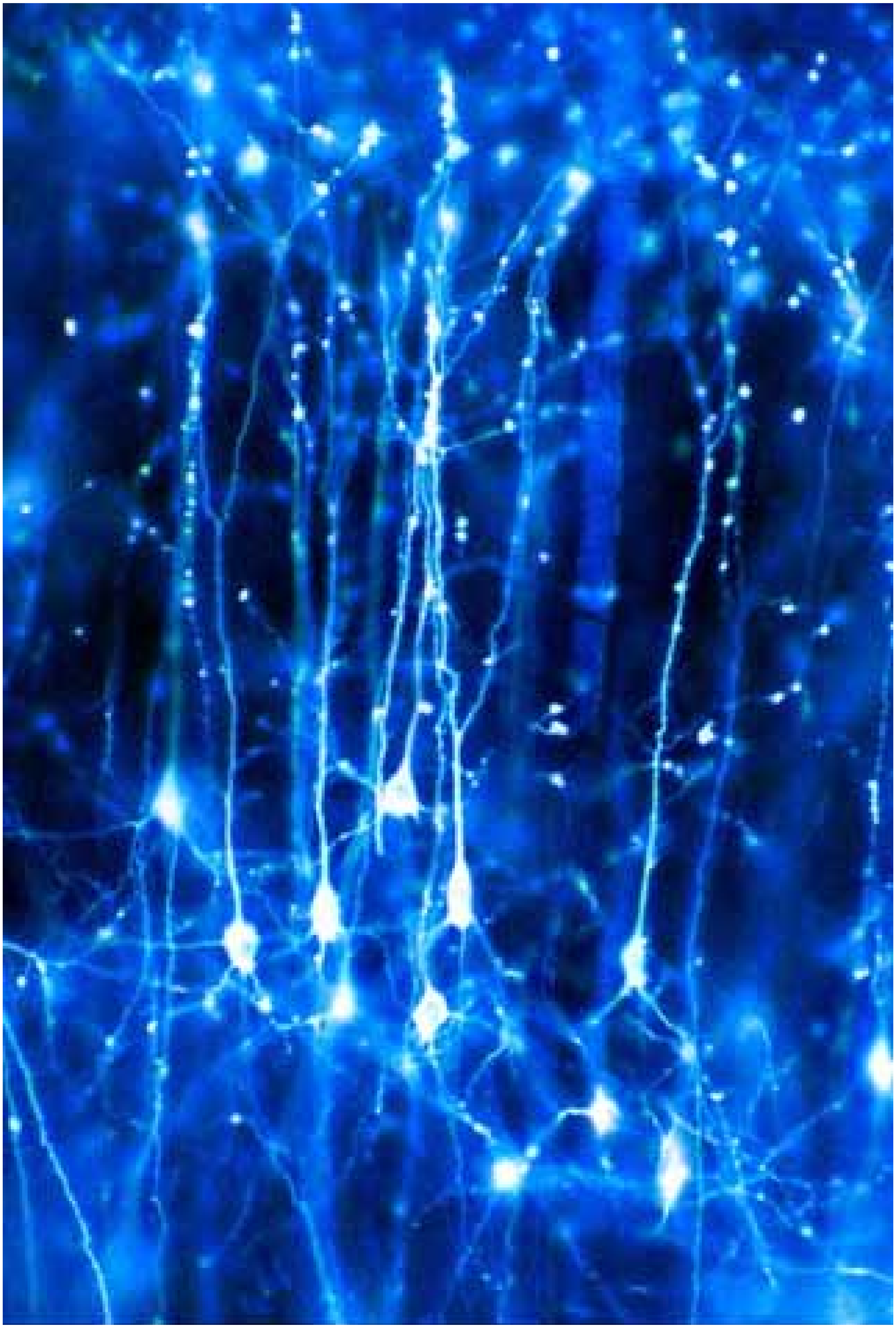
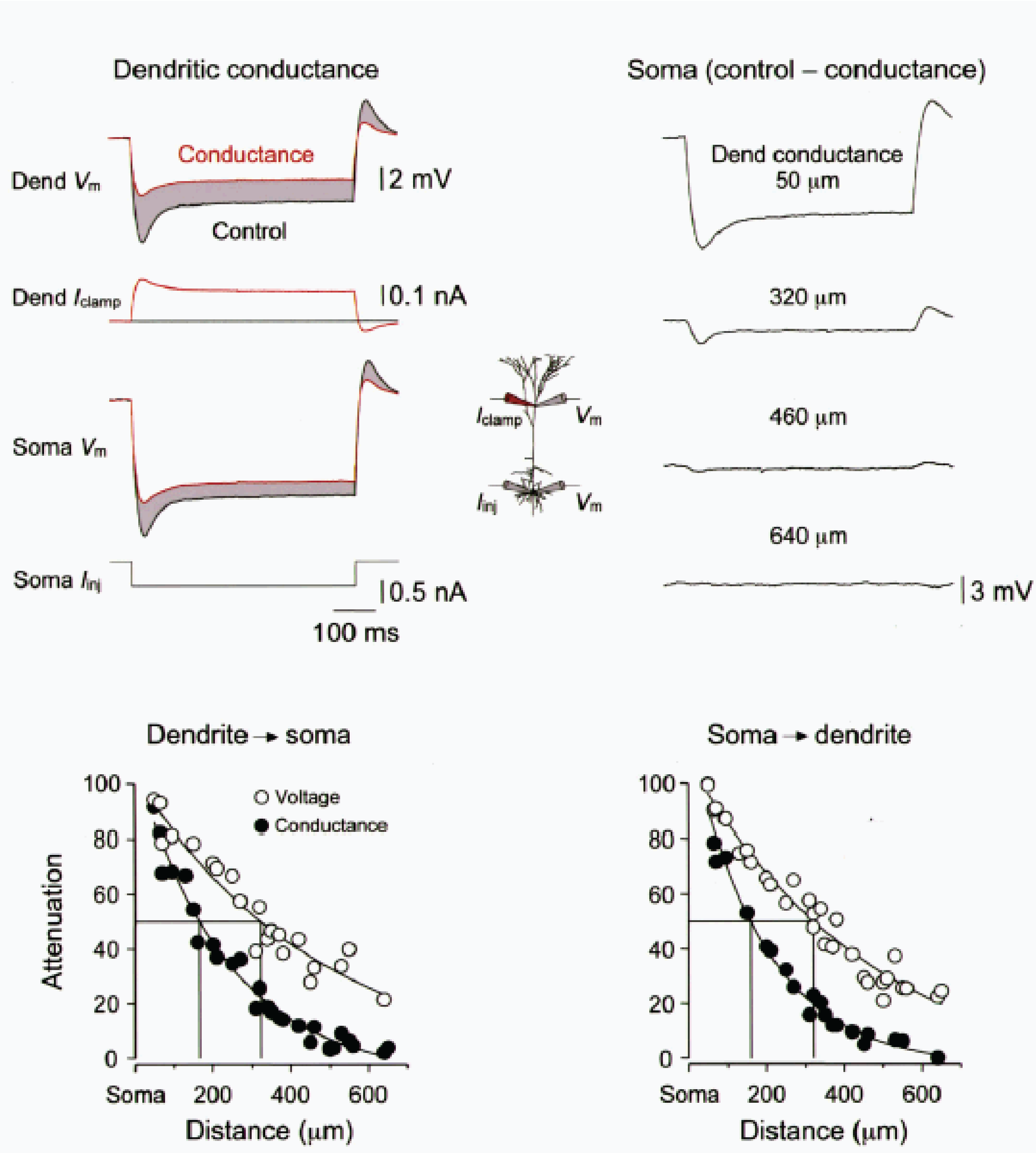
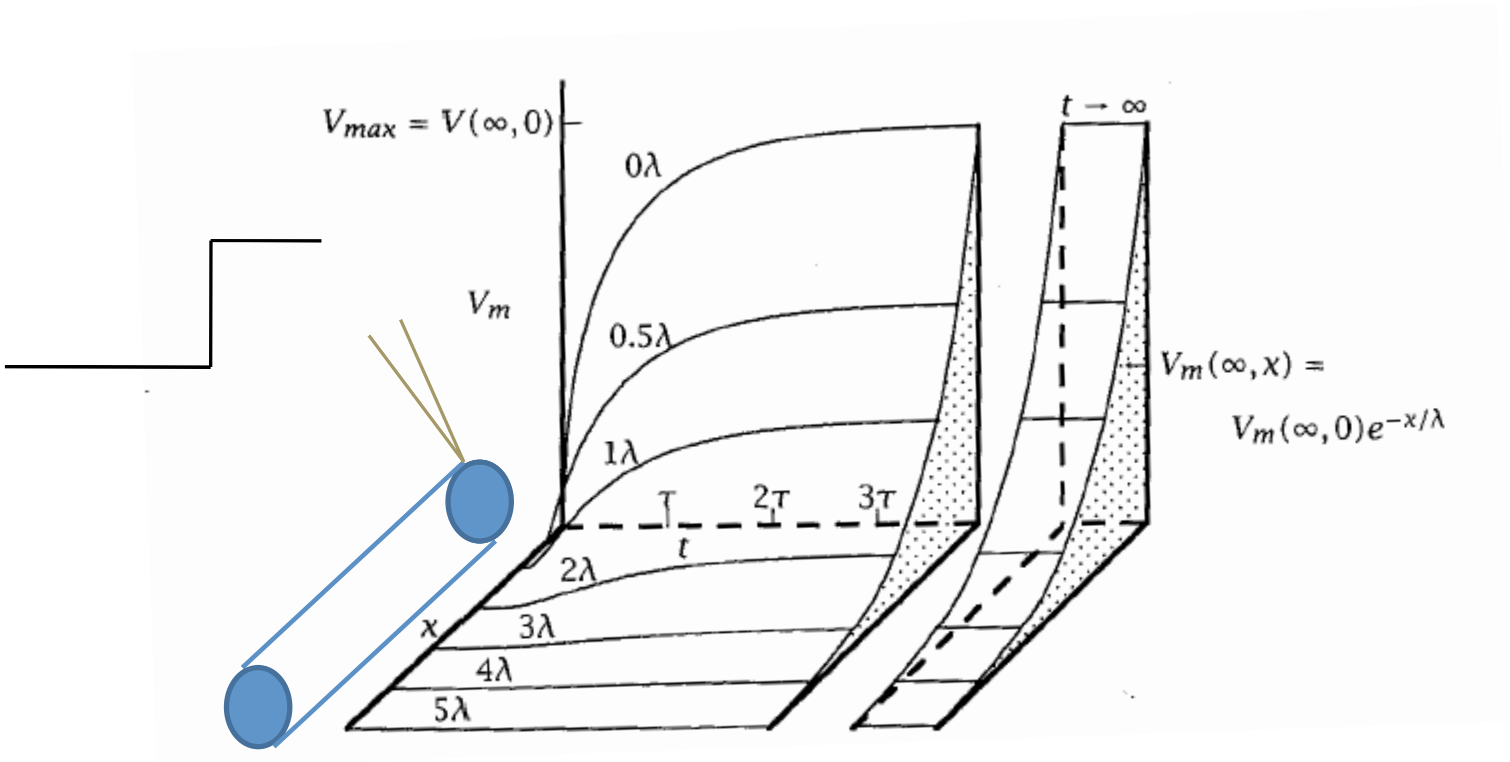
L6 Cortical Neurons



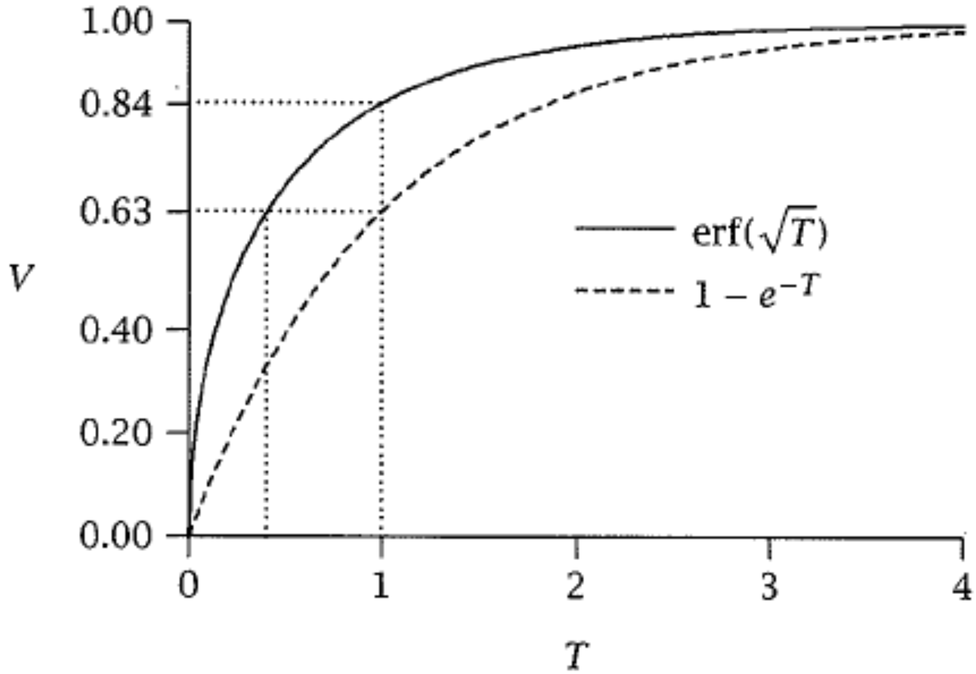
Attenuation in a dendrite



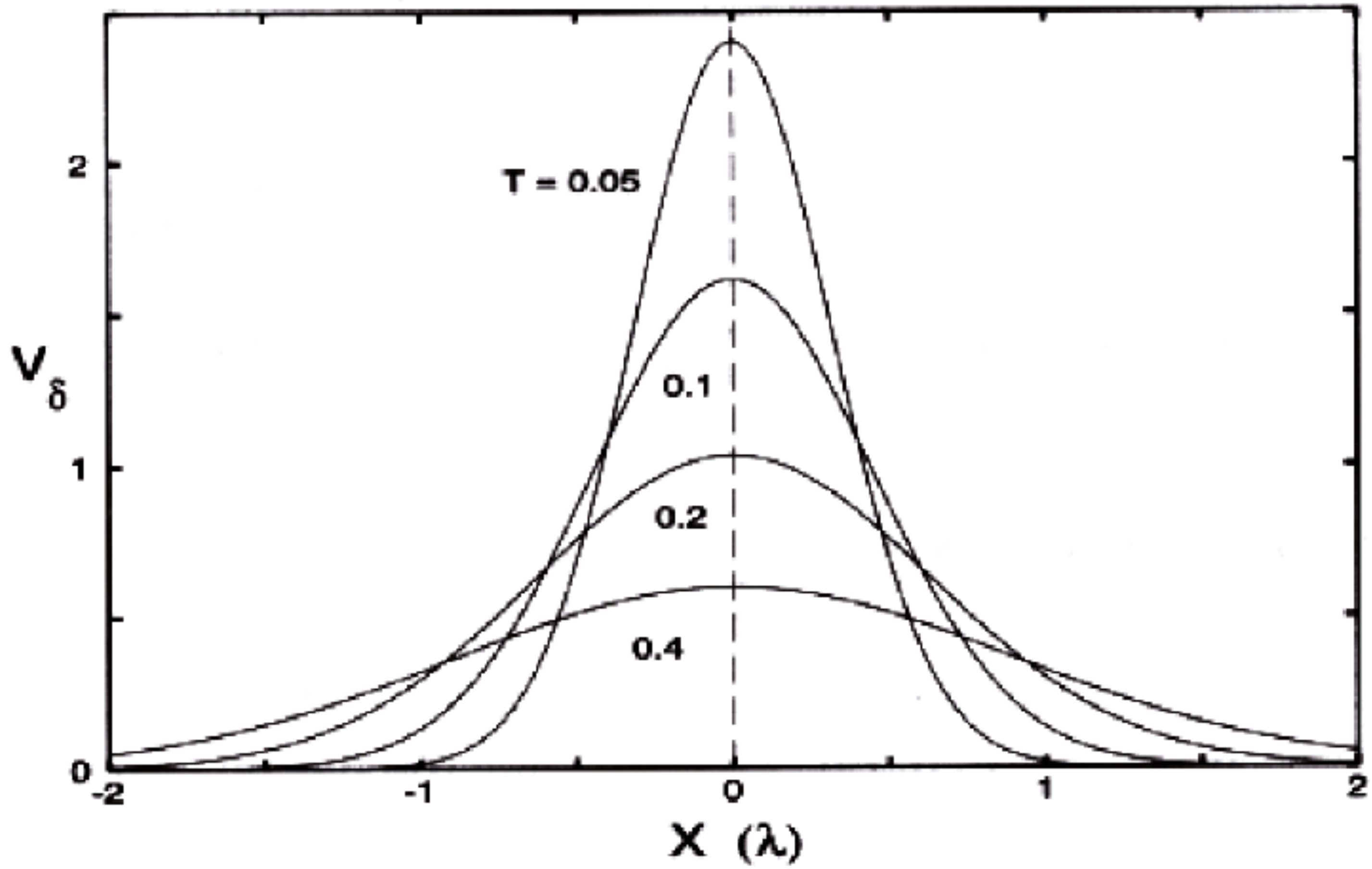
Electrotonic length



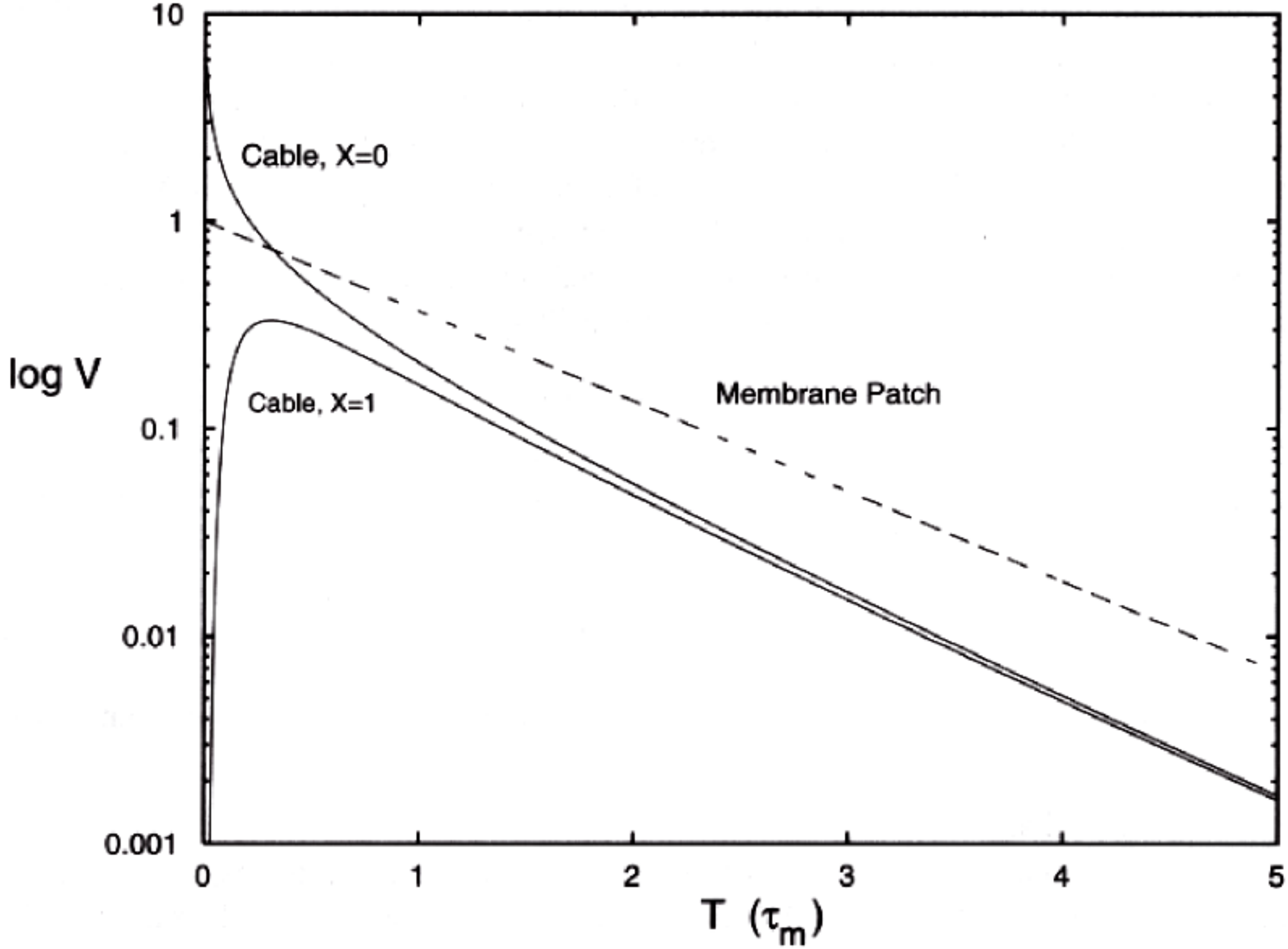
Johnson and Wu



Johnson and Wu



T = 0.05
0.1
0.2
0.4
V
δ
X (λ)
0
1
2
-2
-1
0
1
2



10
1
0.1
0.01
0.001
log V
Cable, X=0
Cable, X=1
Membrane Patch
0
1
2
3
4
5
T (τ_m)

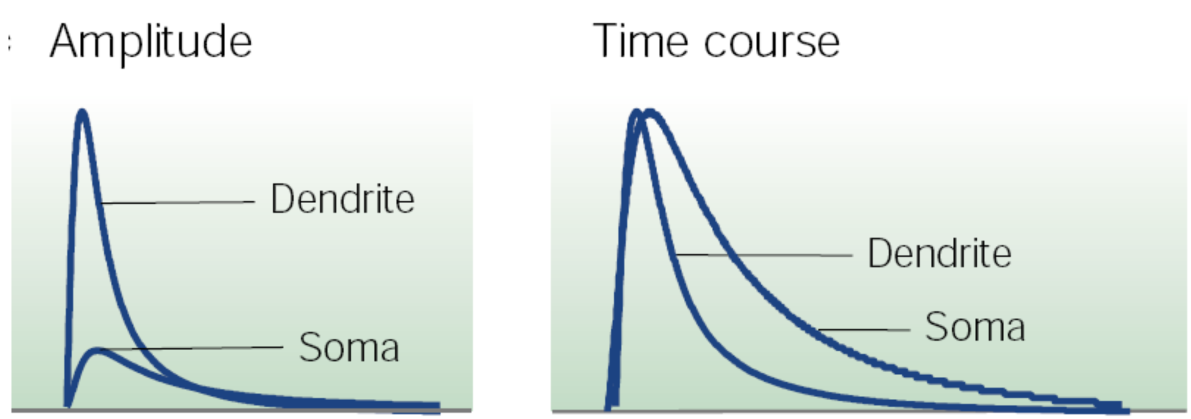
Koch

Properties of passive cables

→ Electrotonic length $$\lambda = \sqrt{\frac{r_m}{r_i}}$$

→ Current can escape through additional pathways: speeds up decay

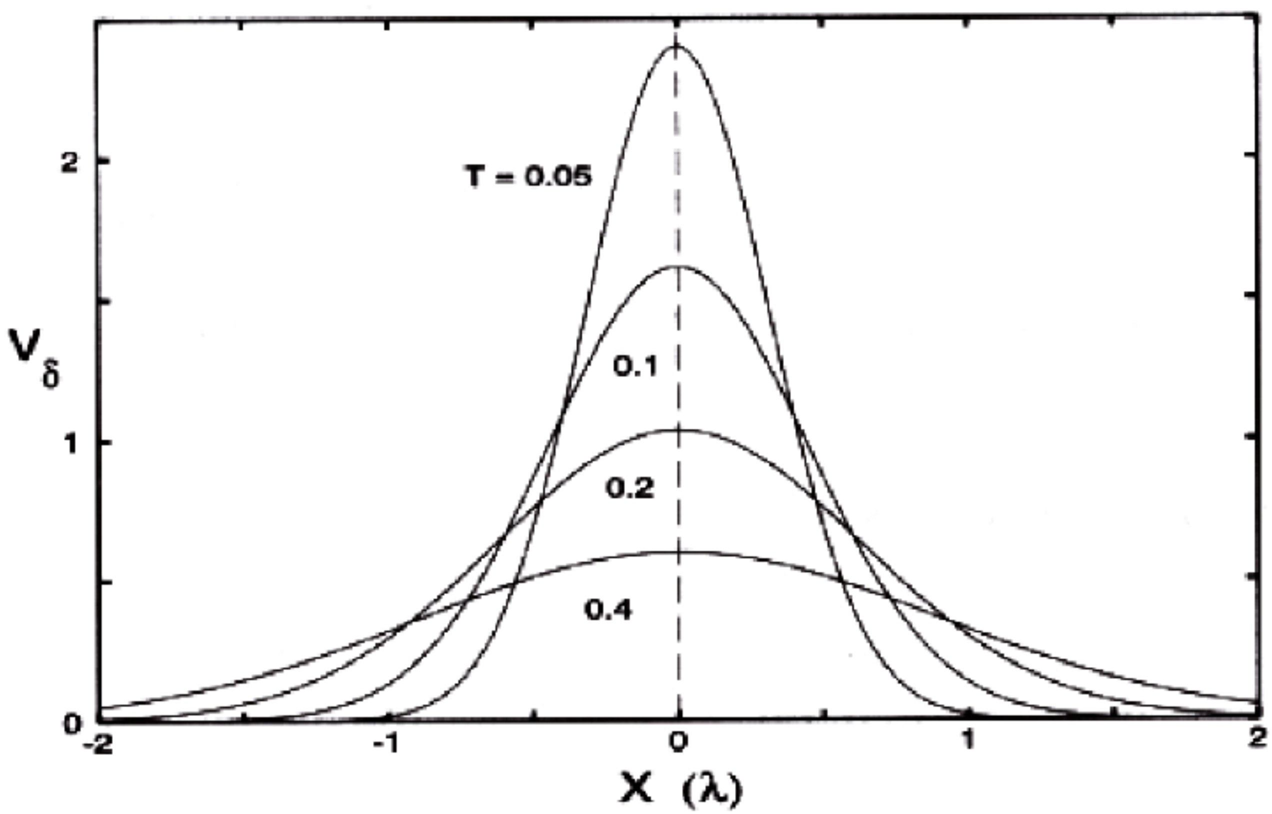
→ Cable diameter affects input resistance $$R_N = \frac{\sqrt{R_m R_i/2}}{2\pi a^{3/2}}$$



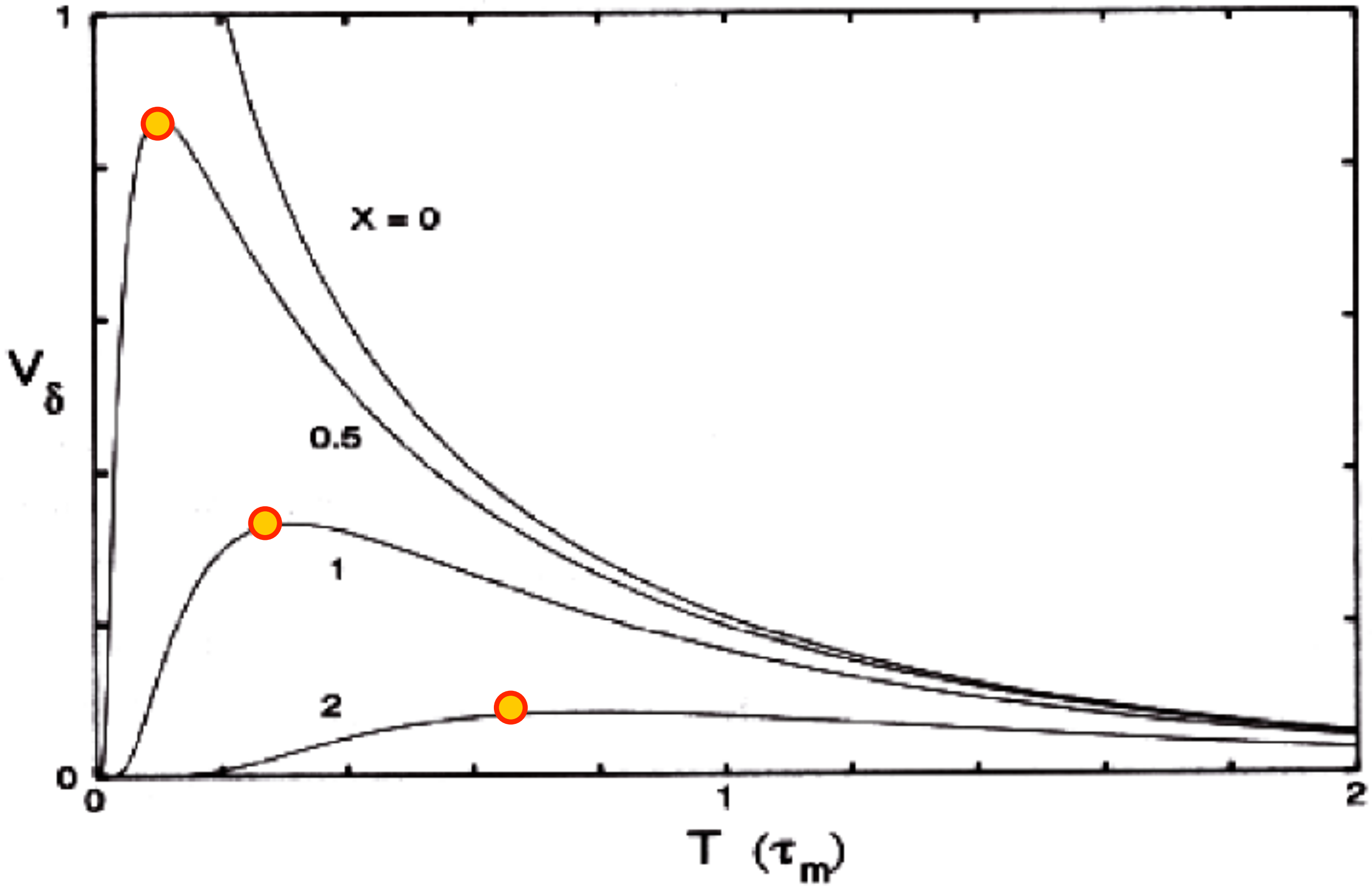
Pulse response

$$V(x,t) \propto \sqrt{\frac{\tau}{4\pi\lambda^2 t}} e^{-\frac{t}{\tau} - \frac{\tau x^2}{4\lambda^2 t}}$$

$$V(x,t) = V(0) e^{-\frac{1}{2}\ln t/\tau - \frac{t}{\tau} - \frac{s^2\tau}{4\lambda^2 t}}$$

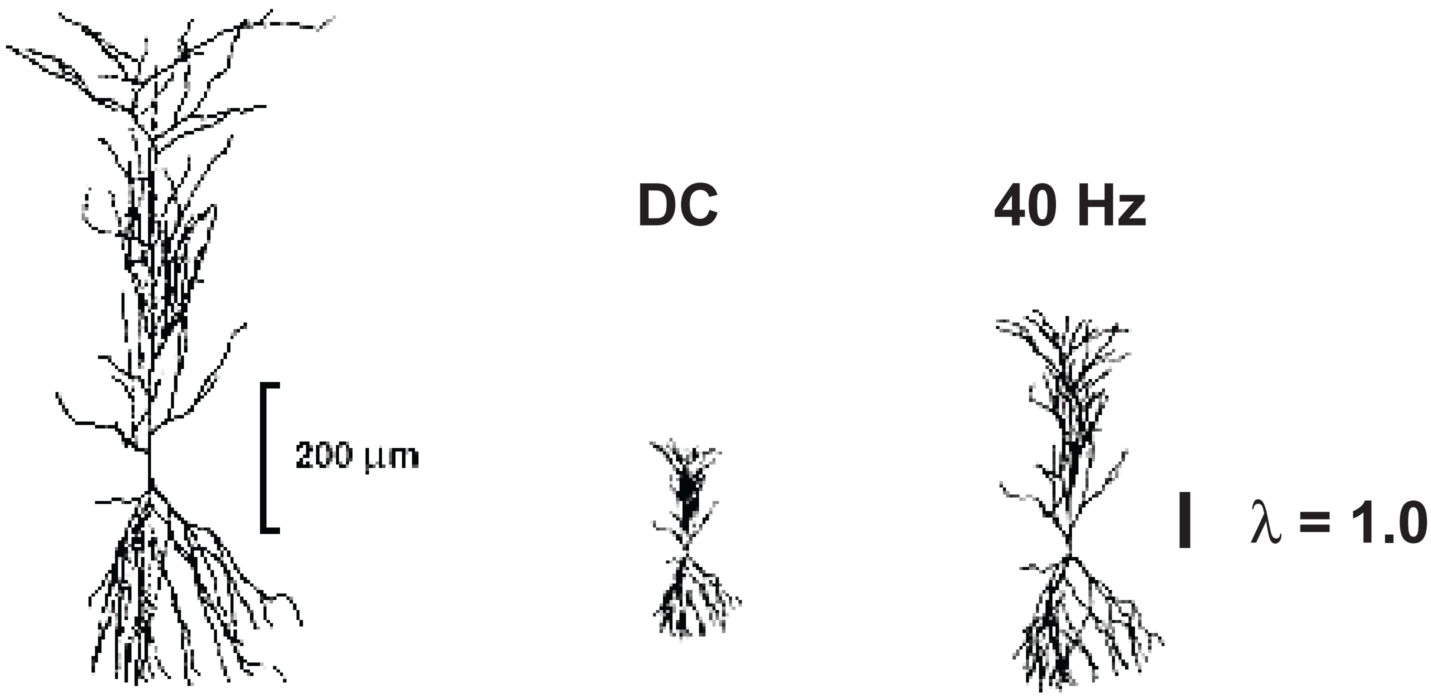


Koch

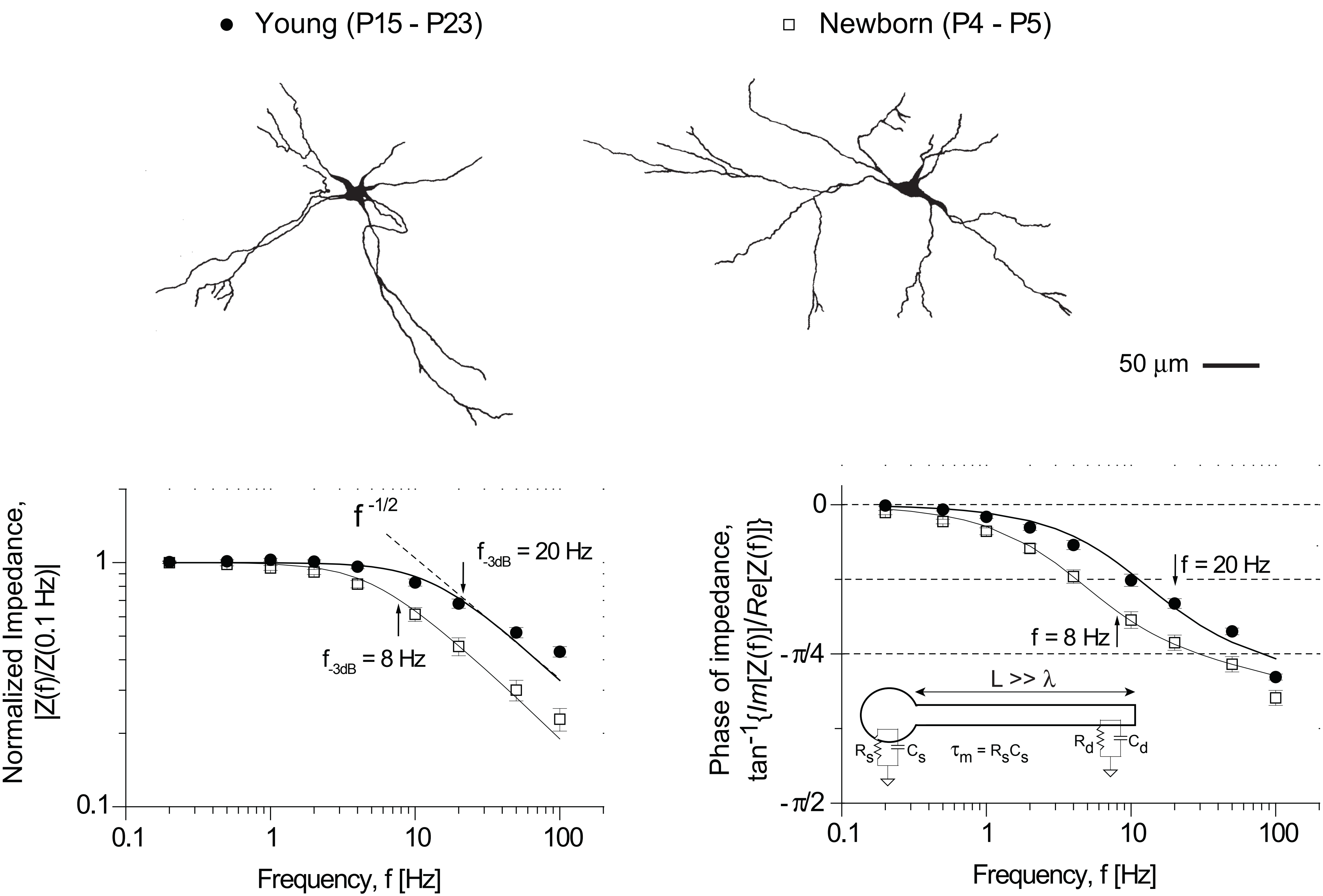


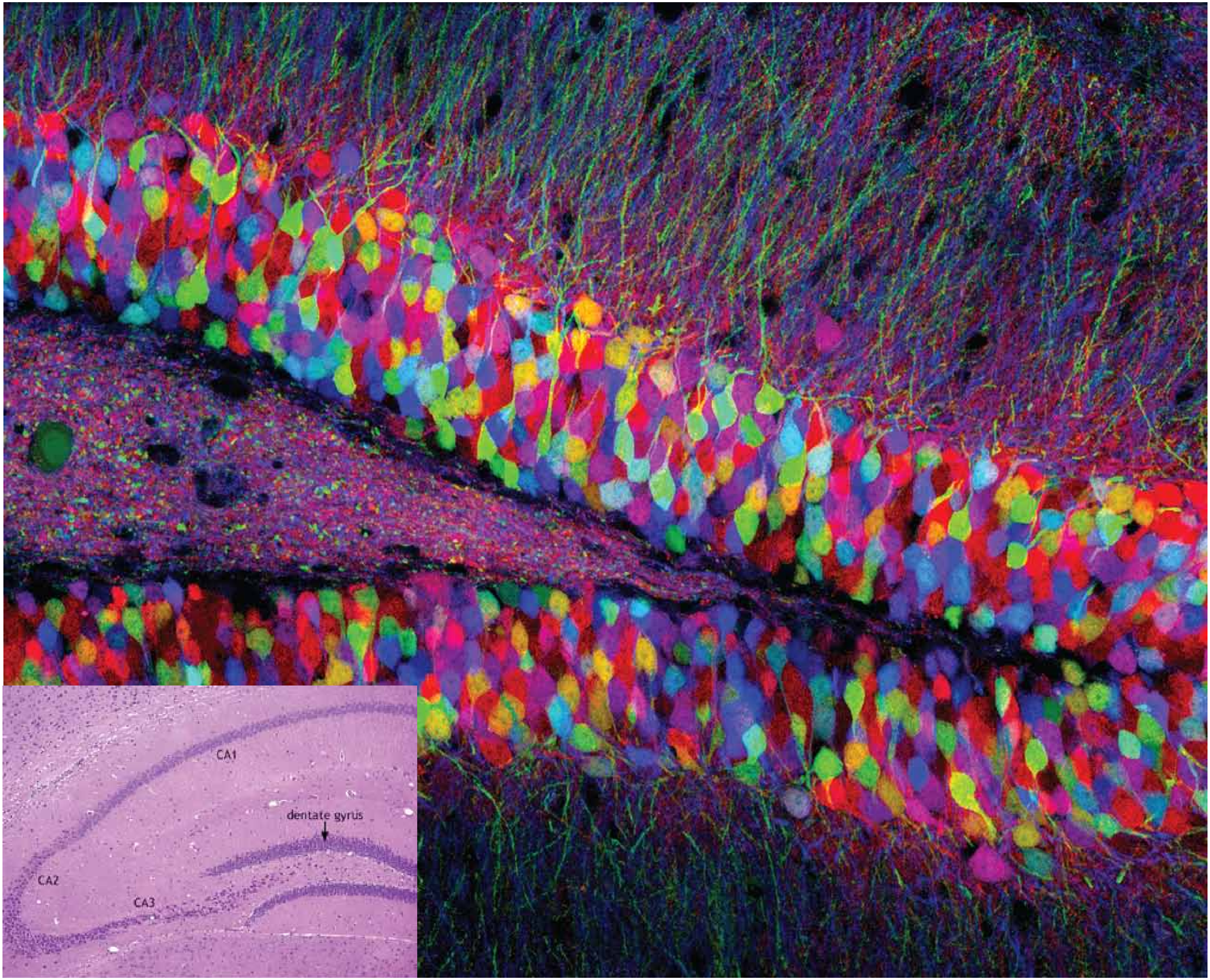
$$\theta = \frac{2\lambda}{\tau_m} = \sqrt{\frac{2a}{R_m R_i C_m^2}}$$

The electronic length is smaller (and the cell electronicially longer) at high frequencies than at DC



Rat Motoneurons in the Facial Nucleus




CA1
dentate gyrus
CA2
CA3

Filtering and distant-dependant gain in hippocampal CA1 dendrites (Jeff Magee)