

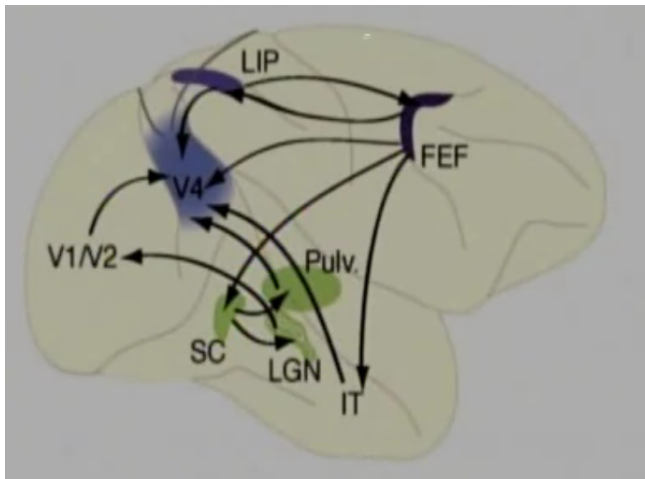
Long-range and local circuits for top-down modulation of visual processing

S. Zhang, M. Xu, T. Kamigaki, J.P.H. Do, W.C. Chang, S. Jenvay,
K. Miyamichi, L. Luo, & Y. Dan

(CSHL Cognition Talk)

Introduction

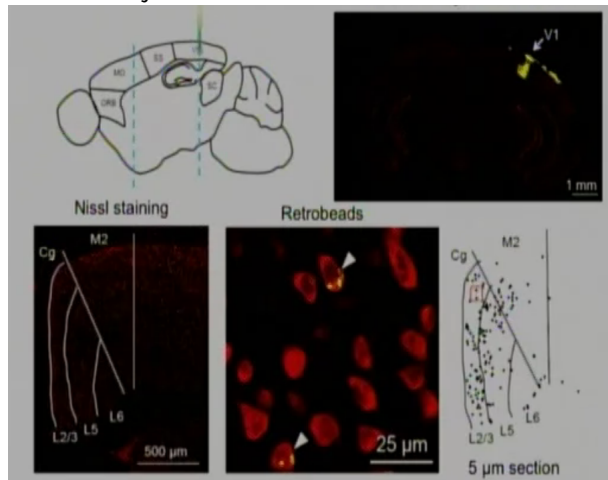
- ▶ Frontal areas modulate activity of sensory cortices
- ▶ In primates, FEF modulates perceptual decision tasks and eye saccades



What is the circuit mechanism of modulation of V1 in mice?

Which areas in mouse project to V1?

retrobead injection site: V1

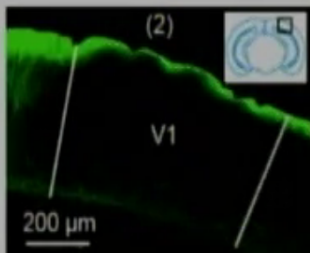
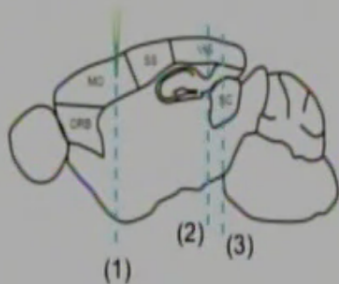


≈200 cells in Cg section

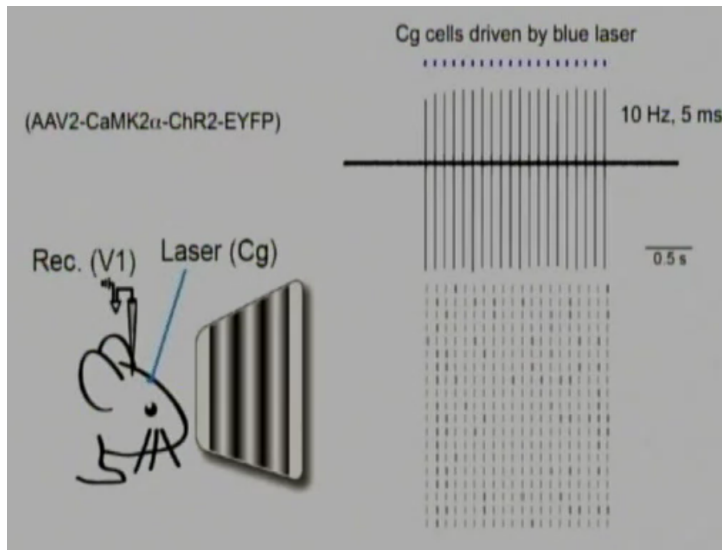
Cg is involved in emotion formation, learning and memory (in humans)

Anterograde tracing

Injection in Cg of AAV-CaMK2 α -ChR2-EYFP

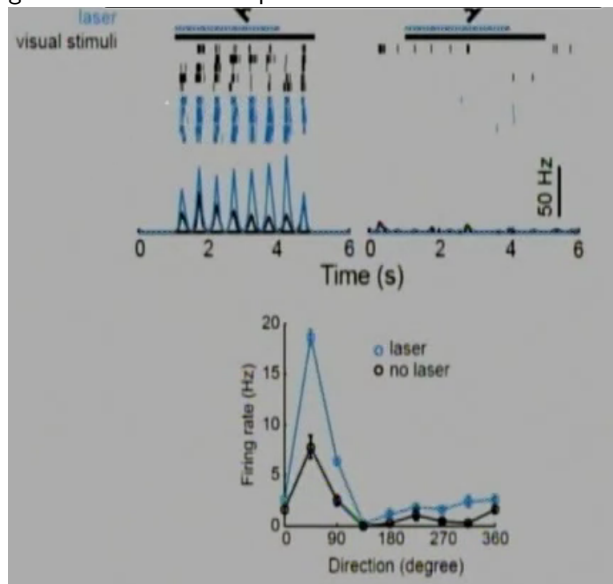


Optogenetic Activation of Cg

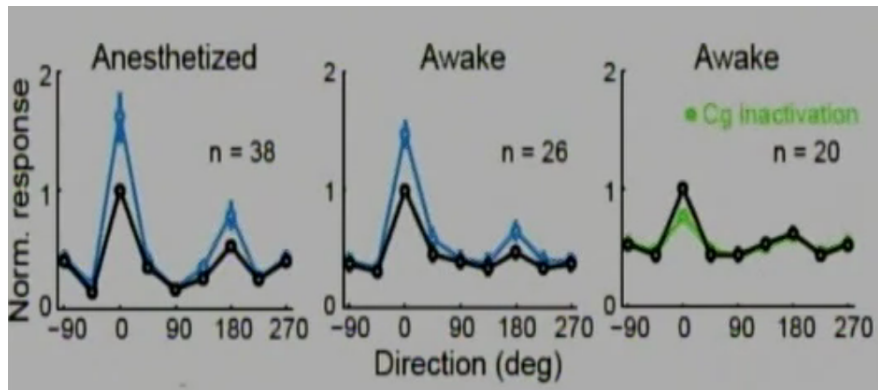


Activation of Cg enhances V1 responses

gain modulation of response to visual stimulus

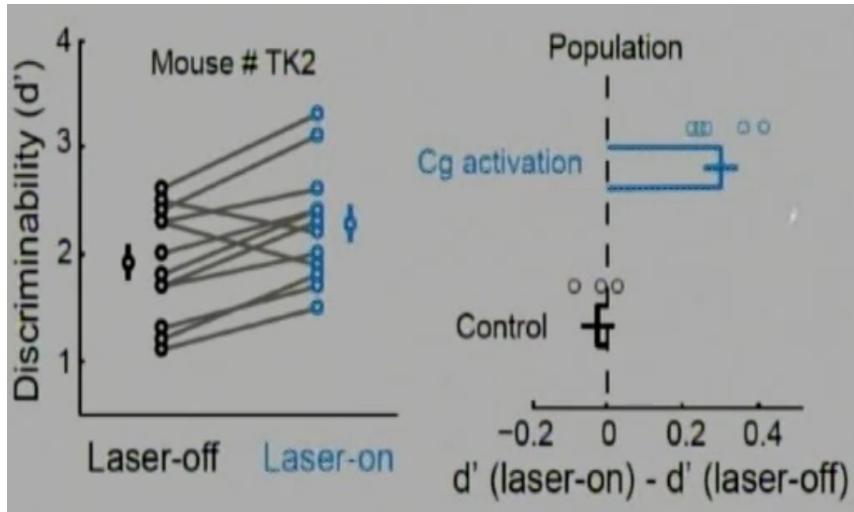


Activation of Cg enhances V1 responses



Cg inactivation with halorhodopsin (light-gated Cl ion pump)

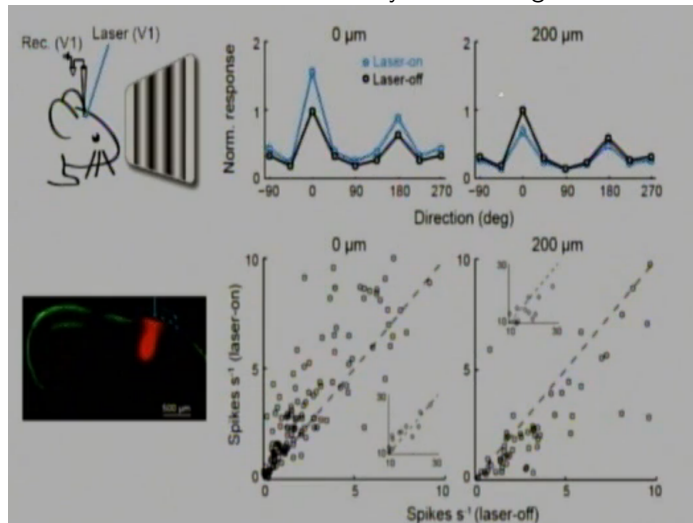
Activation of Cg enhances V1 responses



go no go task each dot is a day of 200-300 trials with interleaved laser trials

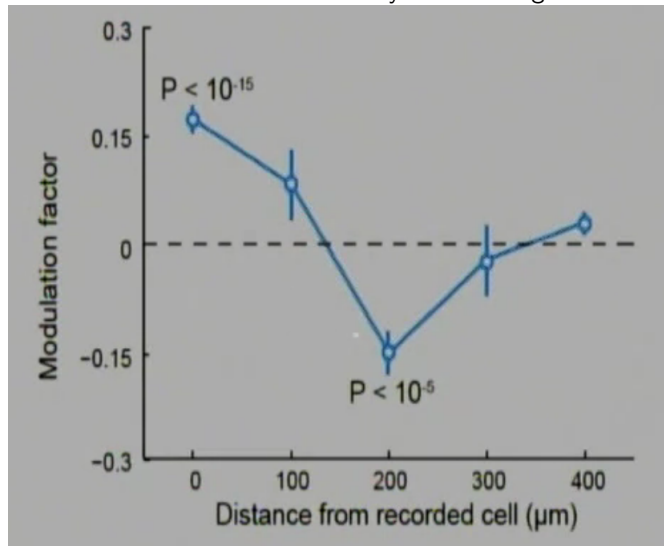
Spatial response profile of Pyr cells to axon stim

Cg activation enhances responses near the Cg axon stimulated, but inhibits cells recorded 200 μm away from the Cg axon

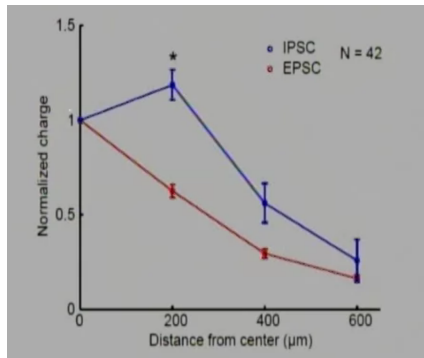
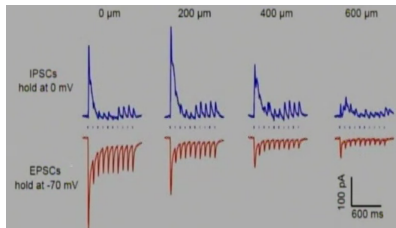


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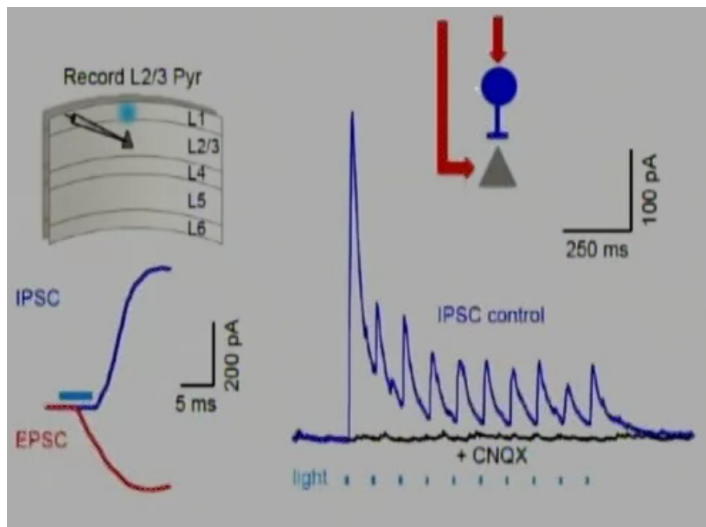


Spatial profile of EPSC/IPSC

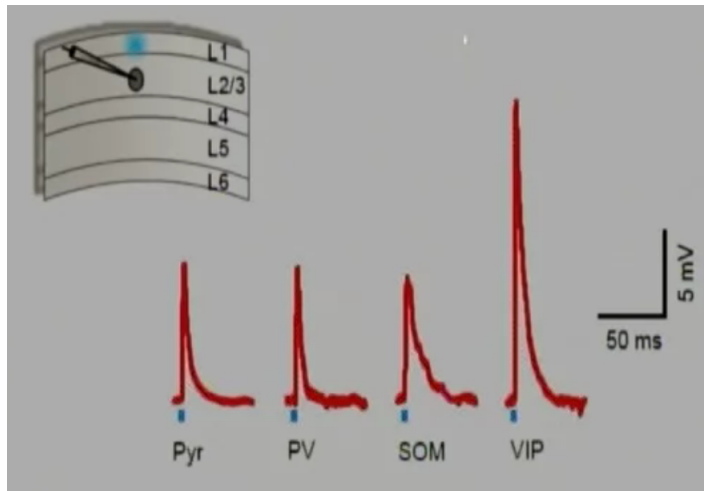


Cg-induced IPSC is disynaptic

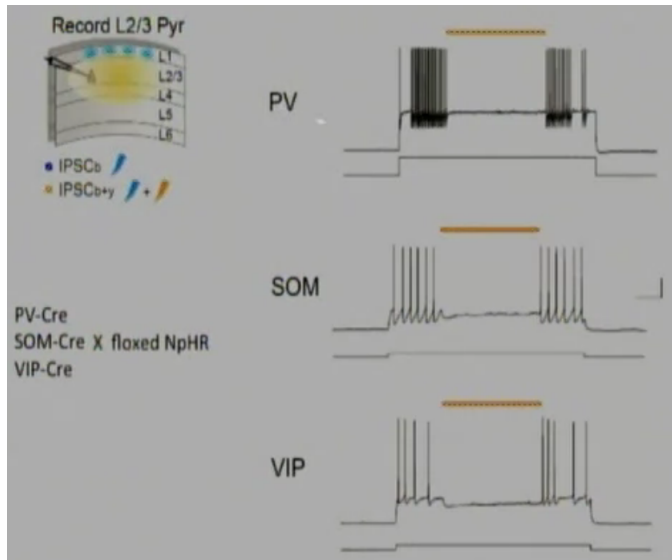
1. latency of IPSC
2. CNQX (blocks glutamate receptors) eliminates IPSC



All 3 interneuron subtypes are activated, but especially VIP

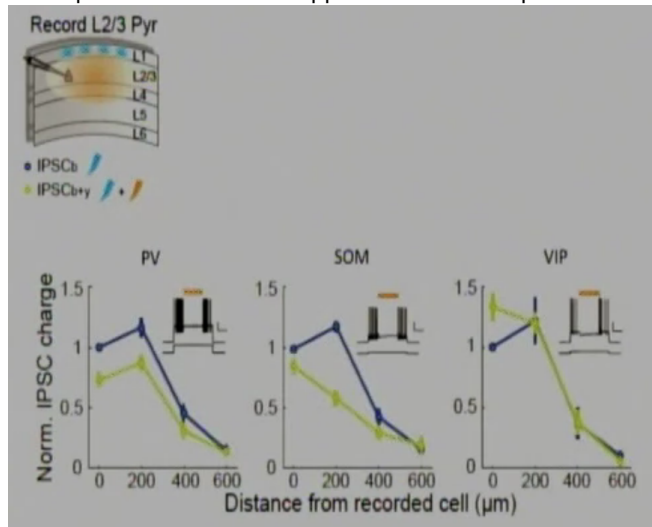


Use Cre line mice with halorhodopsin to selectively turn off subpopulations

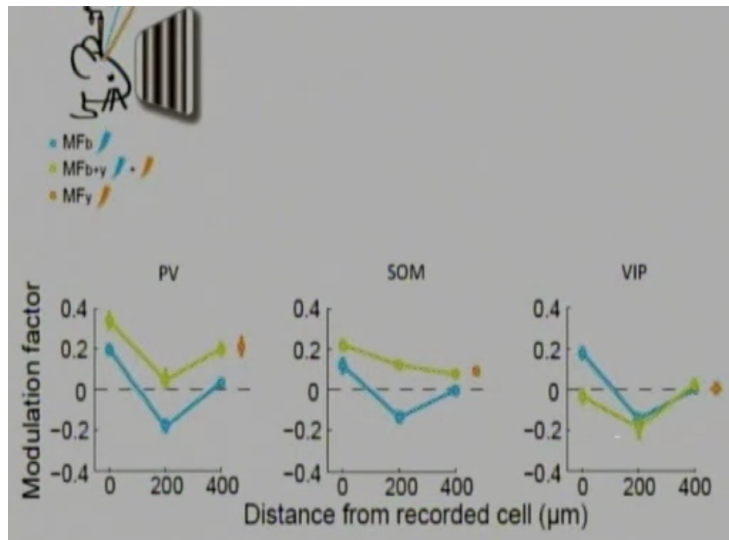


Activate Cg axons (blue) and Cre virus (orange)

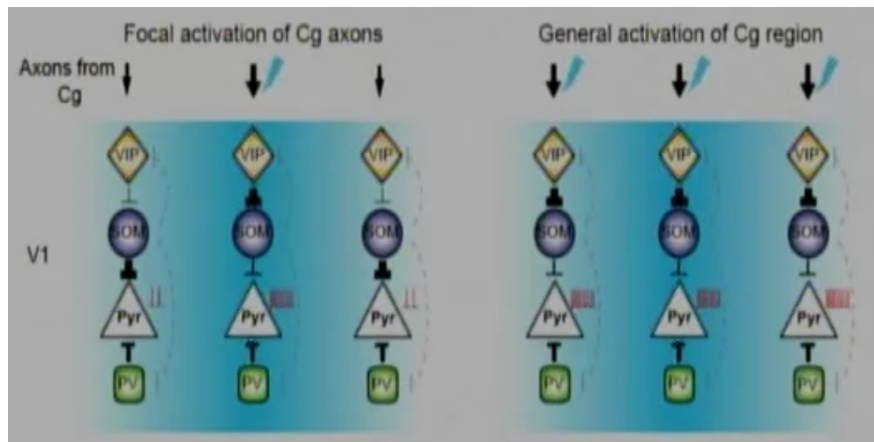
SOM produces surround suppression and VIP produces center facilitation



Contribution of interneurons to Cg modulation



Circuit Mechanism



Conclusions

- ▶ Cg innervates V1
- ▶ top-down modulation can produce gain modulation in pyramidal cells in V1
 - ▶ through center facilitation drive of VIP and surround drive of SOM
- ▶ full-field stimulation produces overall disinhibition of cortex (as seen in running mice)
- ▶ how do Cg neurons fire and do their patterns correspond to the behavioral task?