Two–state Model

Detailed balance of chemical reactions:

$$\frac{\alpha_1(x)}{\alpha_2(x)} = e^{\frac{W_1(x)-W_2(x)+\Delta\mu}{K_B T}}$$
$$\frac{\beta_1(x)}{\beta_2(x)} = e^{\frac{W_1(x)-W_2(x)}{K_B T}}$$

Chemical driving force:

$$\Delta\mu = \mu_{ATP} - \mu_{ADP} - \mu_P$$

Transition probabilities:

$$\omega_i(x) = \alpha_i(x) + \beta_i(x)$$

Fokker–Planck equations

Probability density: $P_i(x)$

The system of equations:

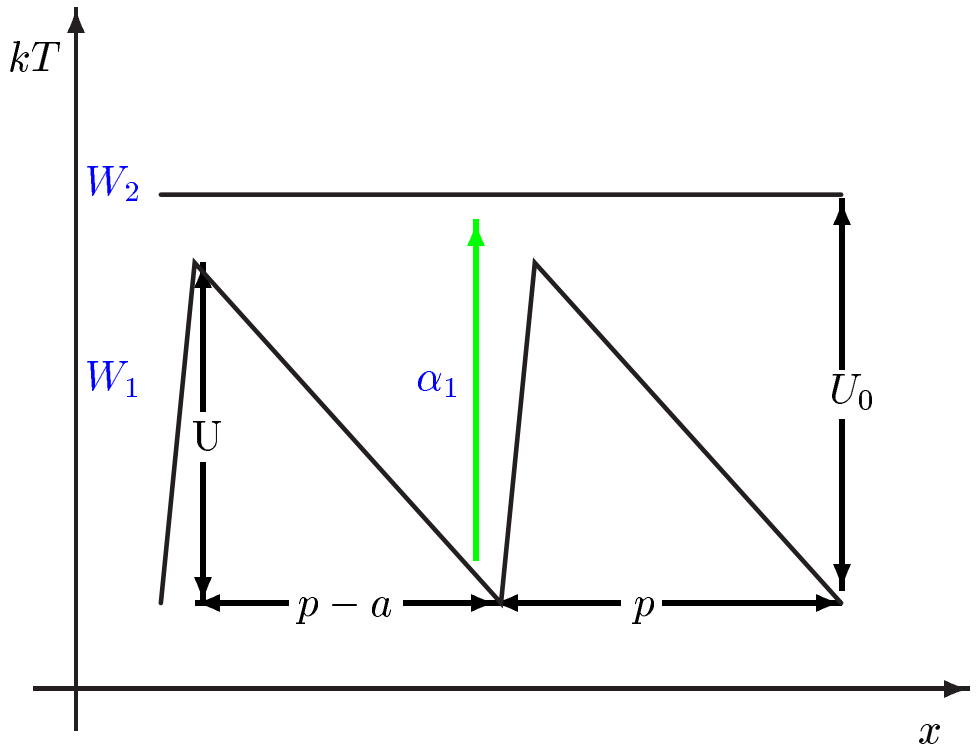
$$\begin{aligned} \partial_t P_1 + \partial_x J_1 &= -\omega_1 P_1 + \omega_2 P_2 \\ \partial_t P_2 + \partial_x J_2 &= \omega_1 P_1 - \omega_2 P_2 \end{aligned}$$

Probability current:

$$\begin{aligned} J_i(x,t) &= -\frac{D_i}{kT}\left[P_i\ \partial_x W_i + \right. \\ &- \left. kT\ P_i\ F_{ext} + kT\ \partial_x P_i\right] \end{aligned}$$

Ratchet potential

Essential features of filaments:

- Periodic
- Asymmetric

Ratchet potential: