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Dispersion-relation phase spectroscopy of neuron transport RU WANG, ZHUO WANG, Beckman Institute, University of Illinois at Urbana and Champaign, LARRY MILLET, MARTHA GILLETTE, Cell and Developmental Biology, University of Illinois at Urbana and Champaign, JOSEPH ROBERT LEIGH, NAHIL SOBH, National Center for Supercomputing Applications, University of Illinois at Urbana and Champaign, ALEX LEVINE, Department of Chemistry and Biochemistry, UCLA, GABREIL POPESCU, Beckman Institute, University of Illinois at Urbana and Champaign — Molecular motors move materials along prescribed biopolymer tracks. This sort of active transport is required to rapidly move products over large distances within the cell, where passive diffusion is too slow. We examine intracellular traffic patterns using a new application of spatial light interference microscopy (SLIM) and measure the dispersion relation, i.e. decay rate vs. spatial mode, associated with mass transport in live cells. This approach applies equally well to both discrete and continuous mass distributions without the need for particle tracking. From the quadratic experimental curve specific to diffusion, we extracted the diffusion coefficient as the only fitting parameter. The linear portion of the dispersion relation reveals the deterministic component of the intracellular transport. Our data show a universal behavior where the intracellular transport is diffusive at small scales and deterministic at large scales. We further applied this method to studying transport in neurons and are able to use SLIM to map the changes in index of refraction across the neuron and its extended processes. We found that in dendrites and axons, the transport is mostly active, i.e., diffusion is subdominant.

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