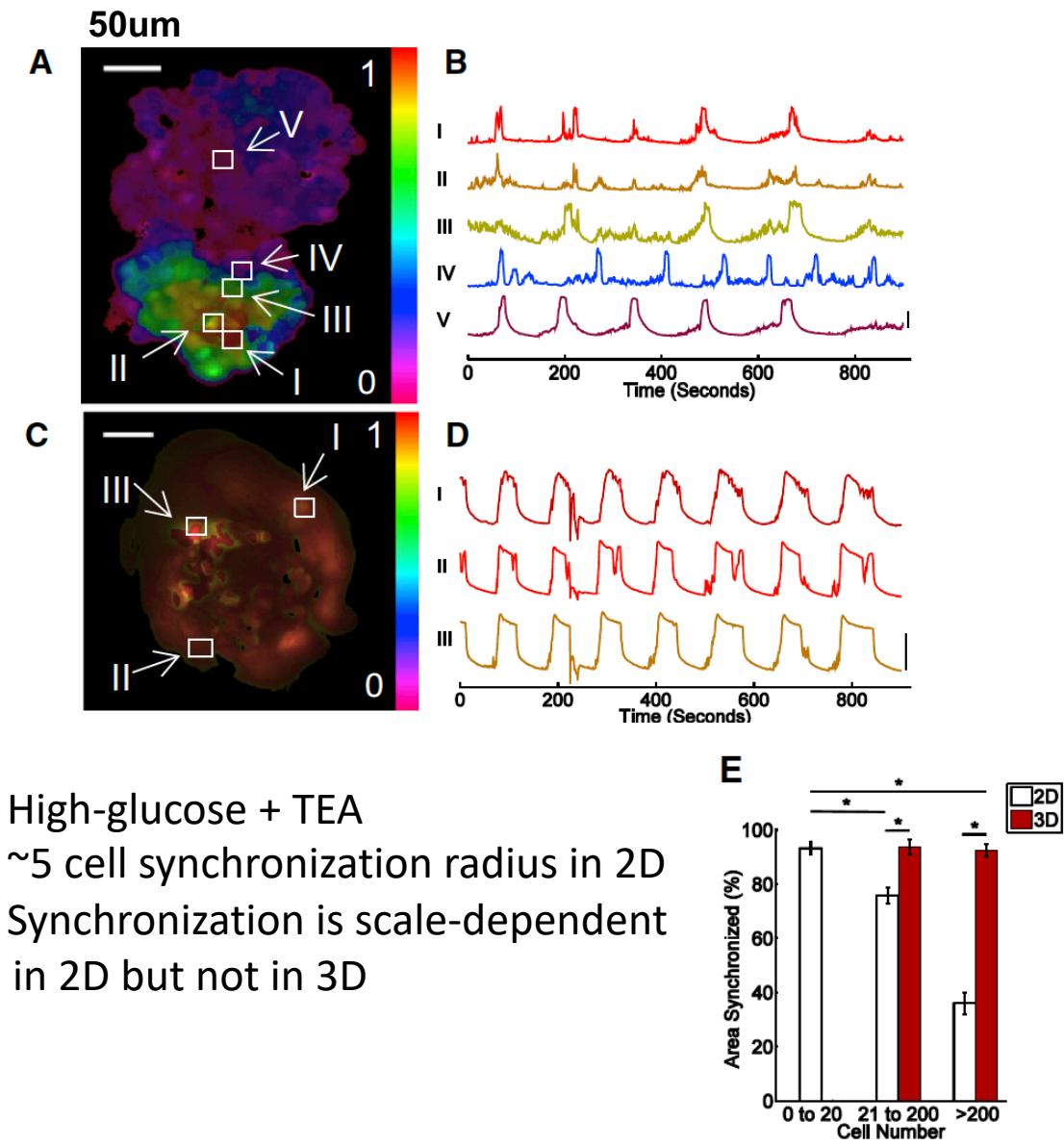
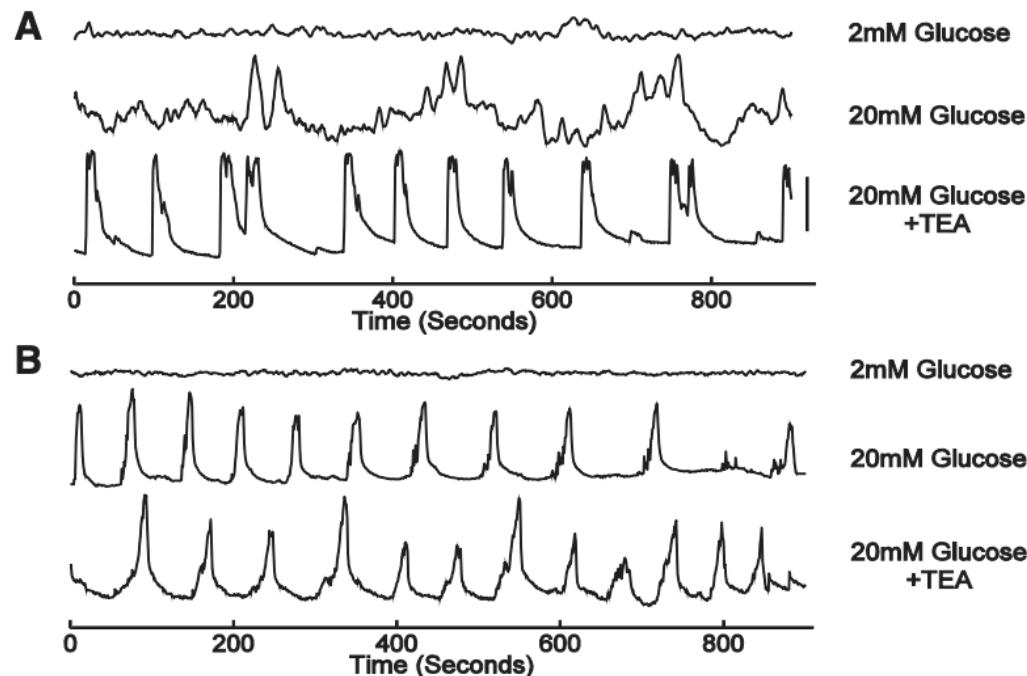


Dimension and size dependence of [Ca²⁺] synchronization

2D: ~4000 cells/mm² (MIN6)

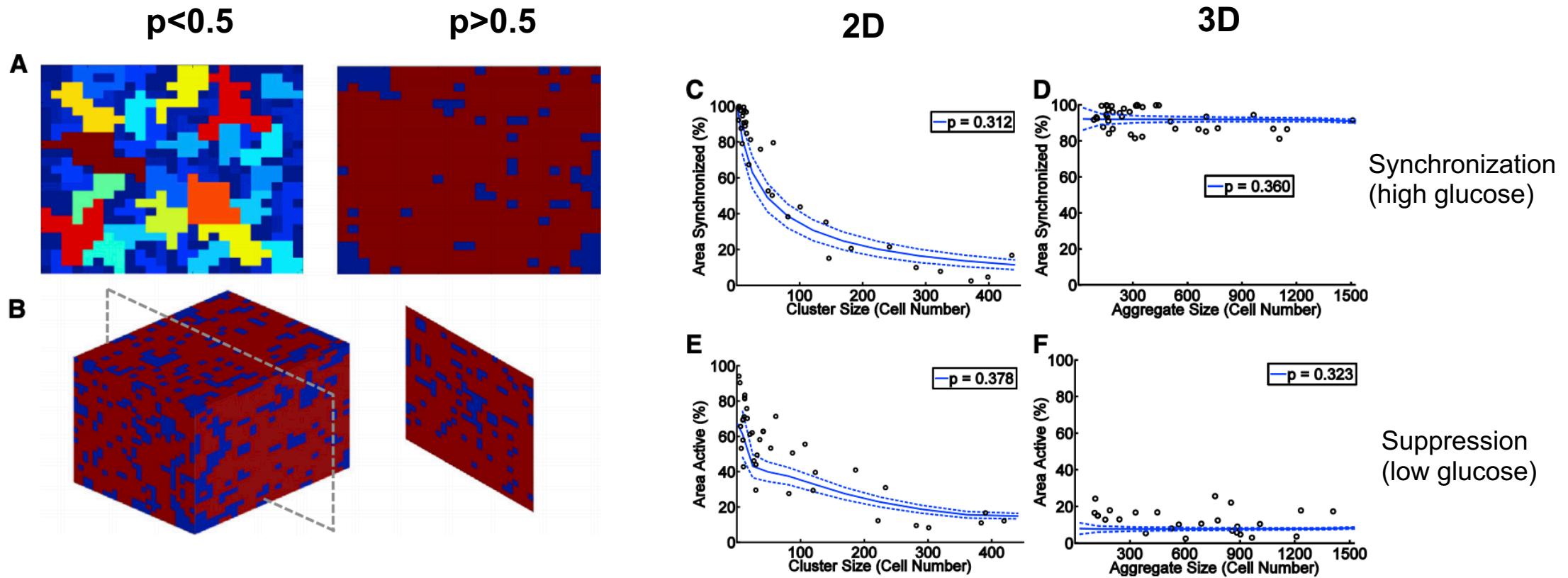
3D: ~520,000 cells/cm² in hydrogel microwell arrays

[Ca²⁺] readout using Fluor4

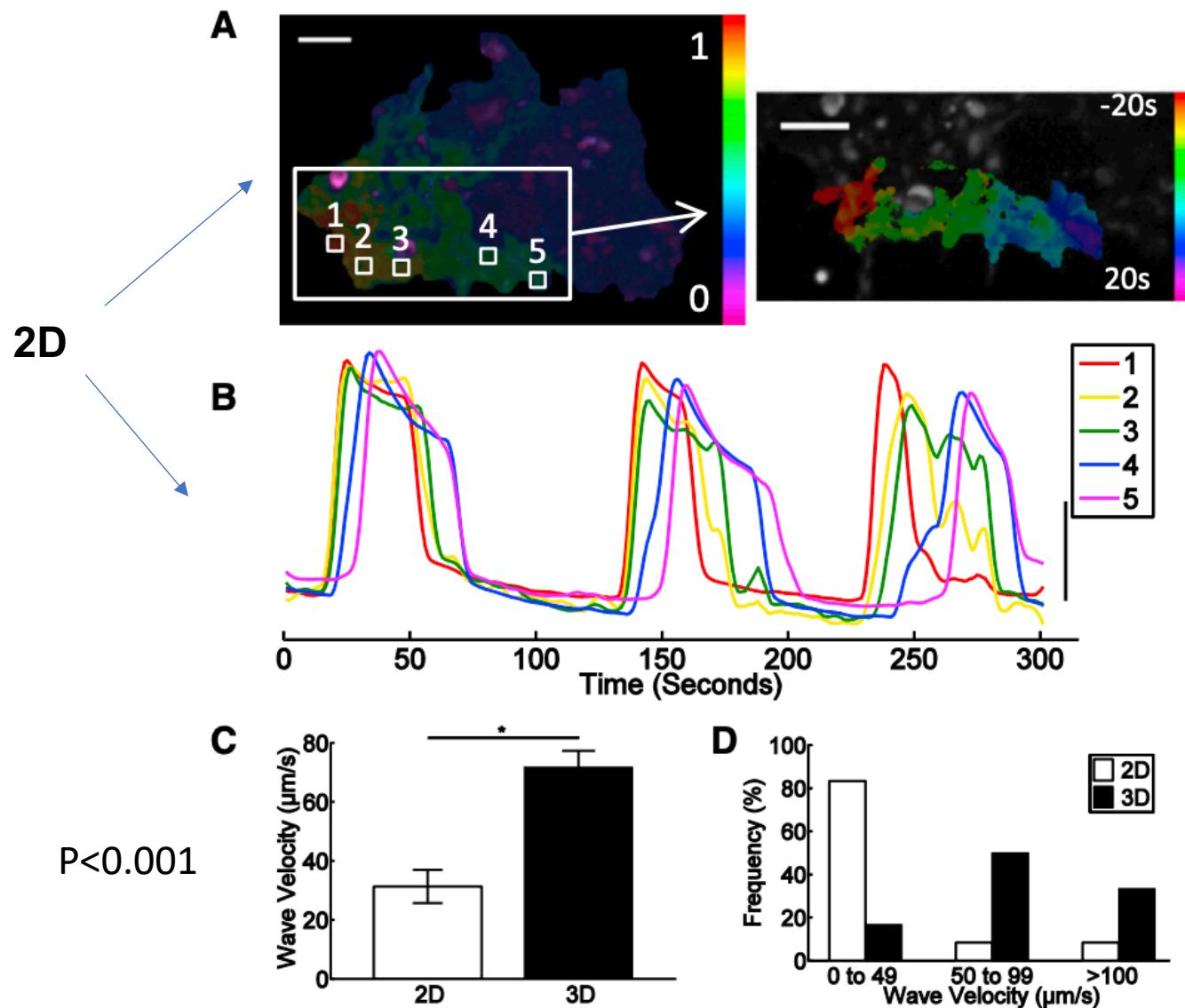


- High-glucose + TEA
- ~5 cell synchronization radius in 2D
- Synchronization is scale-dependent in 2D but not in 3D

Coupled-resistor network model

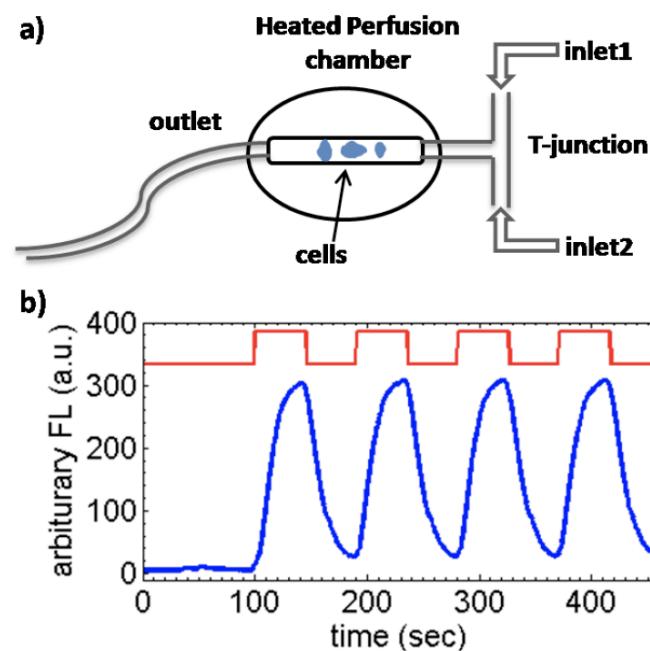
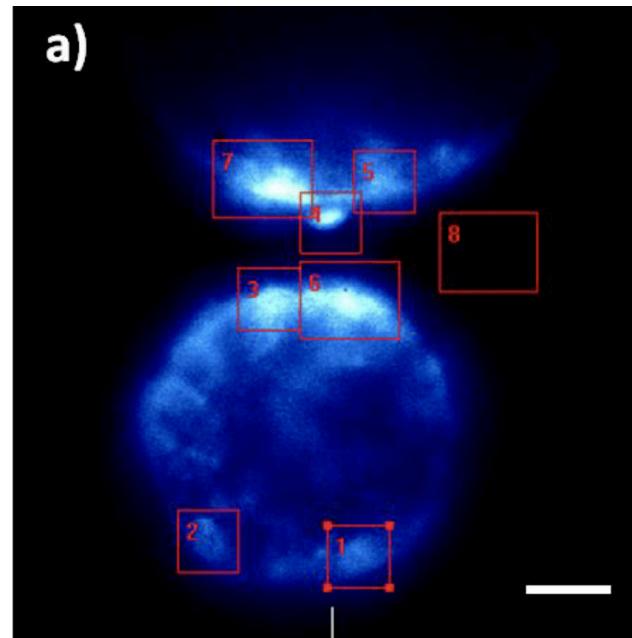


Wave velocity under 2D/3D coupling



Interesting points

1. Low-pass frequency response of beta cells
2. Only small populations of cells (pacemakers) sense glucose stimulus
3. Unknown degree of randomness and strength of coupling
4. Entrainment of cells to glucose stimulus



Coupled phantom burster model

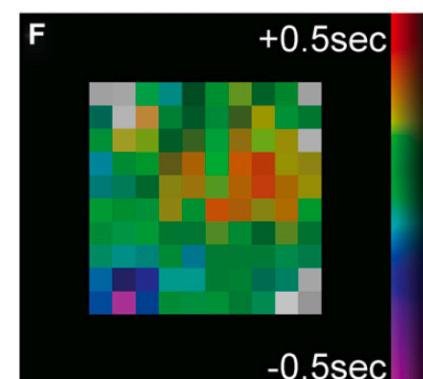
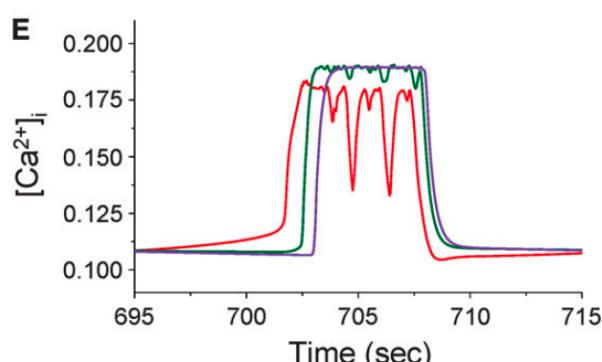
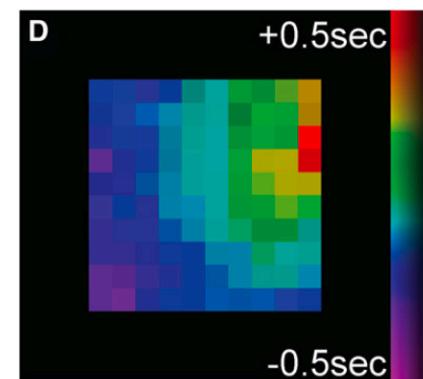
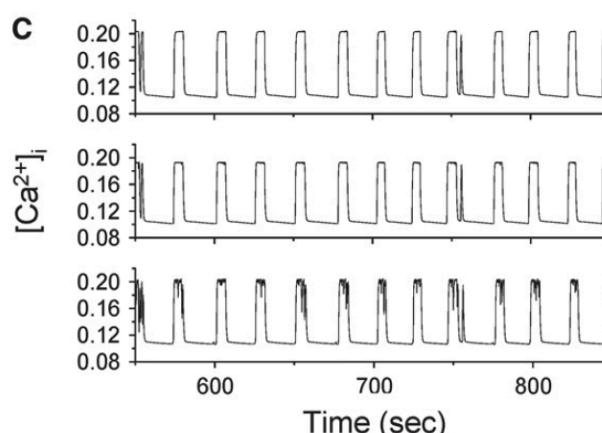
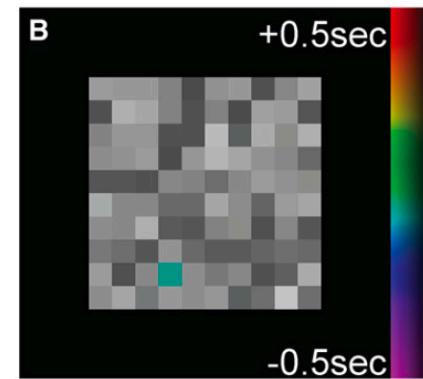
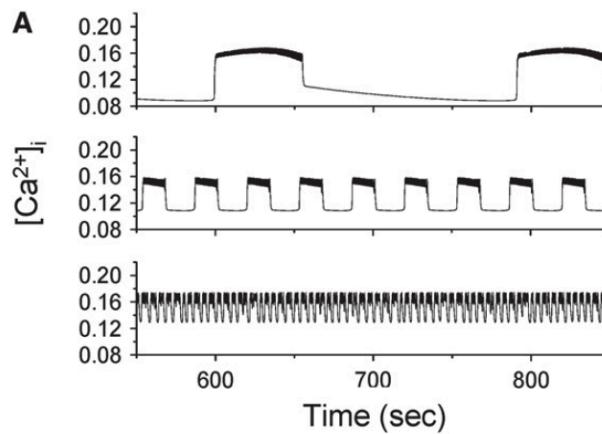
$$C_m \frac{dV_j}{dt} = -(I_{K(Ca)} + I_{K(ATP)} + I_{Ca} + I_K + I_{coupl,j})$$

$$I_{coupl,j} = g_c \sum_i^{\text{neighbor}_j} (V_j - V_i).$$

↑

How is this distributed?

5056



This week

1. Setup triggering between camera and light source, thaw cells
2. Develop image processing methods for readout

Widefield imaging setup

mCitrine(Ex. 516nm, Em. 529nm) or FuraRed (Ex. 435nm, Em. 639nm)

@XXX Hz, Exposure Time: YYY ms

Coming weeks

Experiment 1: Steady state [Ca²⁺]/GEVI oscillations (like Theresa's experiments)

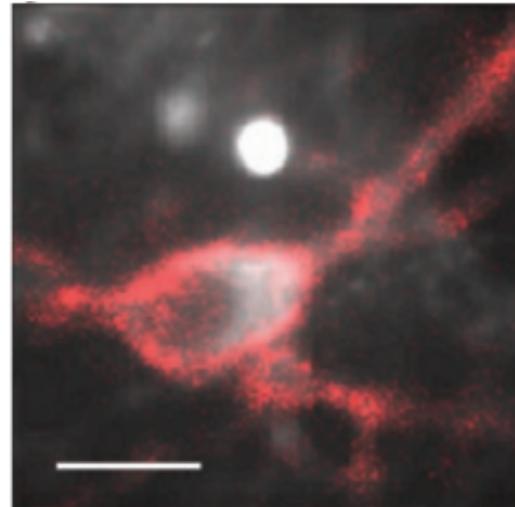
Experiment 2: (if time allows) [Ca²⁺]/GEVI response to transient glucose stimulation

Estimating membrane potentials

$$S_i(t) = a_i + b_i V(t) + \varepsilon_i(t)$$

$$\langle \varepsilon_i(t_1) \varepsilon_j(t_2) \rangle = \sigma_i^2 \delta_{i,j} \delta(t_1 - t_2)$$

$$\xi_i^2 = \left\langle (\hat{V}_i(t) - V(t))^2 \right\rangle \quad w_i \equiv \frac{1/\xi_i^2}{\sum_i 1/\xi_i^2}$$



Photobleaching Correction

