What is FT useful for ?

- Several interesting consequences of FT such as the Jarzinsky and Crooks equalities are useful to compute the free energy difference bewteen two equilibrium states using any kind of transformation

- Hatano-Sasa relation and the fluctuation dissipation theorem for non equilibrium steady states(NESS). These are useful to compute the response function of NESS

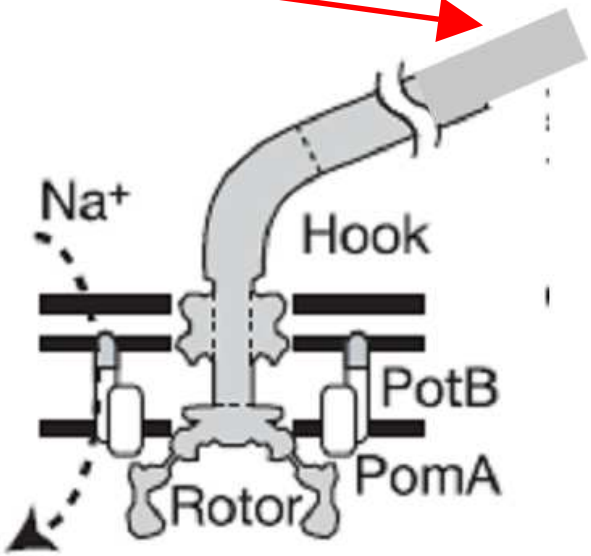
- FT allows the measure of tiny amount of heat exchange bewteen the system and its heat bath. (example: application to aging and biological systems)

- Measure of the offset of a variable

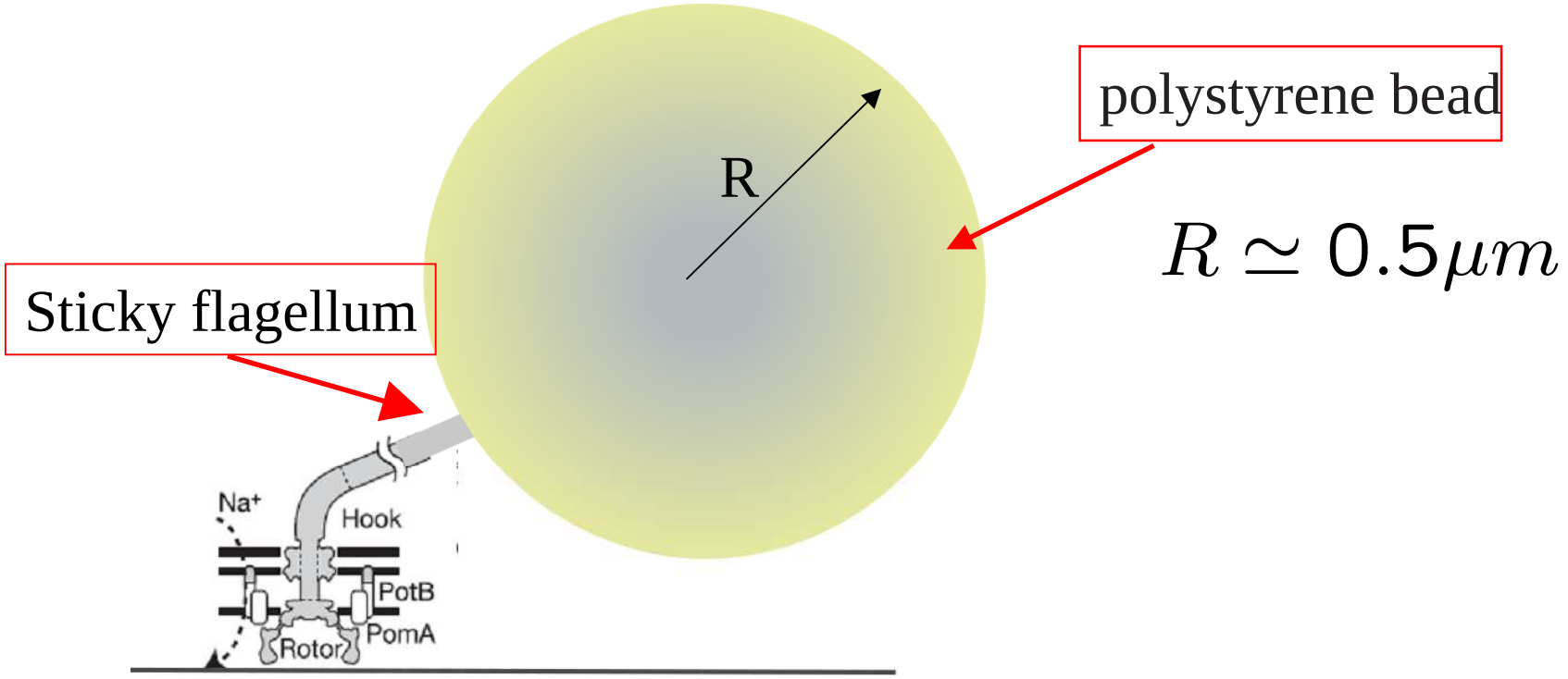
- Measure of the mean injected power.

Molecular motor and FT

Sticky flagellum

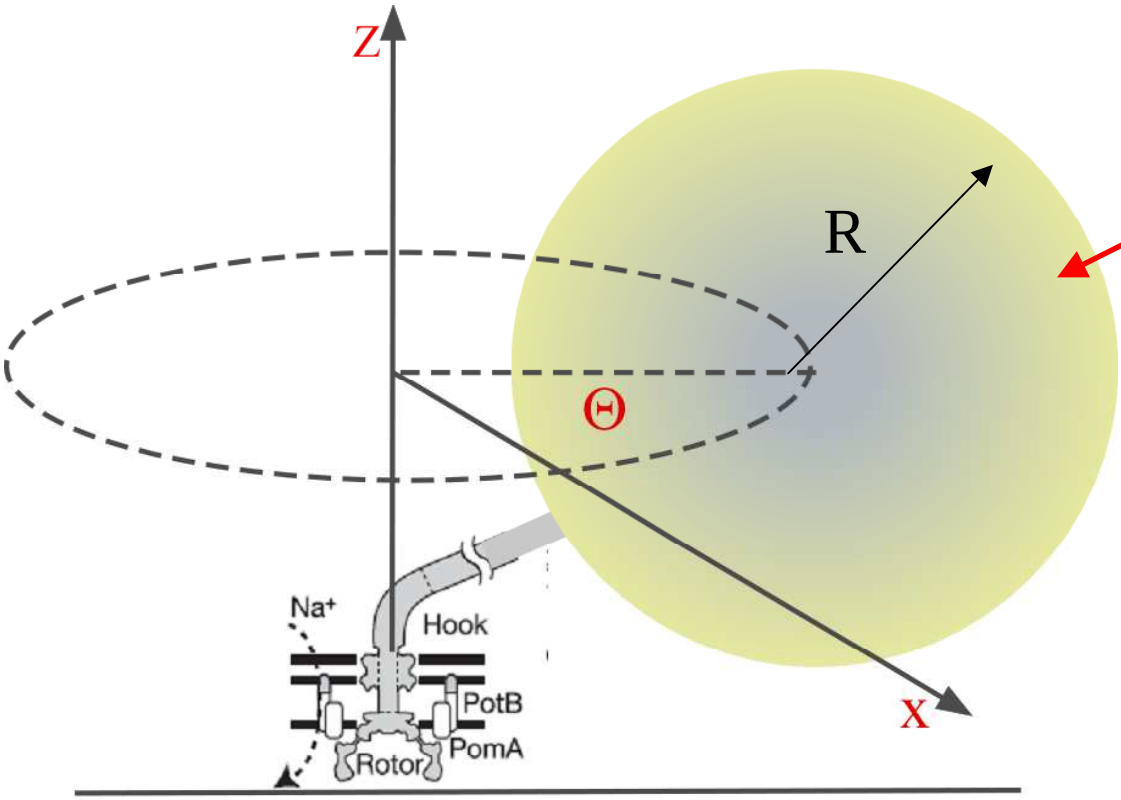


Molecular motor and FT



(drawing not in scale)

Molecular motor and FT



polystyrene bead

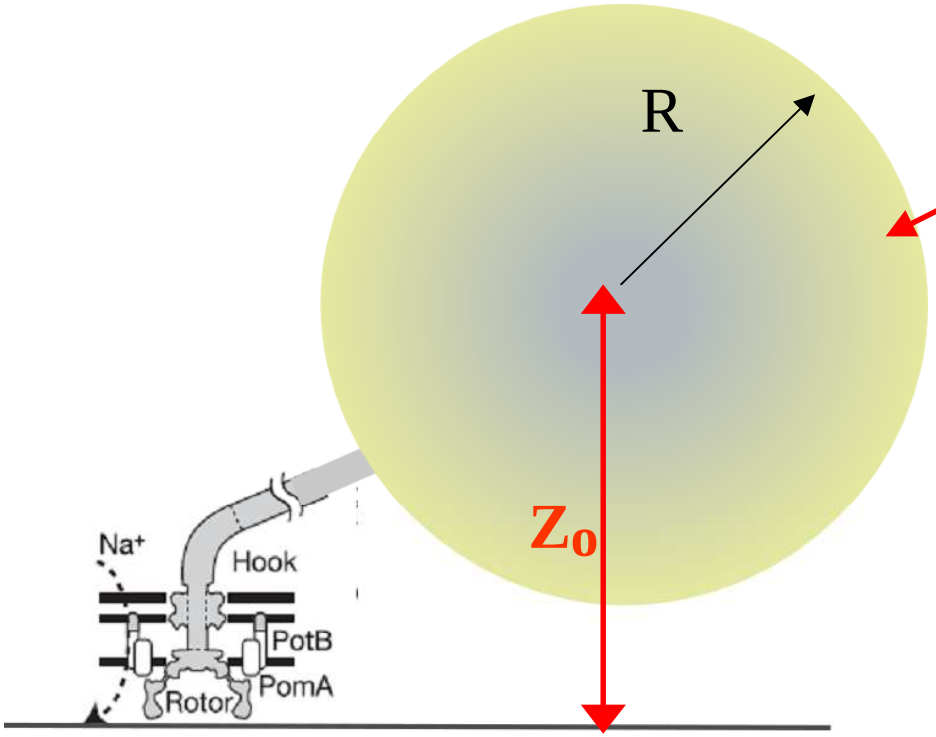
$$R \simeq 0.5 \mu m$$

$$\gamma\dot{\theta} = N + \eta$$

Standard method to determine the torque **N**

$$N = \frac{<\dot{\theta}>}{\gamma}$$

Molecular motor and FT



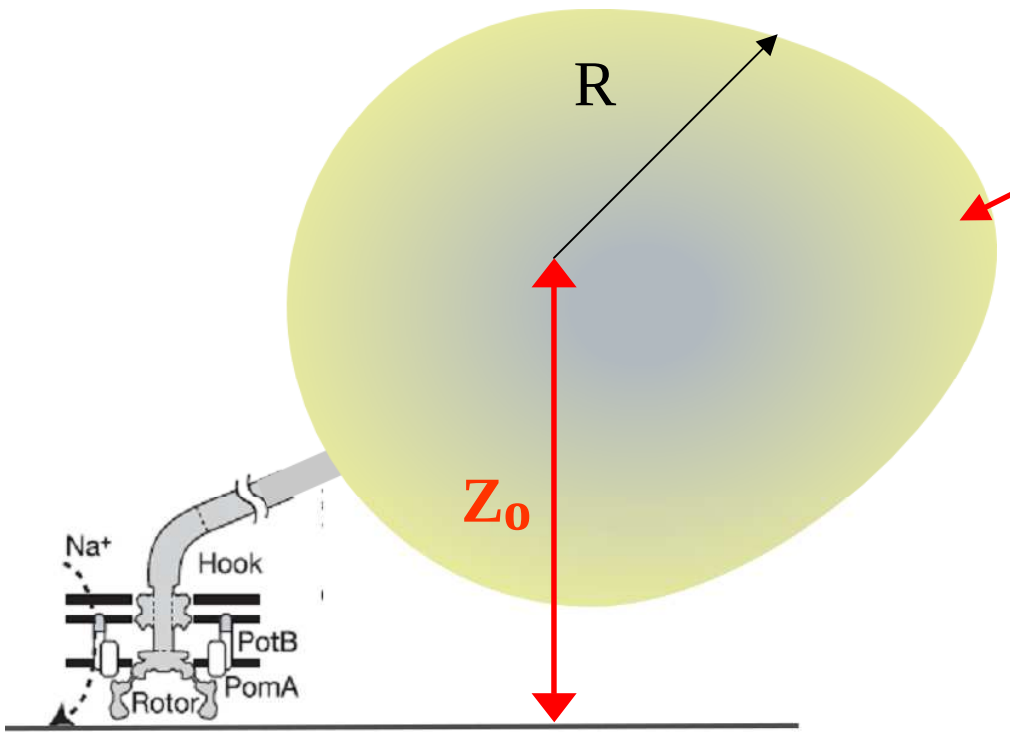
$$R \simeq 0.5 \mu m$$

$$\gamma \dot{\theta} = N + \eta$$

Standard method to determine the torque **N**

$$N = \frac{<\dot{\theta}>}{\gamma}$$ but $$\gamma(R, Z_0)$$

Molecular motor and FT



$$R \simeq 0.5 \mu m$$

$$\gamma \dot{\theta} = N + \eta$$

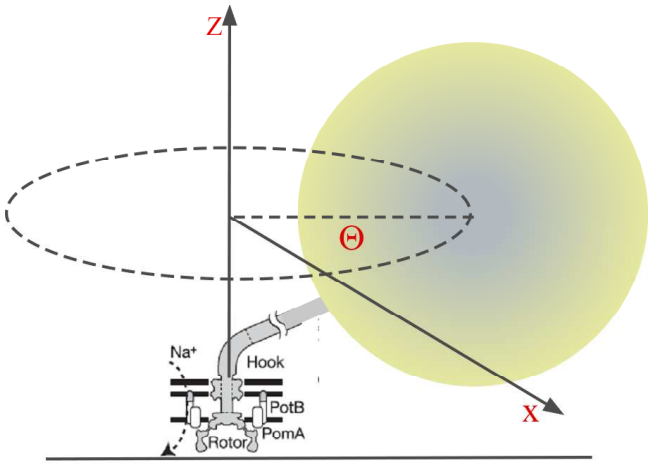
Standard method to determine the torque **N**

$$N = \frac{<\dot{\theta}>}{\gamma}$$

but $\gamma(R, Z_0)$

and of the shape

Molecular motor and FT



New method based on FT
to determine the torque **N**

$$\gamma\dot{\theta} = N + \eta$$

$$W_\tau = N \int_t^{t+\tau} \dot{\theta}\ dt = N\ \Delta\theta_\tau \quad \text{where } \Delta\theta_\tau = (\theta(t+\tau) - \theta(t))$$

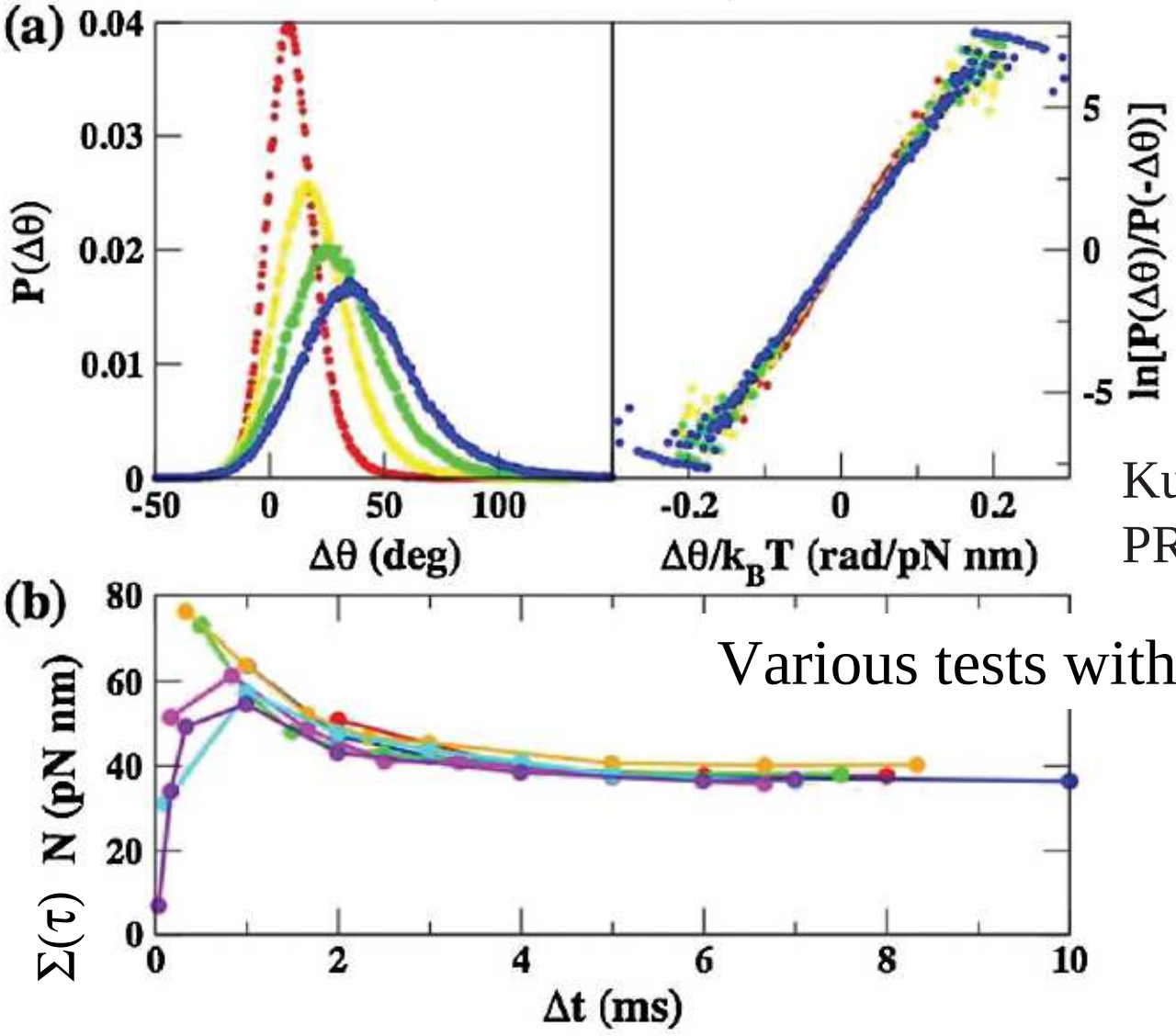
SSFT for W_τ : $$\log\left(\frac{P(\Delta\theta_\tau)}{P(-\Delta\theta_\tau)}\right) = \Sigma(\tau)\ N\ \frac{\Delta\theta_\tau}{k_B T}$$

γ is not needed

with $\Sigma(\tau) \to 1$ for $\tau \to \infty$

Molecular motor and FT

$$\log\left(\frac{P(\Delta\theta_\tau)}{P(-\Delta\theta_\tau)}\right) = \Sigma(\tau)\ N\ \frac{\Delta\theta_\tau}{k_B T}$$



Kumiko Hayashi et al.,
PRL 104, 218103 (2010)

Various tests with different beads

(size and shape)