

**TABLE 1** Parameter values used in the simulations

Symbol	Meaning	Typical value
$A$	Cross-sectional area of the channel	1 nm <sup>2</sup>
$c_\ell$	Luminal proton concentration	10 <sup>-5</sup> protons/nm <sup>3</sup>
$c_C$	Cytoplasmic proton concentration	10 <sup>-7</sup> protons/nm <sup>3</sup>
$D_p$	Free proton diffusion coefficient	10 <sup>9</sup> nm <sup>2</sup> /s
$D_r$	Rotor diffusion coefficient (free swimming)	20 radian <sup>2</sup> /s
	Rotor diffusion coefficient (tethered)	0.7 radian <sup>2</sup> /s
$D_s$	Stator diffusion coefficient	4 × 10 <sup>4</sup> nm <sup>2</sup> /s
$E$	Membrane potential	160 mV
$k$	Elastic constant of the stator	1–15 pN/nm
$k_B T$	Boltzmann's constant × absolute temperature	4.2 pN-nm
$L$	Length of the MotA/MotB channel	8 nm
$q^2/(4\pi\epsilon_0)$	Electrostatic constant	230 pN-nm <sup>2</sup>
$\epsilon$	Dielectric constant	2–10
$\lambda$	1/electric screening distance	0.28 nm <sup>-1</sup>