How Does the Motor Protein Kinesin Move?
It Crouches to Step but Resists Pushing!

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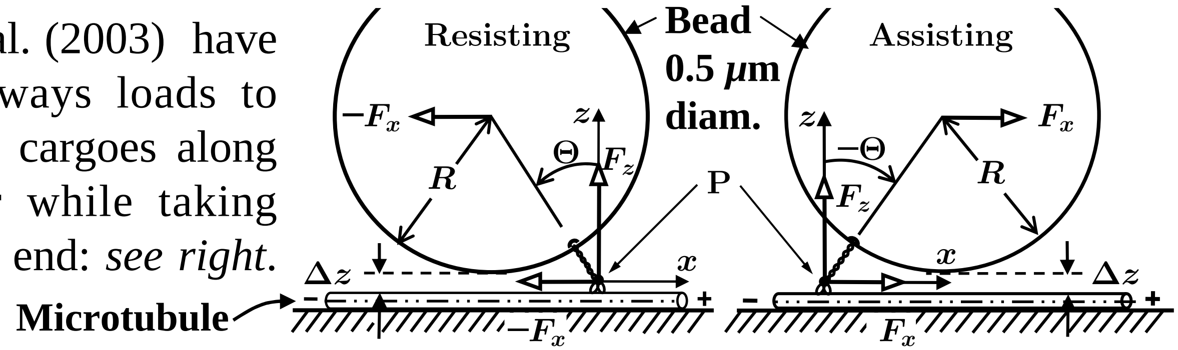
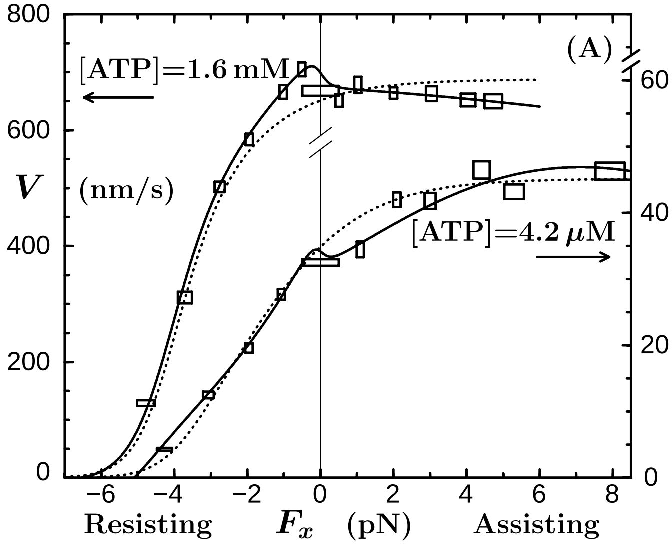
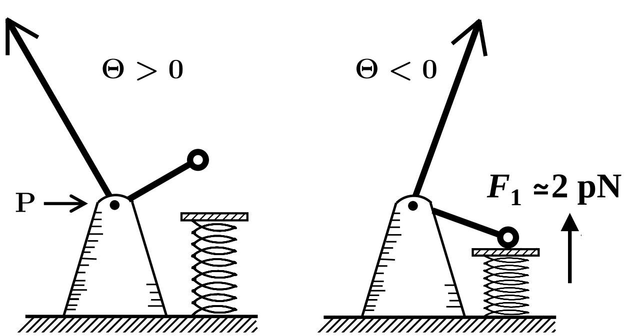
Optical trap experiments by Block et al. (2003) have applied resisting, assisting and sideways loads to kinesin, a molecular motor that moves cargoes along microtubules by pulling on a tether while taking hundreds of 8.2 nm steps towards the + end: *see right*.



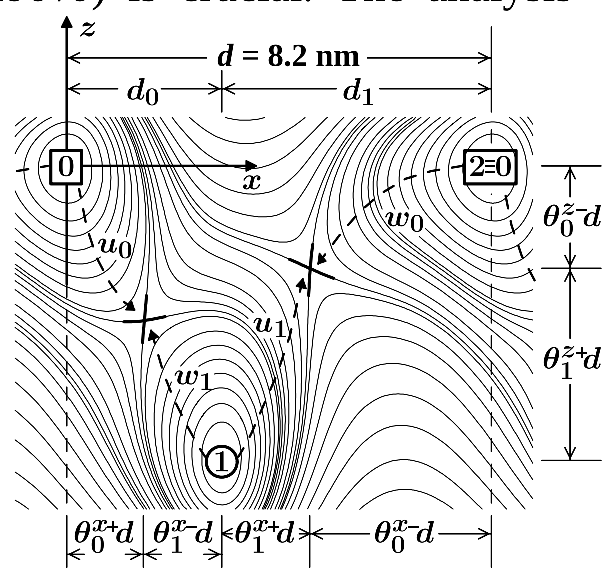


To analyze the velocity-force data (*see left*) and gain insight into intermediate motions when kinesin takes an 8.2 nm step, discrete-state stochastic models with a *three-dimensional* 'energy landscape' have been applied: *see below*.* The geometry of the kinesin-tether-bead linkage (*see above*) is crucial. The analysis implies that on binding ATP, the motor 'crouches,' the point P moving *downwards* by 0.5-0.7 nm, while inching *forwards* by only 0.1-0.2 nm, before completing the step by a unitary 'swing' of ~ 7.8 nm. Assisting and leftwards loads are opposed by ~ 2 pN which *reduces* the velocity: *see left*.

*Y. C. Kim and M. E. Fisher, arXiv: cond-mat/0506185.



A schematic mechanism to resist forward loading



An $(x,0,z)$ section of a 3D energy landscape