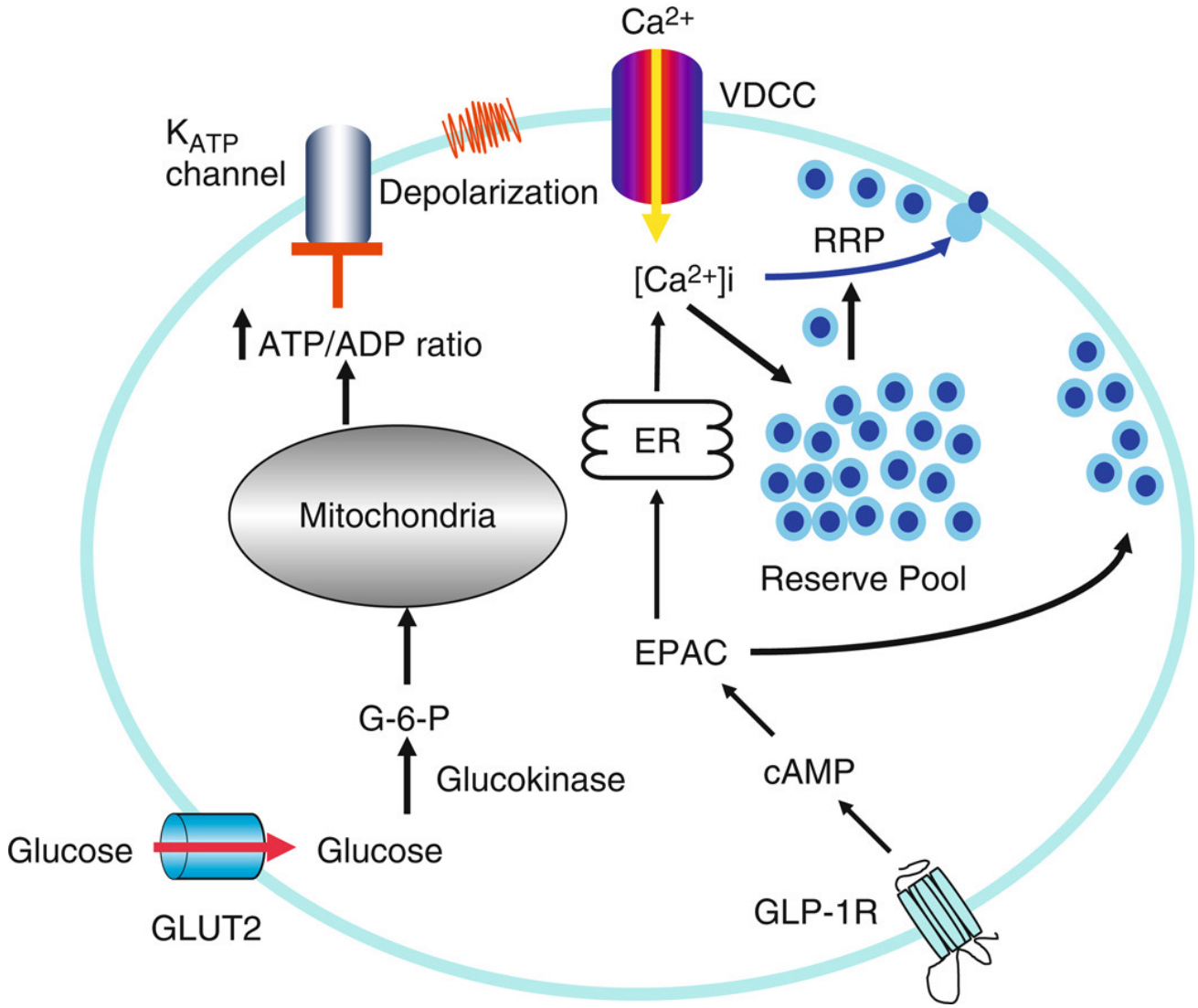
Intracellular Ca^{2+} is involved in Insulin Granule Exocytosis

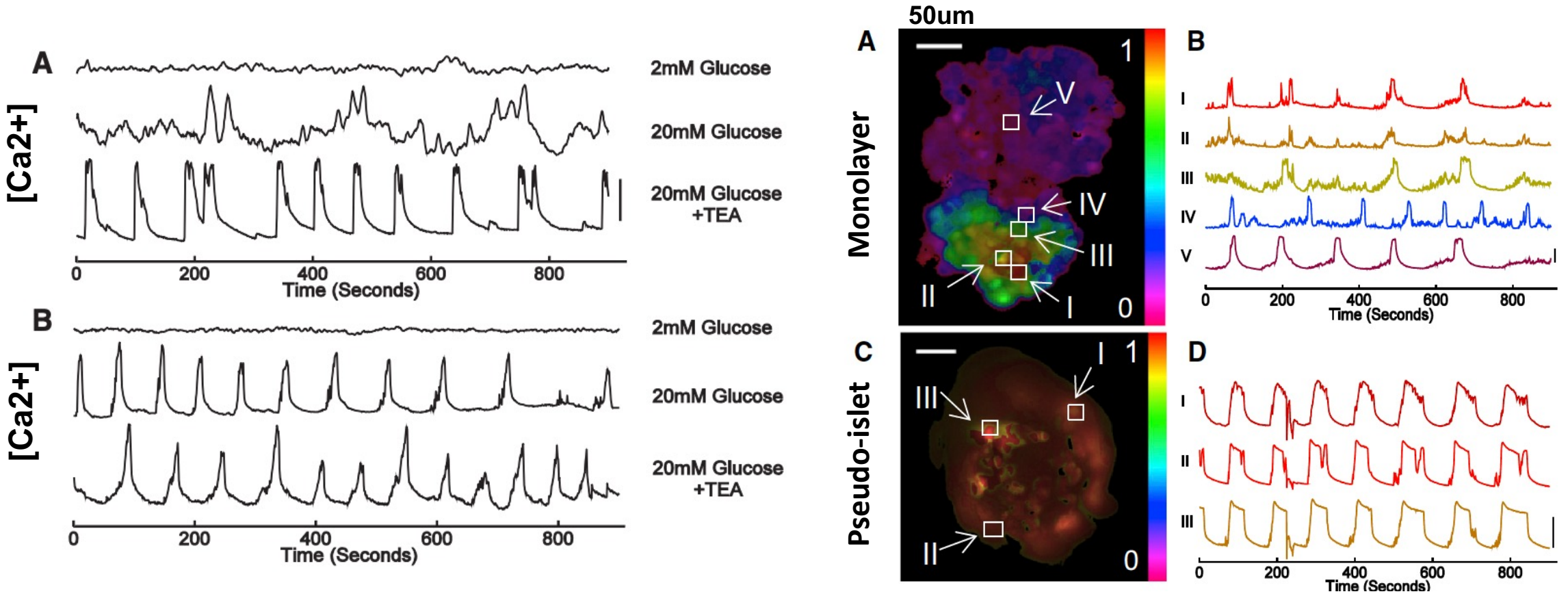
- ATP-sensitive K^+ channels open and depolarize the cell in response to glucose metabolism
- Voltage-gated Ca^{2+} open and increase in $[Ca^{2+}]$ triggers insulin granule exocytosis
- Gap junctions allow communication of glucose stimuli to neighboring beta cells



Insulin Granule Biogenesis, Trafficking, and Exocytosis. **Vitam Horm 2009**

Synchronization of [Ca2+] oscillations is dependent on growth geometry

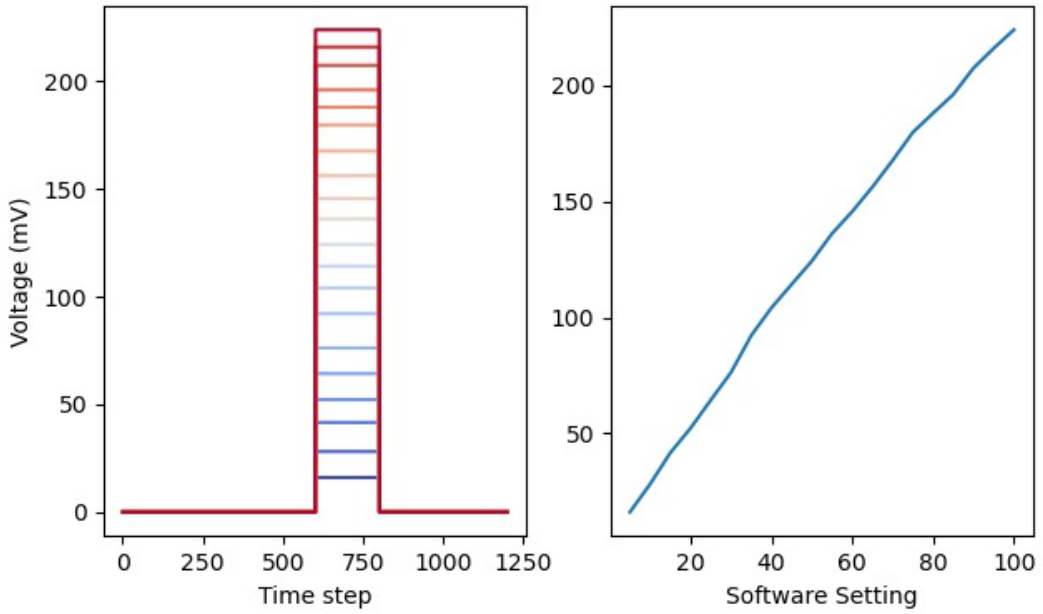
- Ca2+ oscillations appear to be more tightly controlled in pseudo-islets relative to monolayers
- MIN6 monolayers show reduced synchronization of [Ca2+] oscillations relative to pseudo-islets

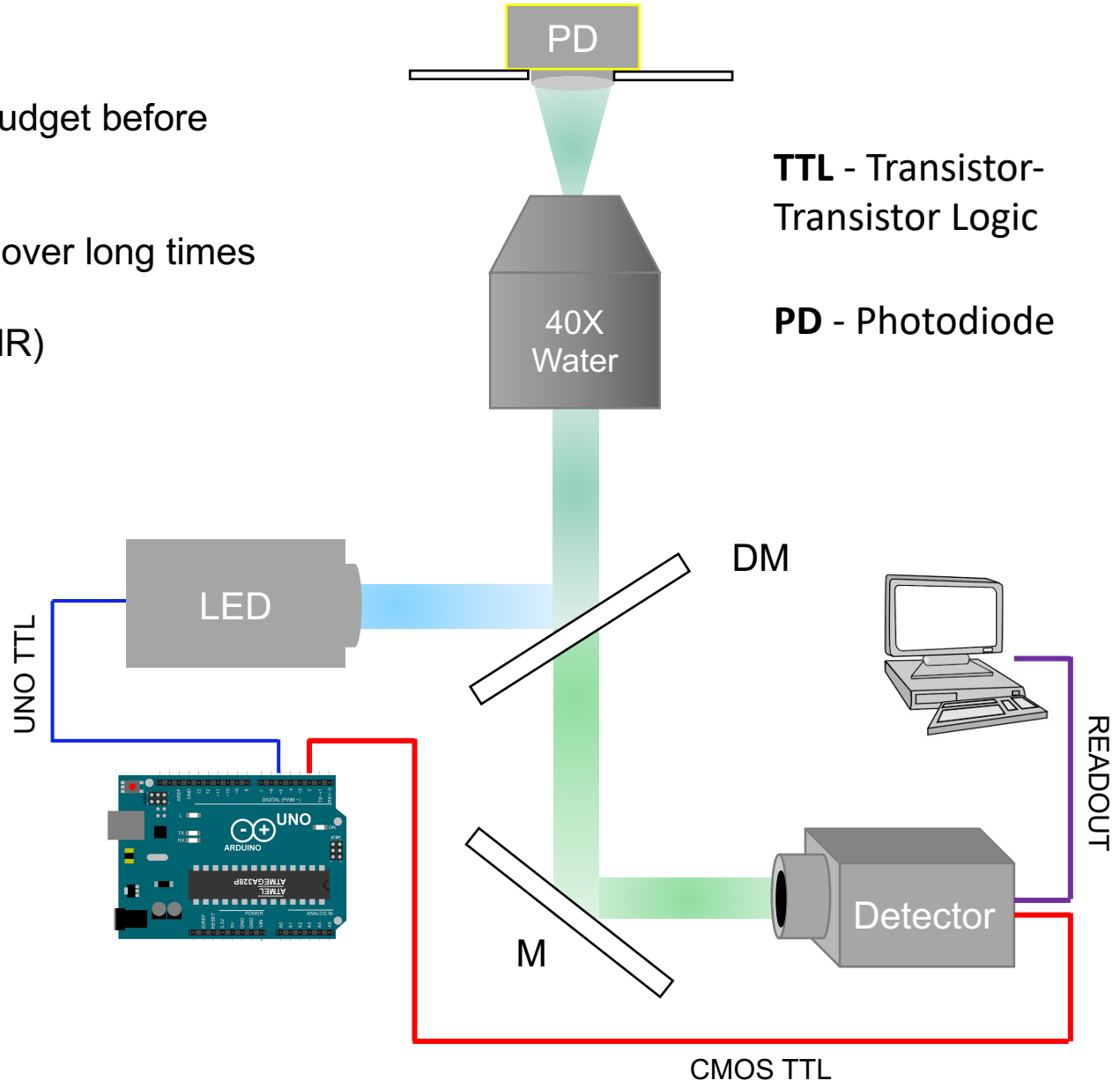


Dimensionality and size scaling of coordinated Ca2+ dynamics in MIN6 beta-cell clusters. **Biophysical Journal. 2014**

Photobleaching Imposes Constraints on Observable [Ca2+] Dynamics

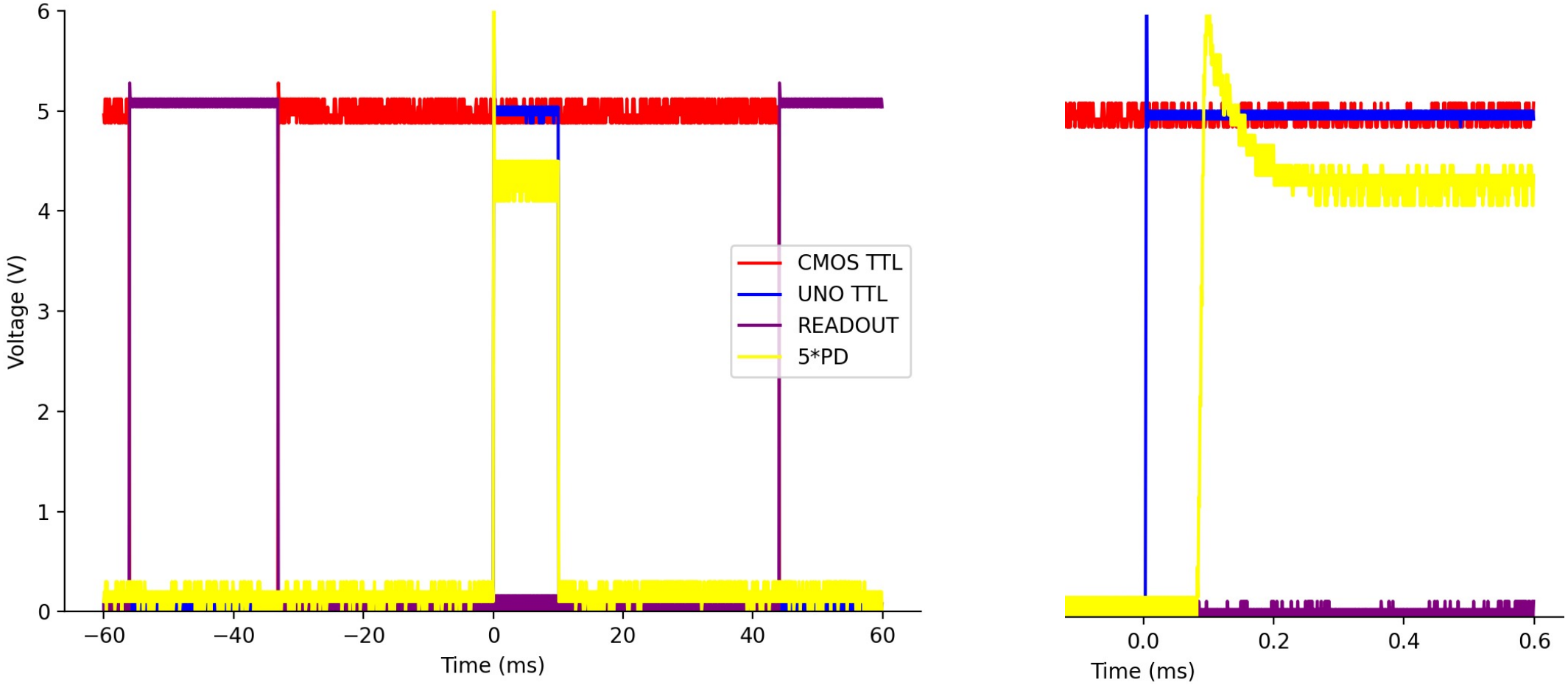
- Fluorescent calcium indicators have a finite photon budget before photobleaching
- High frame rates over short times or low frame rates over long times
- High quantum efficiency and signal to noise ratio (SNR)



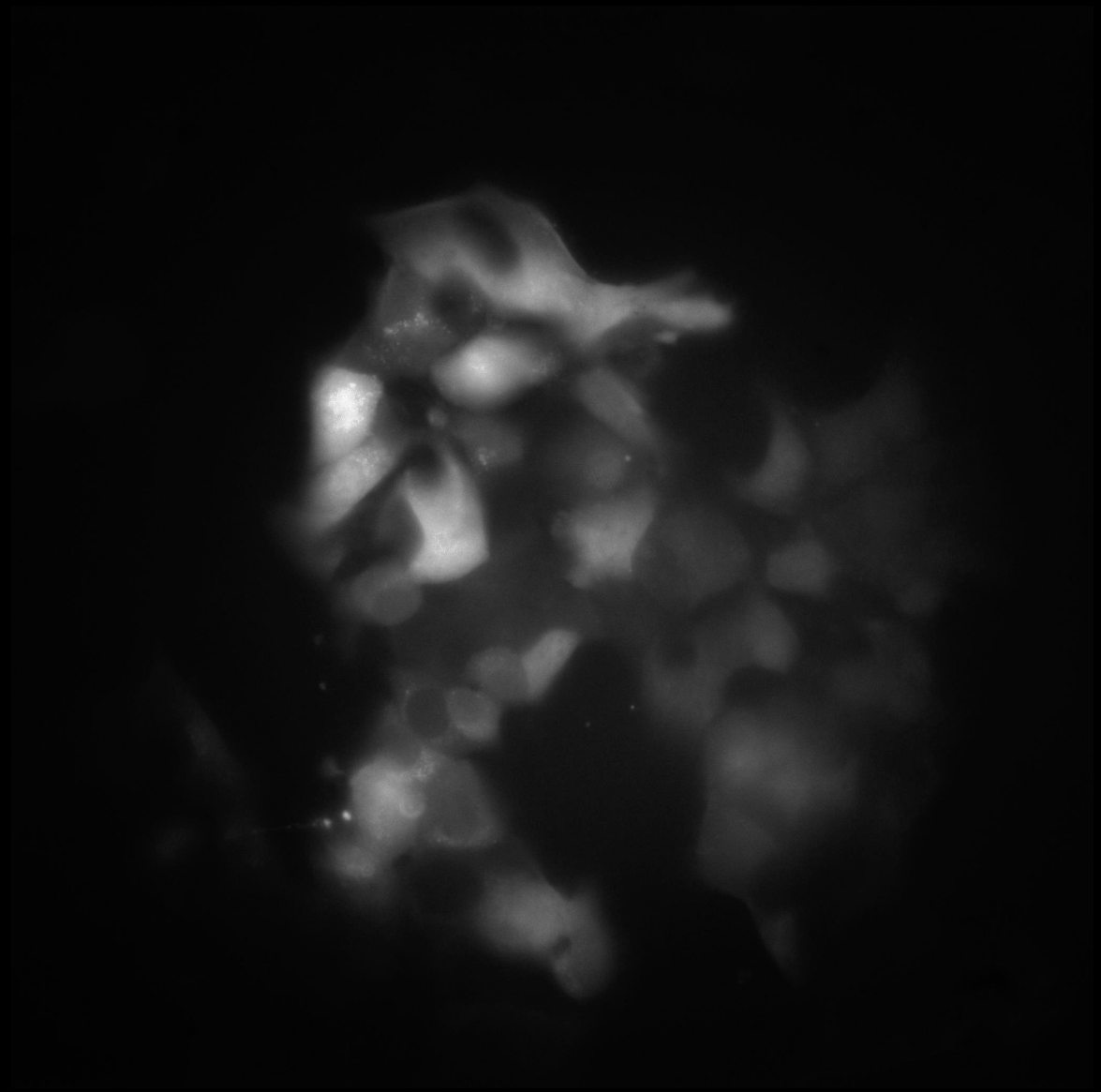


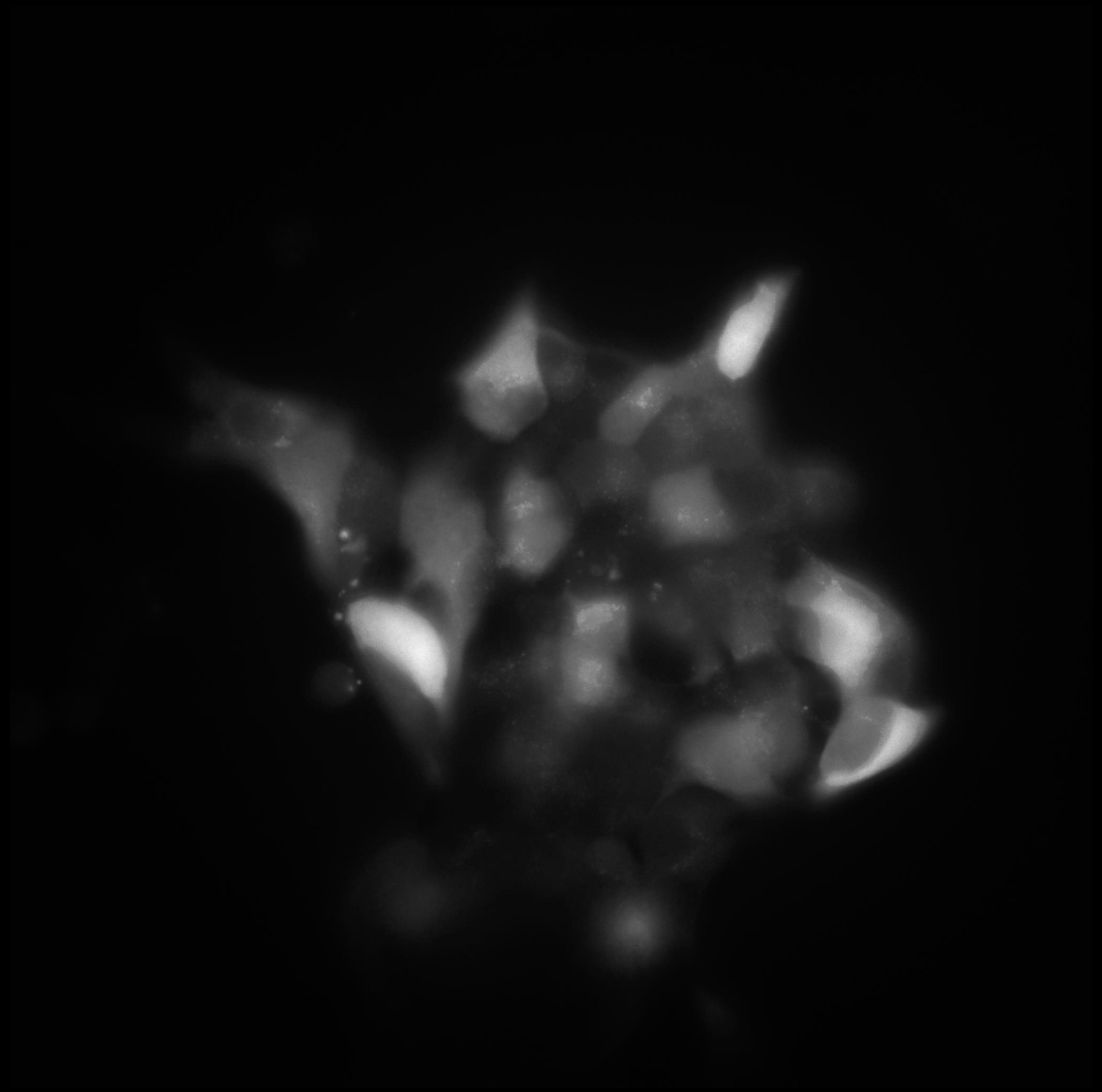
Transistor-Transistor Logic (TTL) Allows Precisely-Timed Pulsatile Excitation

- Brief excitatory pulses during sensor exposure limits photobleaching at low frame rates
- Global shuttering mechanism prevents collection bias over the CMOS sensor

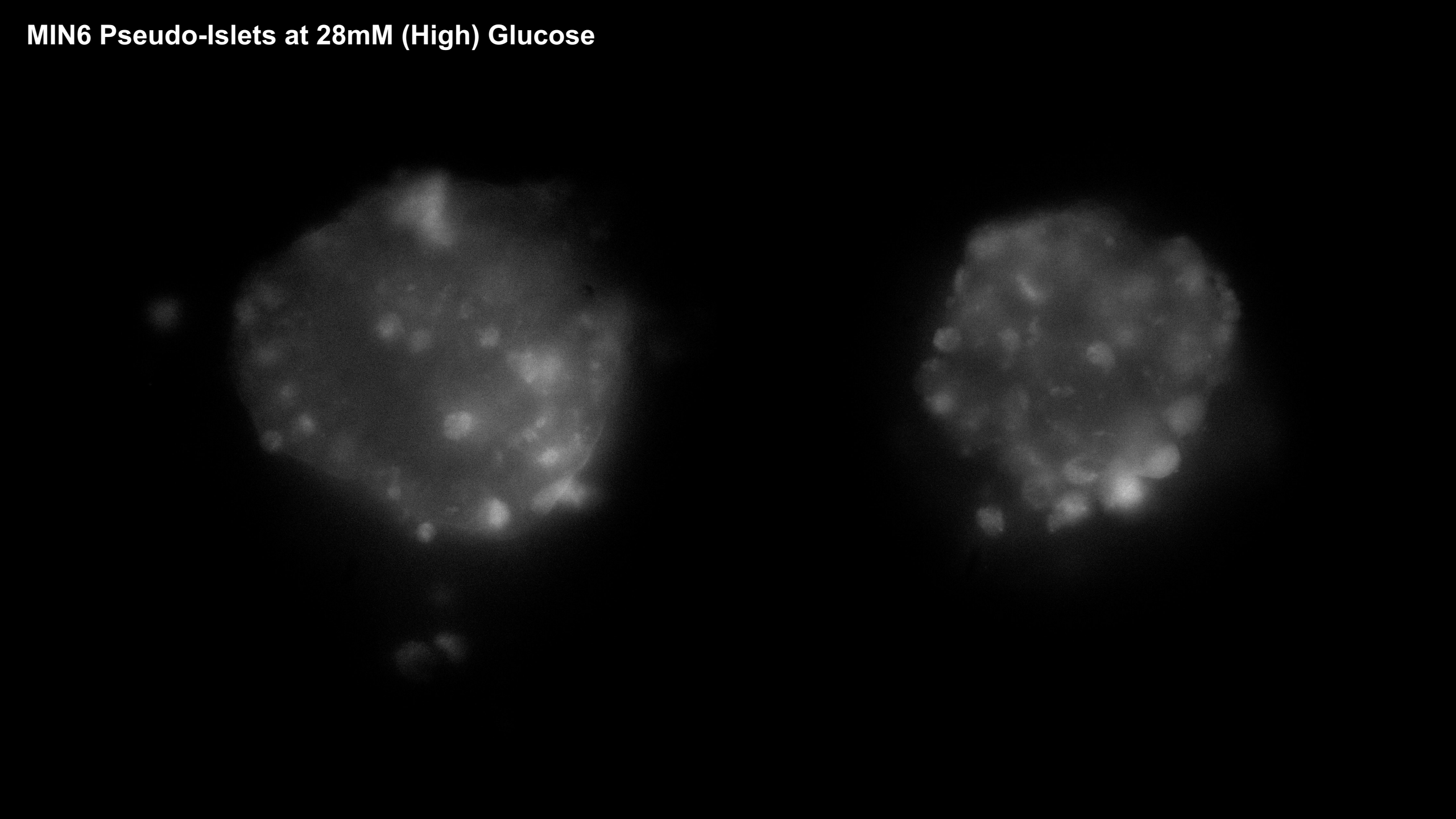


MIN6 Monolayers at 28mM (High) Glucose





MIN6 Pseudo-Islets at 28mM (High) Glucose



Cell-Cell [Ca2+] Synchronization at 28mM Glucose