



On the Cooperativity of Kinesin Motors during Cargo Transport and Directional Microtubule Sliding

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Abstract:

We are interested in the development and the application of novel optical techniques to investigate molecular transport in cell biology and nanotechnology. Building on our experience in single molecule biophysics and in the in vitro reconstruction of subcellular mechano-systems we study cooperative effects in motor transport and cell motility. Moreover we aim to apply biomolecular motor systems in synthetic, engineered environments for the generation and manipulation of nanostructures. The talk will focus on results, where we used total internal reflection fluorescence (TIRF) and fluorescence reflection interference contrast (FLIC) microscopy in conjunction with quantum dots and 3D-nanometer tracking to learn about the interaction of kinesin motors with microtubules. We will show - that during cargo transport - multiple kinesin-1 motors (i) do not inherently synchronize, (ii) can switch protofilaments, and (iii) hold their cargo about 20 nm away from the surface of the microtubule. Moreover, we observe coexisting transport regimes with distinct velocities when kinesin-1 motors collectively act against each other in a tug-of-war scenario. These results indicate, that kinesin-1 motors facilitate flexible, responsive and effective molecular transport systems that are also of large interest for nanotechnological applications. With regard to kinesin motors being involved in the sliding of microtubules during mitosis and meiosis, we show that kinesin-14 (Ncd) diffuses along microtubules in a tail-dependent manner and switches its orientation between sliding microtubules. Nevertheless, Ncd alone can slide apart anti-parallel microtubules (with significant force) while locking together (i.e. statically crosslinking) parallel ones. These results show that kinesin-14 causes sliding and expansion of an anti-parallel microtubule array by dynamic interactions through the motor domain on the one side and the tail domain on the other.

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