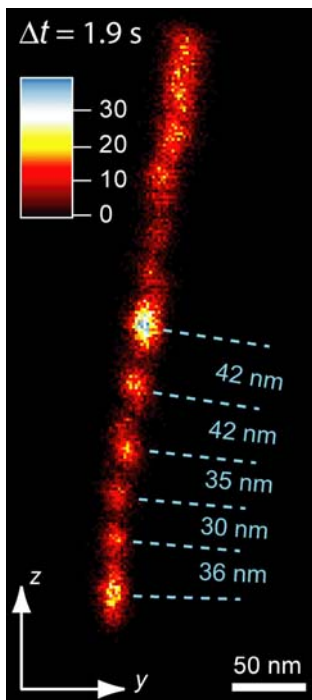
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KEY WORDS: Optical trapping, particle tracking, photonic force microscopy, phagocytosis, single molecules, thermal fluctuations.

The usage of optical traps combined with arbitrary microscopy methods has a decisive advantage especially in biology: rare events can be turned into frequent events by bringing e.g. interaction partners into close proximity to each other. New insights especially in cell biology are enabled by recording the relevant processes in a small volume at ultra-high speed and with nanometer precision.



Here we investigate phagocytosis, which is the process by which bacteria are internalized into macrophages. This process, which is a central mechanism in the immune system, was so far mainly investigated by conventional light and electron microscopies. However, its mechanical properties were barely known up to now. We used optical tweezers-based microscopy to investigate the mechanics of phagocytosis. The motion of an optically trapped bead was tracked interferometrically in 3D with nanometer precision at a microsecond timescale. The measurement of the thermal bead fluctuations during the binding to the cell membrane enabled the observation of individual receptor-ligand bond formation. By inducing binding of beads to filopodia, we found that filopodia act as cellular tentacles: They retract a few seconds after binding and pull the bound beads towards the cell. The observation of discrete F-actin dependent 36-nanometer steps during retraction led to the hypothesis that an actin-based molecular motor plays an important role in the retraction. Force-velocity measurements revealed the mechanical properties of this putative motor.