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Supplemental Information

Predicted Effects of Severing Enzymes on the Length Distribution and Total Mass of Microtubules

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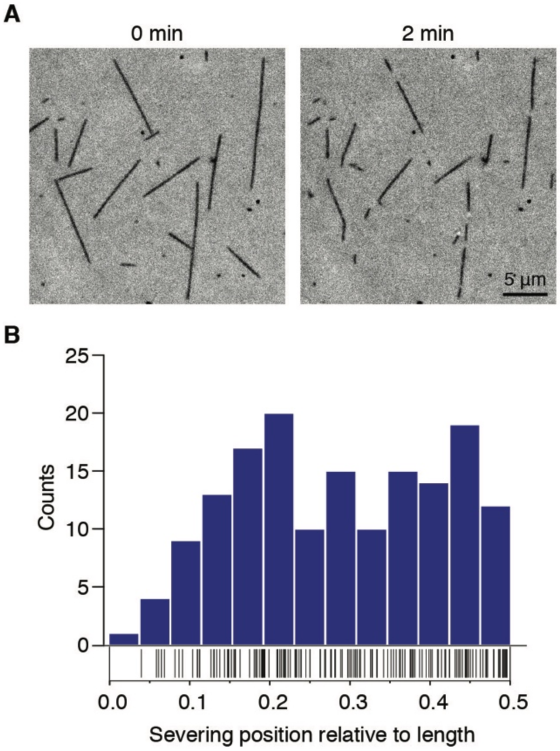
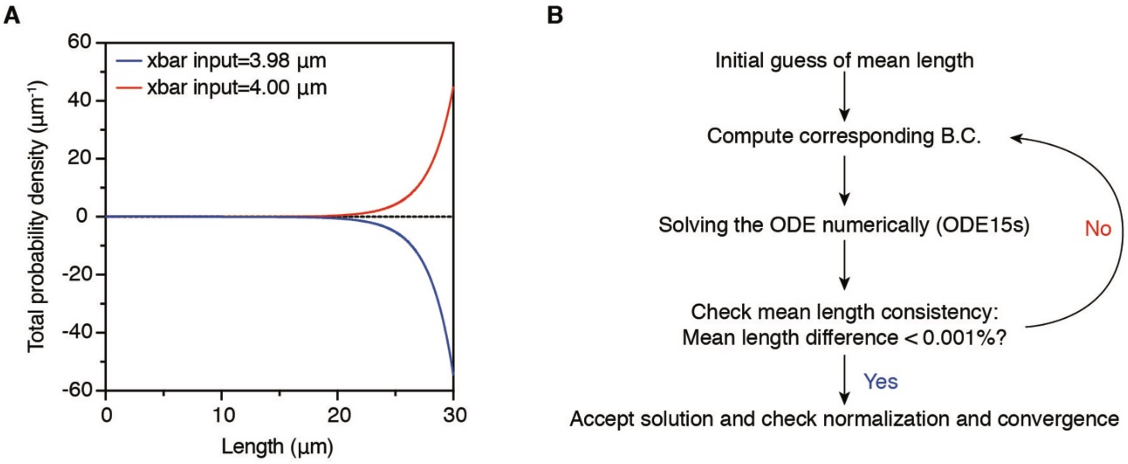
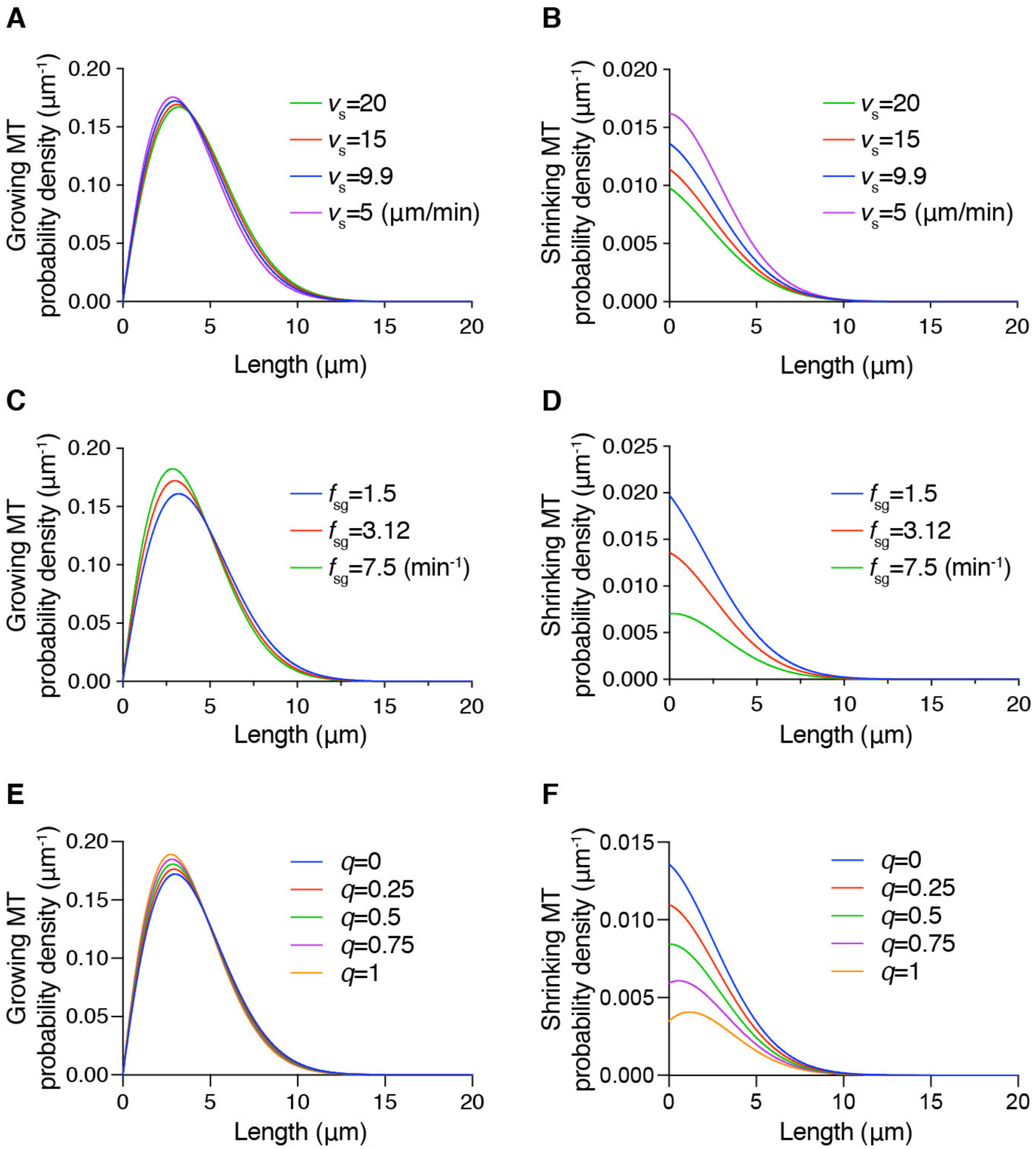


Supplementary Figure 1. Severing positions on stabilized microtubules. A Example of GMPCPP-stabilized microtubules severed by *Drosophila* spastin. Breakages of microtubules are visible with interference reflection microscopy (IRM). **B** Distribution of severing positions along microtubule length showed as histogram and rug plot. The severing position is quantified by measuring the shorter fragment length divided by the full length before a cut occurred. The lower frequency near the tip (<0.1) results from the difficulty of detecting short fragments limited by the optical resolution. The uniformity of the severing positions is tested using a chi-squared test that excludes the first three bins. The test result (χ^2=7.34, p-value = 0.60, degrees of freedom=9) suggests that the experimental distribution is consistent with a uniform distribution. The total number of measurements (N=159) were collected from duplicate experiments.



Supplementary Figure 2. Numerical solution of microtubule length distribution. A The numerical integration results diverge with opposite signs when the input $\bar{x}$ deviates from the true mean length, and the direction depends on whether it is an over- or under-estimation. The dynamic parameters used were described in Table 1, with a severing rate of 0.05 µm^{-1}·min^{-1}. The true mean length is 3.991 µm in this condition (Fig. 3A-3C, red curves for the converged and self-consistent solution). **B I**terative procedure for solving the steady-state length distribution numerically. Normalization error is smaller than 0.001.



Supplementary Figure 3. Steady-state length distribution with respect to different dynamic parameters. **A,B** Effect of shrinkage rate v_s on growing and shrinking microtubule distribution. The growing probability distribution is almost unperturbed while the shorter shrinking microtubules probability is more affected. **C,D** Growing and shrinking microtubule distributions for different rescue frequencies. Promotion of rescue has an opposite effect on growing and shrinking distribution: it increases the amount of short growing microtubules but decreases the amount of short shrinking ones. **E,F** Steady-state length distribution with different probability of new plus ends immediately starting in the growing state after cut (denoted by q). The effect of q is similar to rescue and has a strong impact on the microtubule disappearance probability $p_s(0^+)$. The solutions are solved with a severing rate of 0.05 $\mu m^{-1} \cdot min^{-1}$.