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Spatial Organization of Organelles in Living Cells: Insights from Mathematical Modelling

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Abstract : Intracellular transport in fungi has a number of important roles in, e.g., filamentous fungal growth and cellular metabolism. Two basic mechanisms for intracellular transport are motor-driven trafficking along microtubules (MTs) and diffusion. Mathematical modelling has been actively developed to understand such intracellular transport and provide unique insight into cellular complexity. Based on live-cell imaging data in Ustilago hyphal cells, probabilistic models have been developed to study mechanism underlying spatial organization of molecular motors and organelles. In particular, anther mechanism - stochastic motility of dynein motors along MTs has been found to contribute to half of its accumulation at hyphal tip in order to support early endosome (EE) recycling. The EE trafficking not only facilitates the directed motion of peroxisomes but also enhances their diffusive motion. Considering the importance of spatial organization of early endosomes in supporting peroxisome movement, computational and experimental approaches have been combined to a whole-cell level. Results from this interdisciplinary study promise insights into requirements for other membrane trafficking systems (e.g., in neurons), but also may inform future 'synthetic biology' studies.

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