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Cargo transport by several molecular motors STEFAN KLUMPP, Center for Theoretical Biological Physics, UC San Diego, MELANIE MÜLLER, JANINA BEEG, RUMIANA DIMOVA, REINHARD LIPOWSKY, MPI of Colloids and Interfaces, Potsdam, Germany — In cells, cargoes are often transported by small teams of molecular motors rather than by a single motor. Furthermore, many cargoes perform bidirectional movements, which are based on the presence of two motor species on the cargo. We study the transport by several motors theoretically using a model that describes the stochastic binding and unbinding of motors from filaments and that is based on the properties of individual motors as observed in single molecule experiments. We find that the cooperation of several motors leads to a strongly increased run length, which is confirmed experimentally for beads pulled by several kinesin motors. Furthermore, such cargoes exhibit a non-linear force-velocity relation. For the case of two motor teams pulling into opposite direction we find that a stochastic tug-of-war model, where the motors interact only by pulling their common cargo into opposite directions, leads to surprisingly complex motility. In particular, even for two motor teams with equal strength, we find that a tug-of-war leads to fast bidirectional motion similar to what is observed in cells and usually taken as evidence for some unknown coordination mechanism. This behavior is due to a dynamic instability, which arises from the strong force-dependence of the rate with which motors unbind from filaments.

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