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Crowding of molecular motors determines microtubule depolymerization LOUIS REESE, ANNA MELBINGER, ERWIN FREY, Arnold Sommerfeld Center for Theoretical Physics and Center for NanoScience, Department of Physics, Ludwig-Maximilians-Universitaet Muenchen — Assembly and disassembly dynamics of microtubules (MTs) is tightly controlled by MT associated proteins. Here, it is investigated how plus-end-directed depolymerases of the kinesin-8 family regulate MT depolymerization dynamics. We reproduce experimental findings within the framework of a totally asymmetric simple exclusion process with Langmuir kinetics (TASEP/LK). Thereby, crowding is identified as the key regulatory mechanism of depolymerization dynamics. The analysis gives two qualitatively distinct phases. For motor densities above a particular threshold, a macroscopic traffic jam emerges at the plus-end and the MT dynamics become independent of the motor concentration. Below this threshold, microscopic traffic jams at the tip arise which cancel out the effect of the depolymerization kinetics such that the depolymerization speed is determined by the motor density. Because this density varies over the MT length, length-dependent regulation is possible. The critical length at which MTs start to depolymerize in a length-dependent way is discussed. Reference: Louis Reese, Anna Melbinger and Erwin Frey. Biophys. J. 101, 2190 (2011)

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