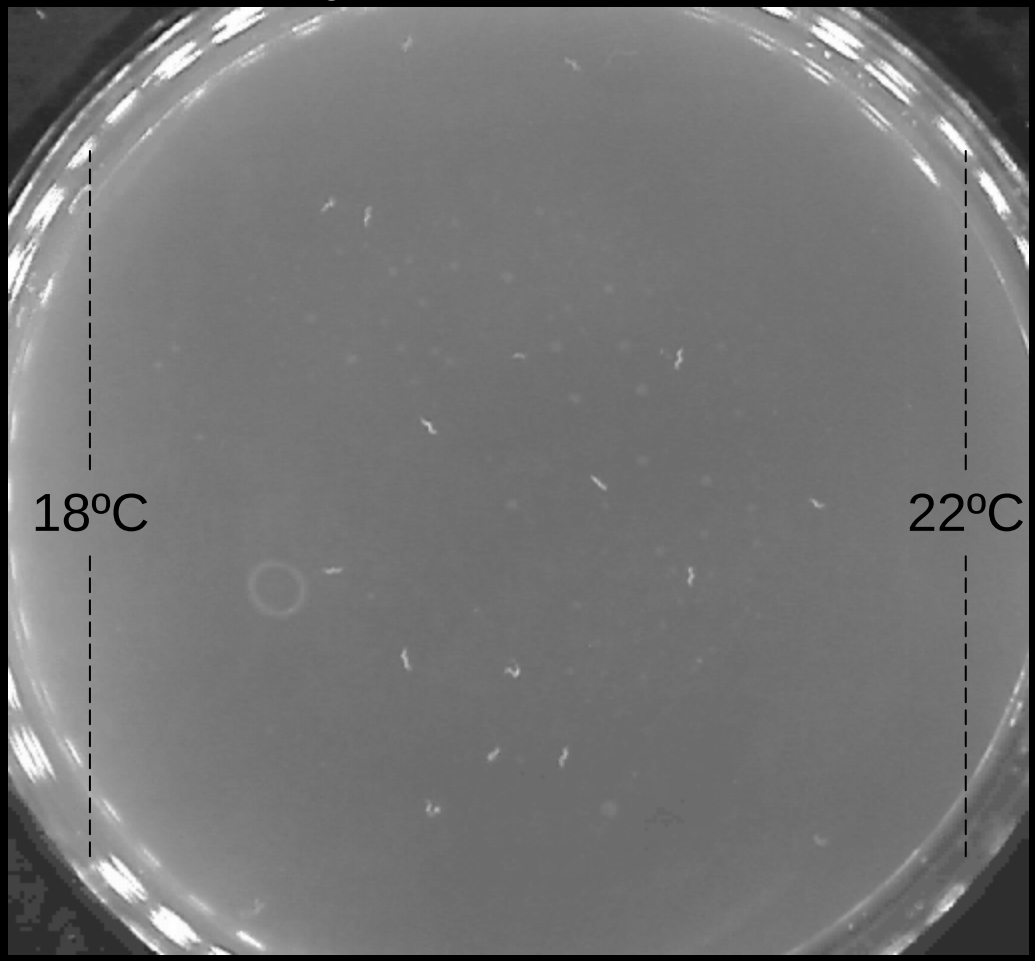
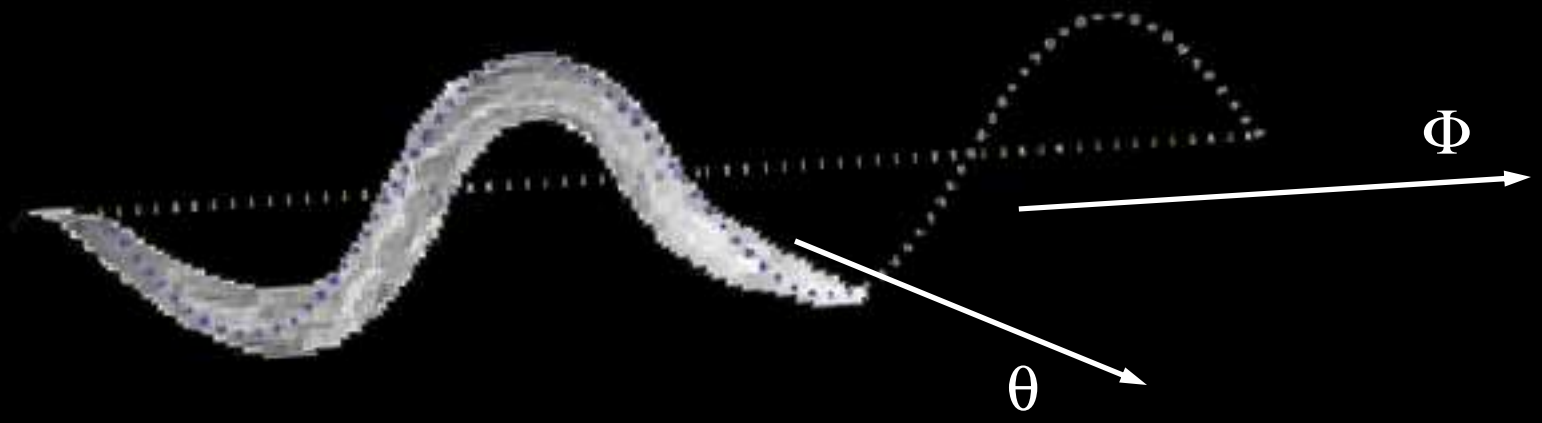
Thermotactic behavior depends on the previous cultivation temperature (T_s) and on the ambient temperature (T)

(Hedgecock and Russell, 1975)
(Mori and Ohshima, 1995)

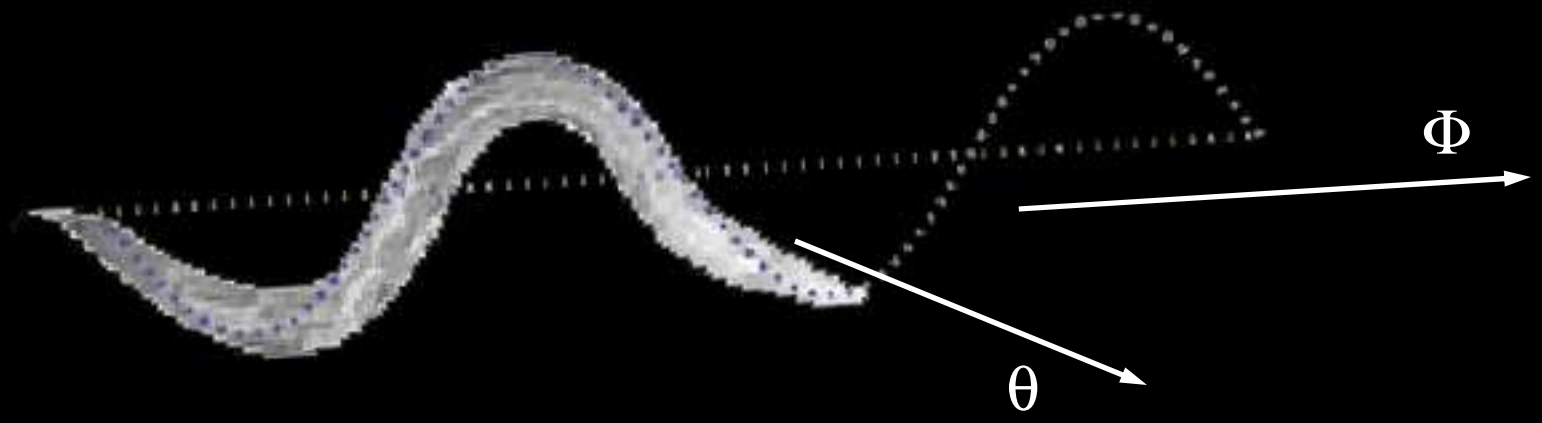
• $T = T_s$: Isothermal Tracking



The worm’s motion while tracking (between turns)



The worm's motion while tracking (between turns)



$$\theta(t) = \Phi + \theta_o sin(\omega t) \qquad (1)$$

$$\Phi = \langle\theta\rangle = \frac{1}{2\pi/\omega}\int_{t}^{t+2\pi/\omega}\theta(\tau)d\tau \qquad (2)$$

The equation of motion of the worm's head while tracking isotherms on a temperature gradient

$$\ddot{\theta} = \theta_o \omega^2 sin(\omega t) \qquad (3)$$

The equation of motion of the worm's head while tracking isotherms on a temperature gradient

$$\ddot{\theta} = \theta_o \omega^2 sin(\omega t) \tag{3}$$

$$\ddot{\theta} = \theta_o \omega^2 sin(\omega t) \left[1 + g\dot{T}^2\right] \tag{4}$$

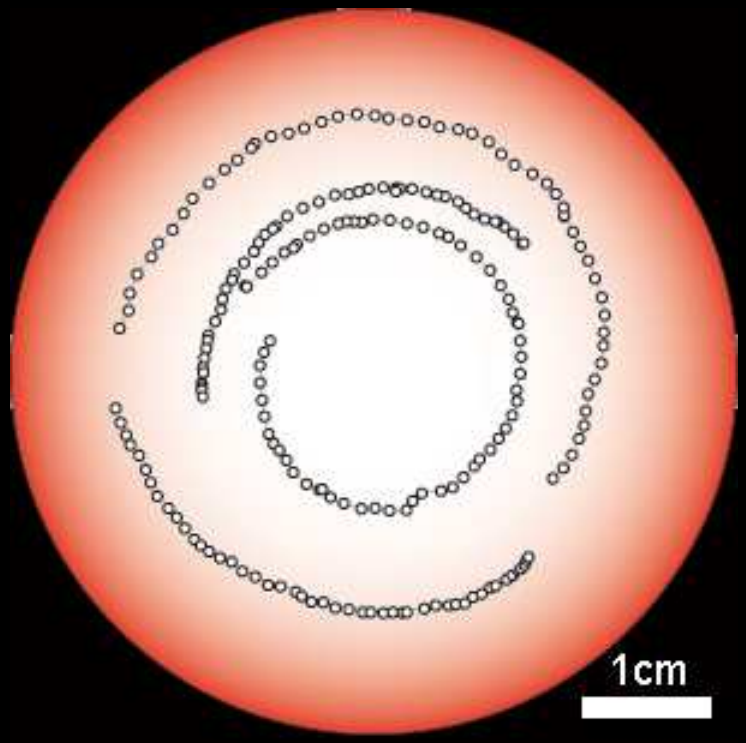
The equation of motion of the worm's head while tracking isotherms on a temperature gradient

$$\ddot{\theta} = \theta_o \omega^2 sin(\omega t) \tag{3}$$

$$\ddot{\theta} = \theta_o \omega^2 sin(\omega t) \left[1 + g\dot{T}^2\right] \tag{4}$$

$$\dot{T} = v sin(\theta) \left|\nabla T\right| \tag{5}$$

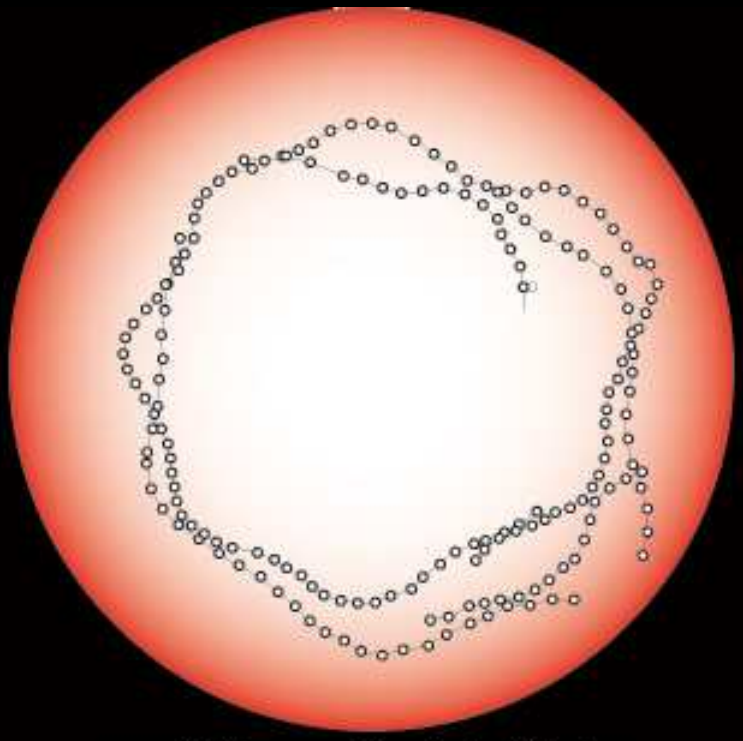
Isothermal tracking on a radial spatial temperature gradient



spatial T gradient: 0.7 °C/cm

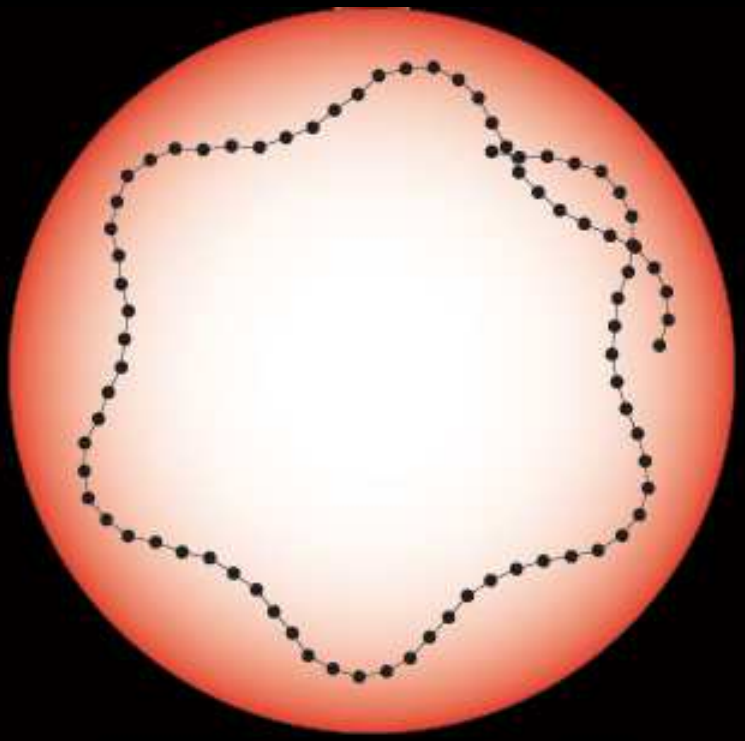
Isothermal tracking on a radial spatial temperature gradient with superposed temporal temperature oscillations

(Experiment)



spatial T gradient: 0.4°C/cm
temporal T oscillations: 0.1°C , 120 sec

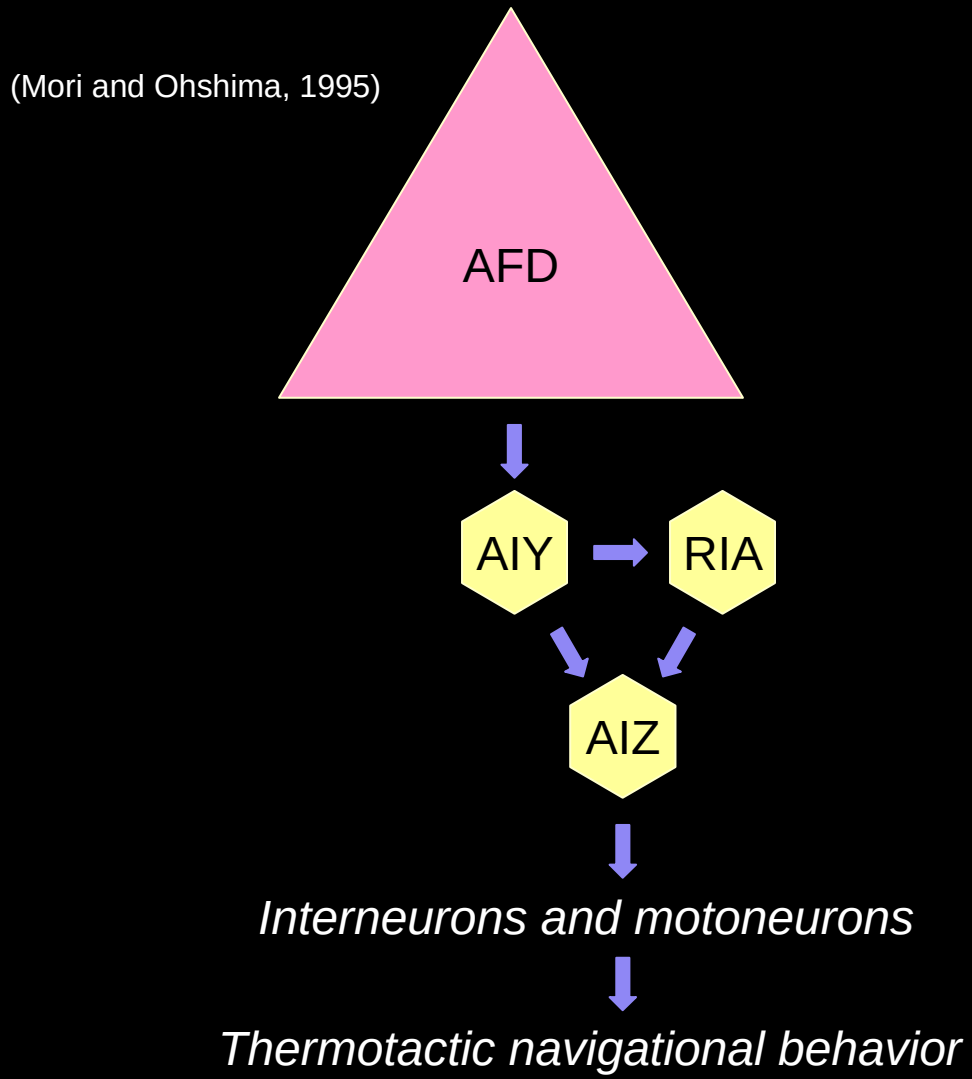
(Simulation)



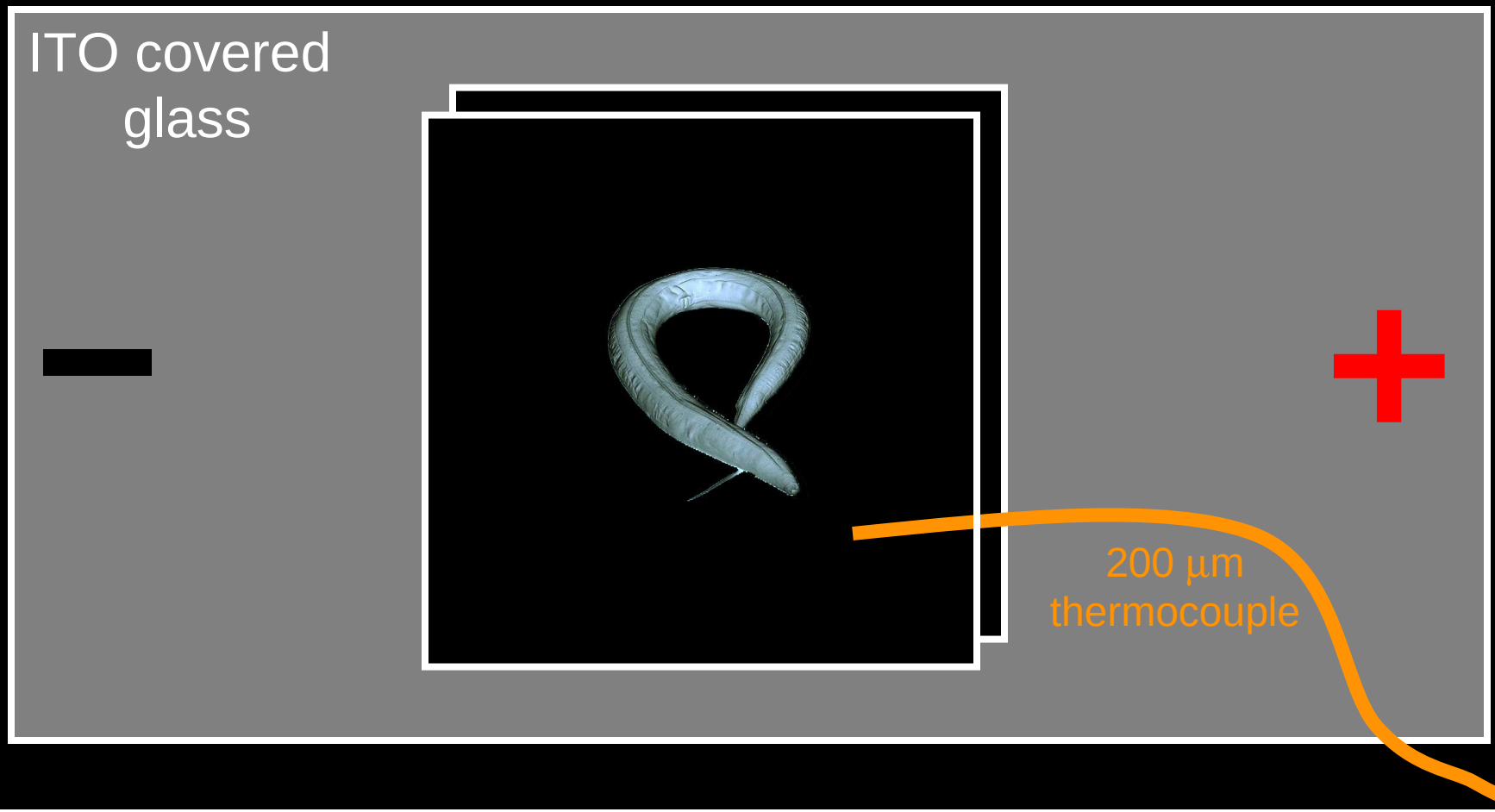
spatial T gradient: 0.4°C/cm
temporal T oscillations: 0.1°C , 120 sec

Single neuron level: the AFD neurons

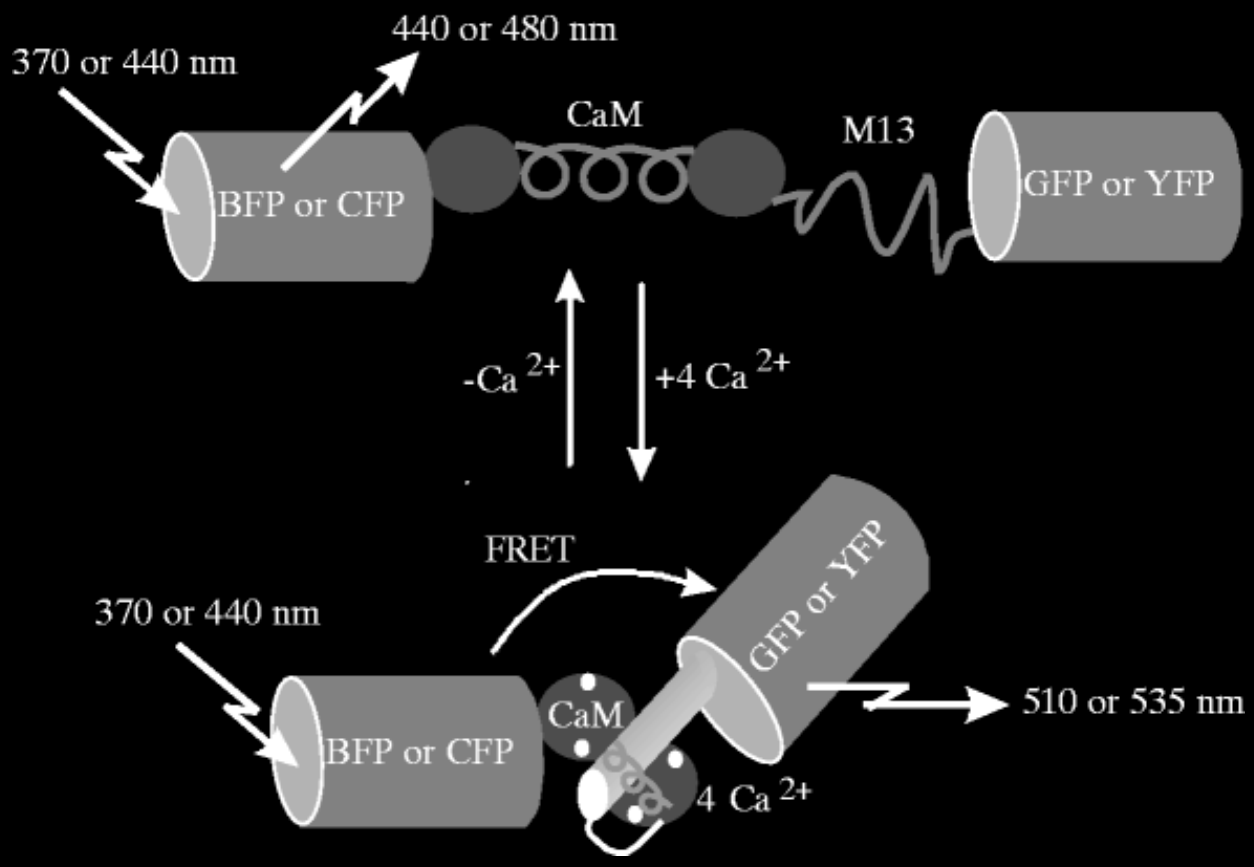
(Mori and Ohshima, 1995)

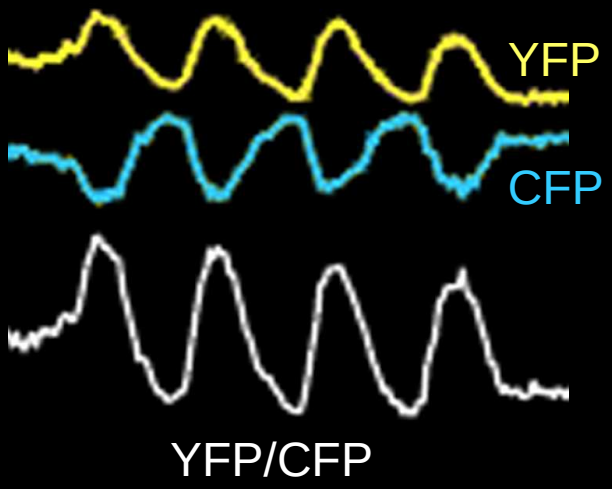


Single neuron level:
Recording neural responses to temperature stimuli



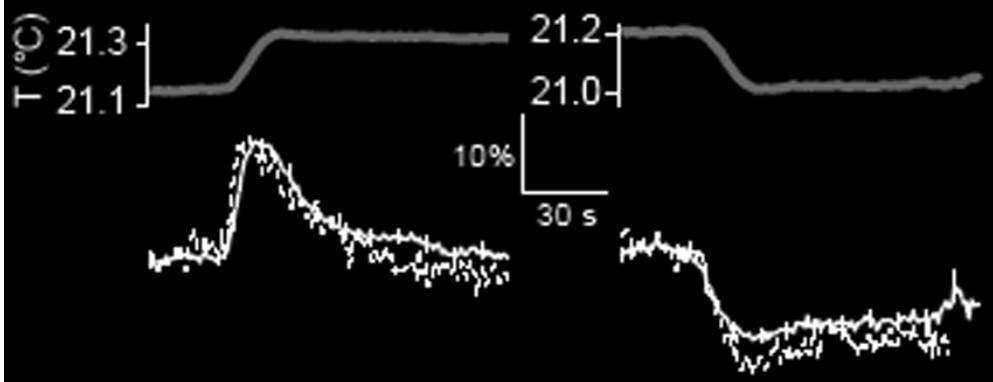
Cameleon is a FRET indicator for Ca^{2+}





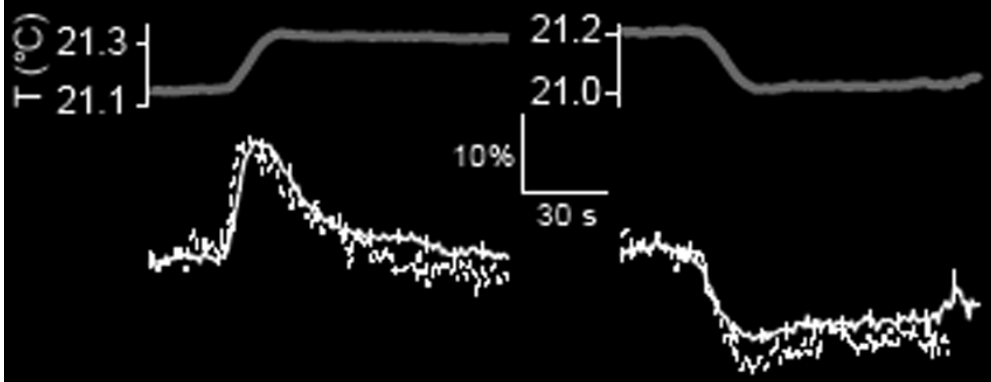
(Adapted from Miyawaki et al., 1997)

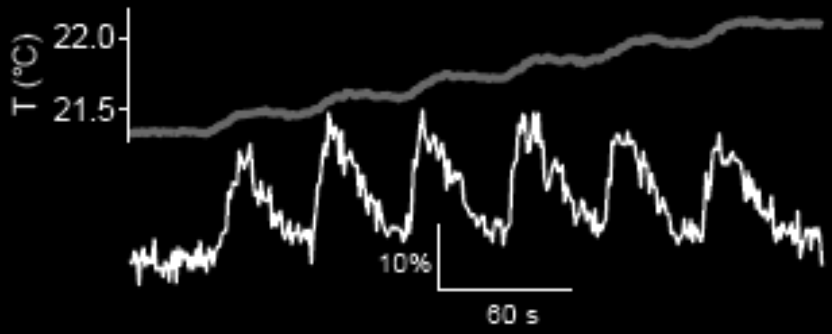
Above a threshold temperature Ca^{2+} dynamics in AFD respond to temperature stimuli

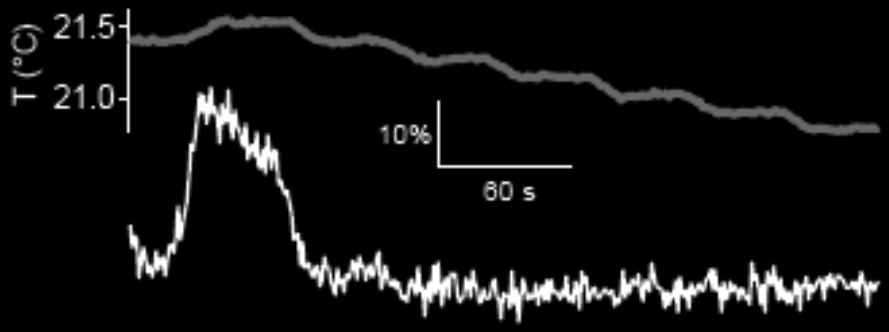


(see also Kimura et al.)

Above a threshold temperature Ca^{2+} dynamics in AFD respond to temperature stimuli

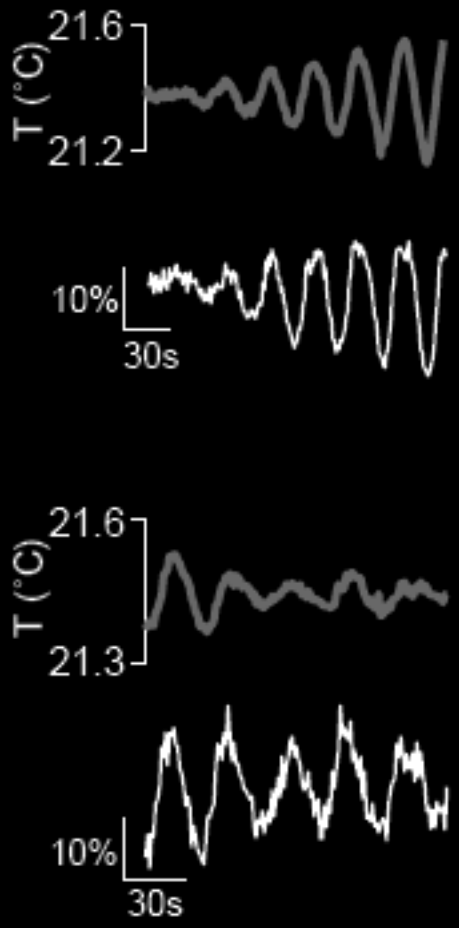




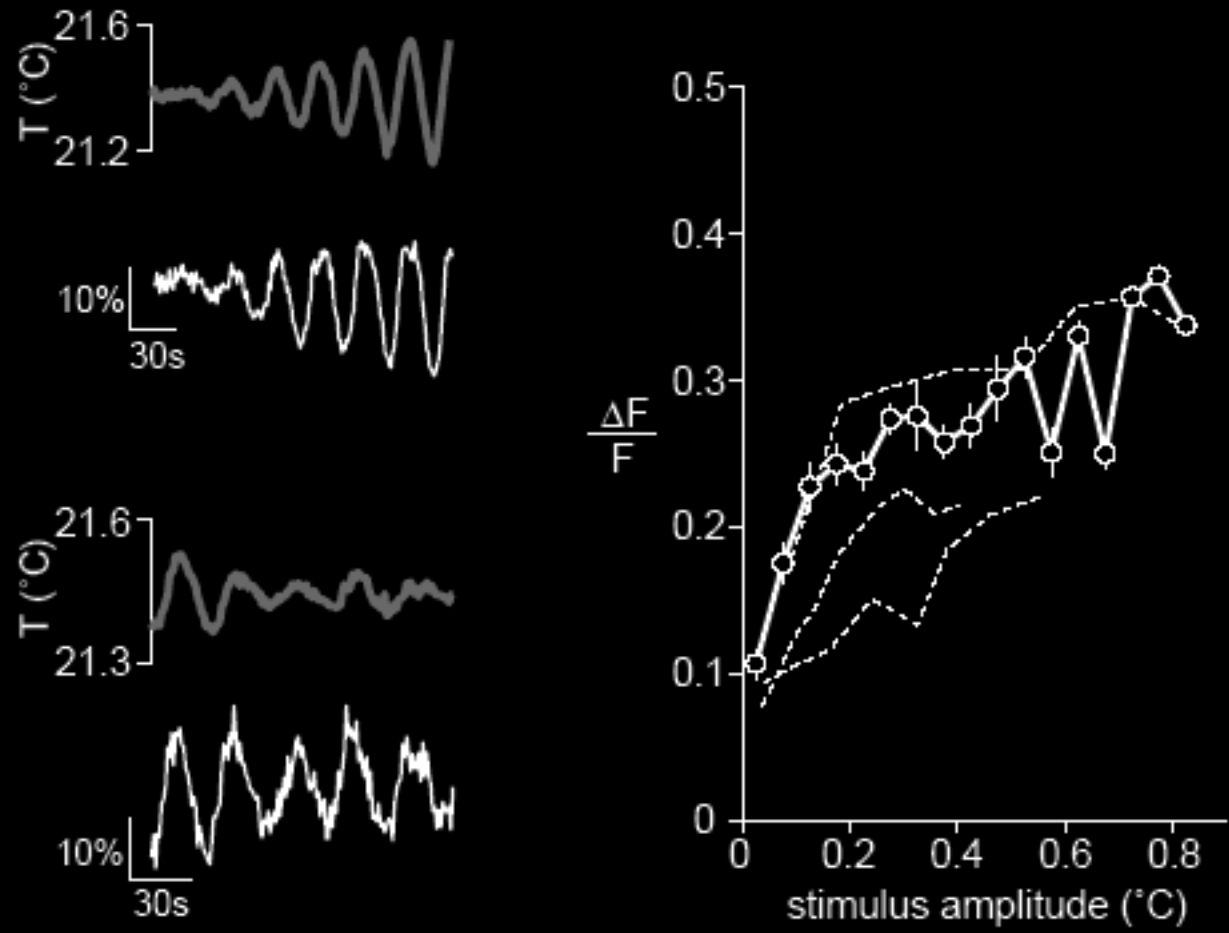


(see also Kimura et al.)

Ca^{2+} dynamics in AFD are sensitive to temperature oscillations between 0.05-0.5°C



Ca^{2+} dynamics in AFD are sensitive to temperature oscillations between 0.05-0.5°C



End (part 1)