Improved red fluorescent genetically-encoded calcium indicators for *in vivo* imaging

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Genetically-Encoded Neuronal Indicator and Effector Project

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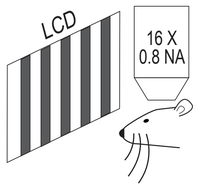
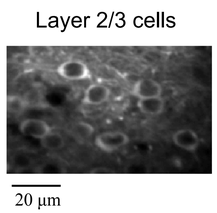
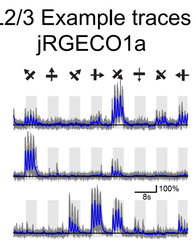
Motivation

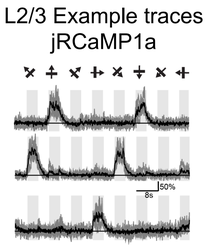
- Optical imaging of calcium dynamics using genetically-encoded calcium indicators (GECIs) is a powerful tool for systems neuroscience
- Current state-of-the-art GECIs emit green light (green GECIs)
- Red GECIs may be used for:
  - Deep tissue imaging
  - Dual-color imaging
  - Parallel use with light-sensitive ion channel (ChR2)
- Here we present high-sensitivity red GECIs, **jRGECO1a**, **jRCaMP1a**, and **jRCaMP1b** for *in vivo* imaging of neural activity.

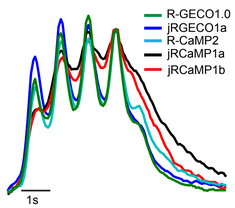
In vivo functional imaging in V1

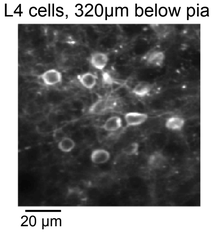


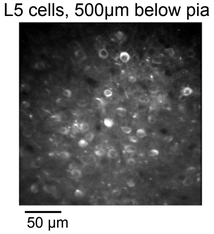


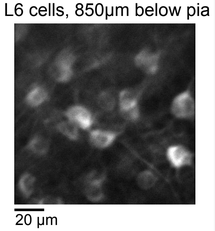


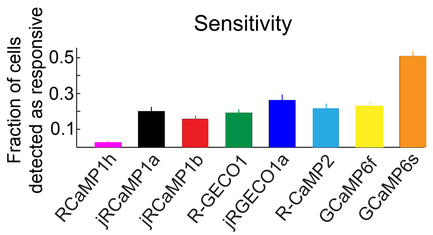


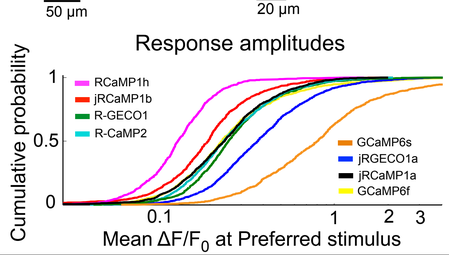






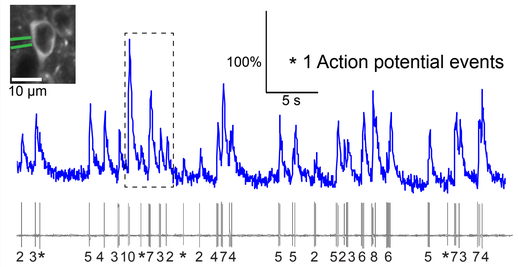


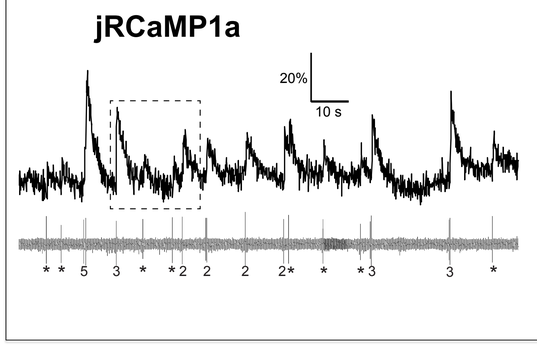


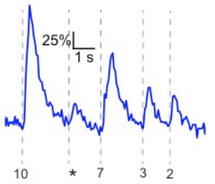


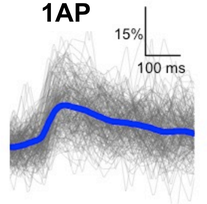
In vivo relationship between spikes and fluorescence dynamics

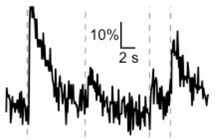
Loose-seal cell-attached recordings in L2/3 neurons

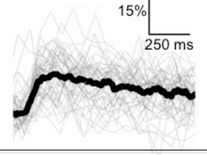


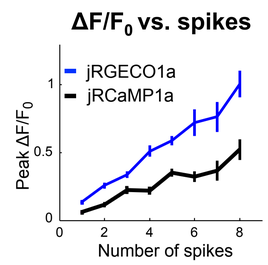


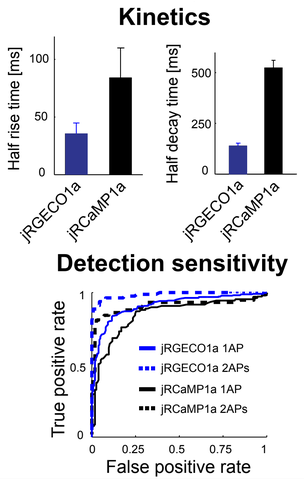




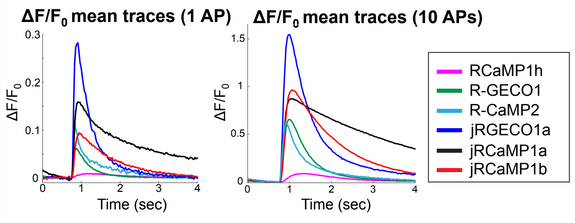


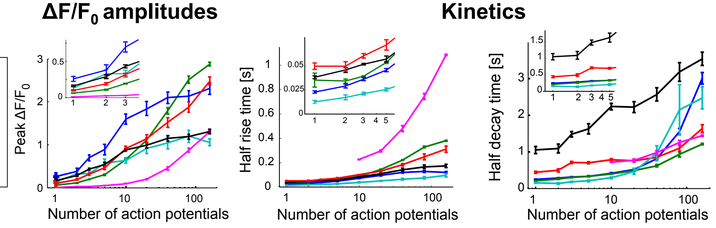




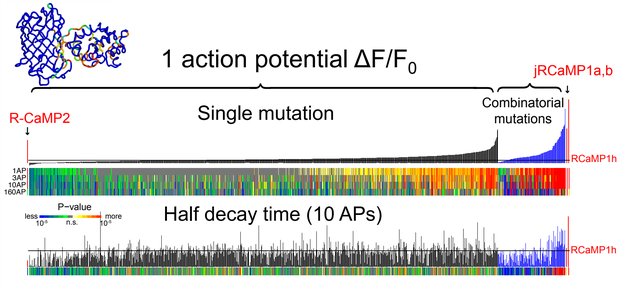


in vitro functional imaging

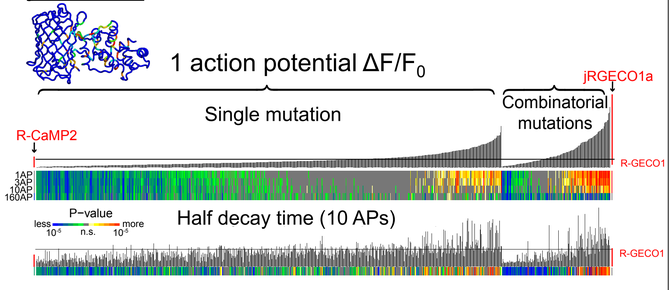




jRCaMP1 variants screened in cultured neurons

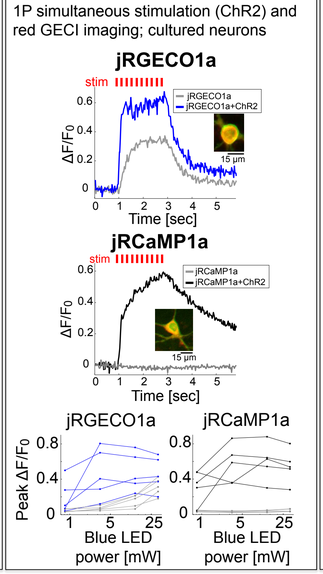


jRGECO1 variants screened in cultured neurons

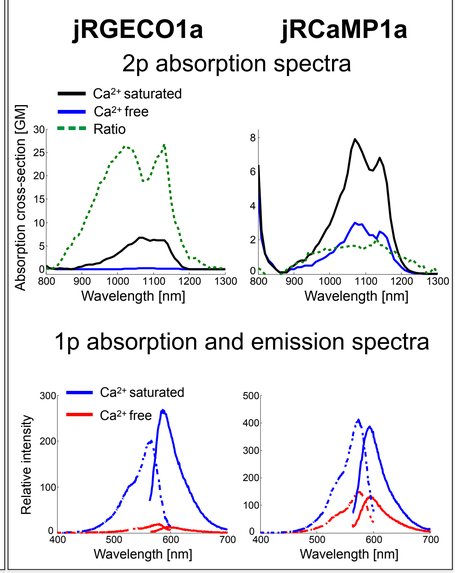


Photoswitching

1P simultaneous stimulation (ChR2) and red GECI imaging; cultured neurons



Absorption and emission spectra



Conclusions

- New **jRGECO1a**, **jRCaMP1a**, and **jRCaMP1b** indicators have improved sensitivity and kinetics
- jRGECO1a *in vivo* performance is similar to GCaMP6
- jRCaMP1 indicators combine improved sensitivity and photostability
- **Reagents distributed through Addgene.org and Penn Viral Vector Core**