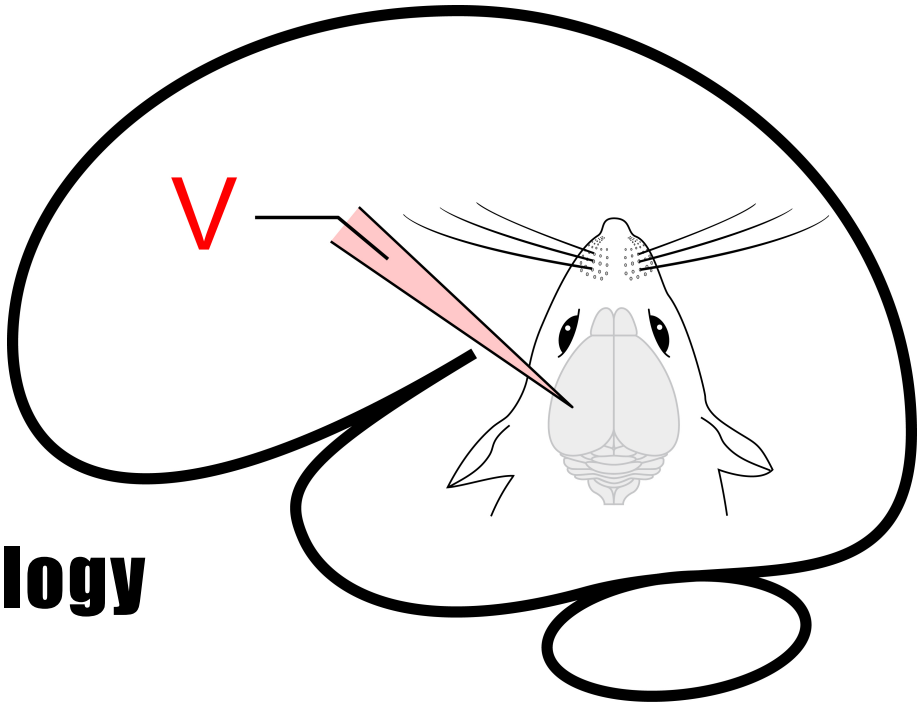
ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE



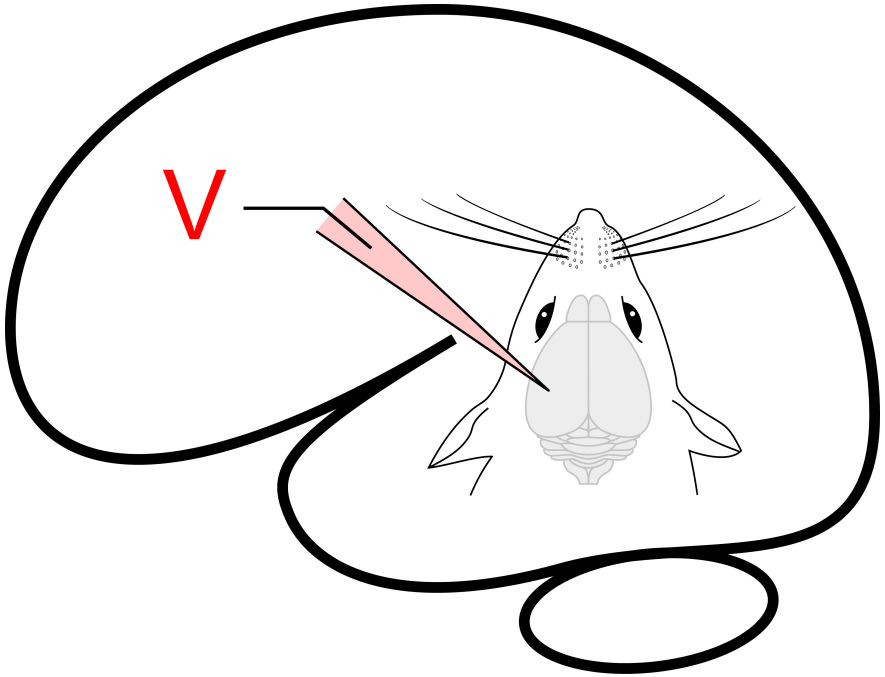
6.4 *In vivo* electrophysiology

Cellular Mechanisms of Brain Function

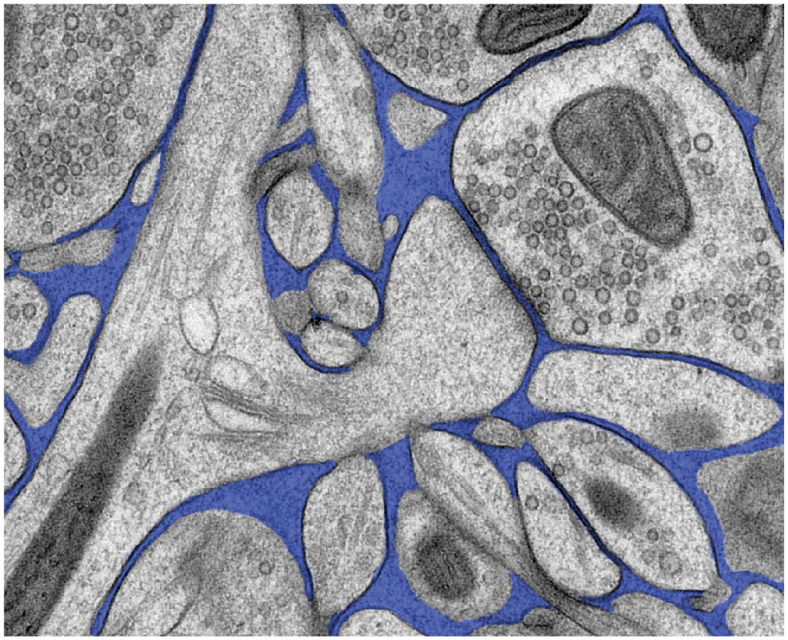
Prof. Carl Petersen

In vivo electrophysiology

Extracellular and intracellular recordings

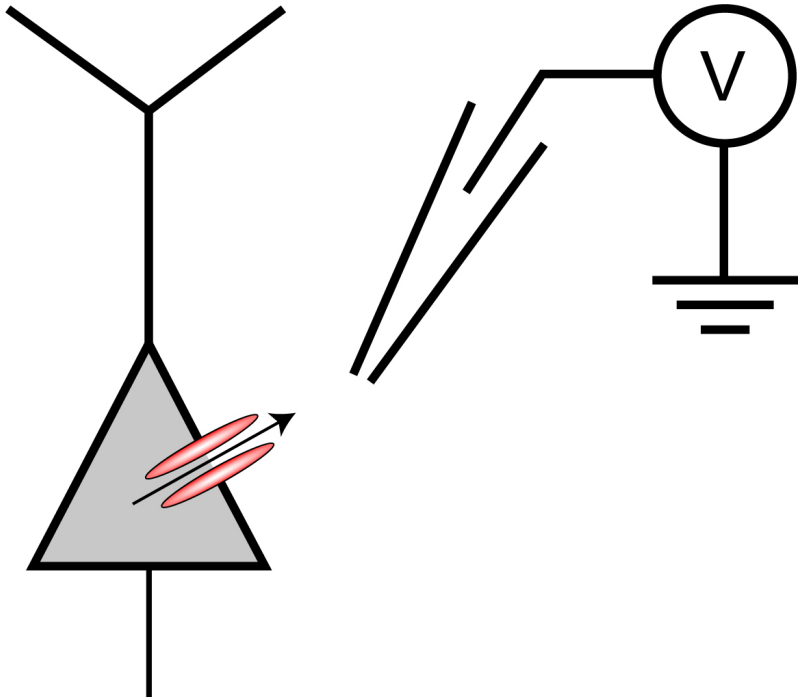


Extracellular potentials

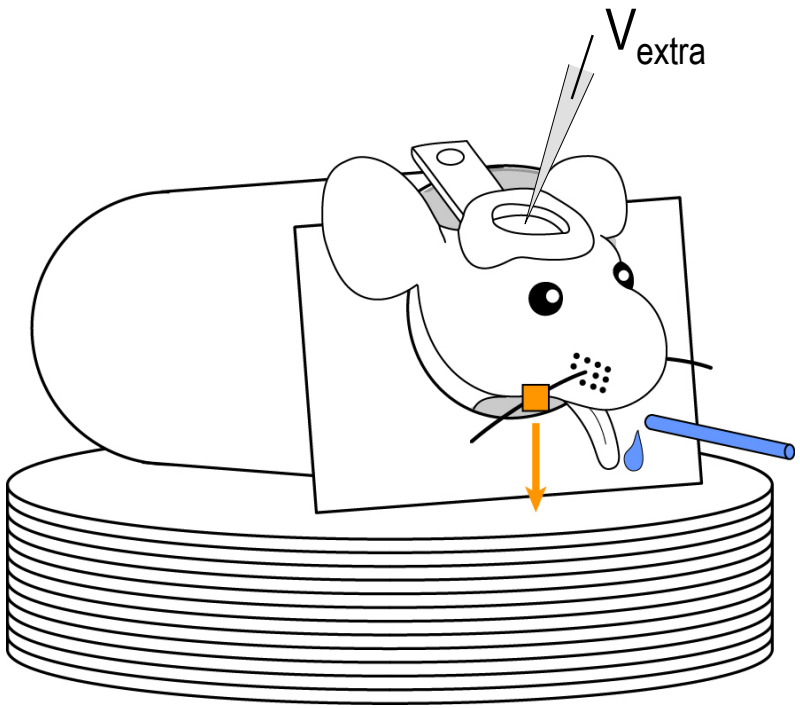


500 nm

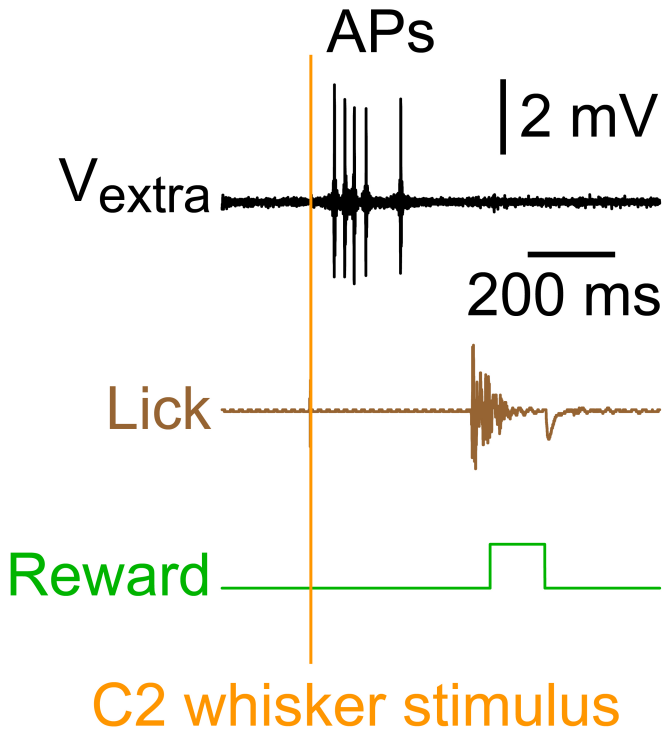
Korogod, Petersen and Knott



Extracellular recording of action potentials

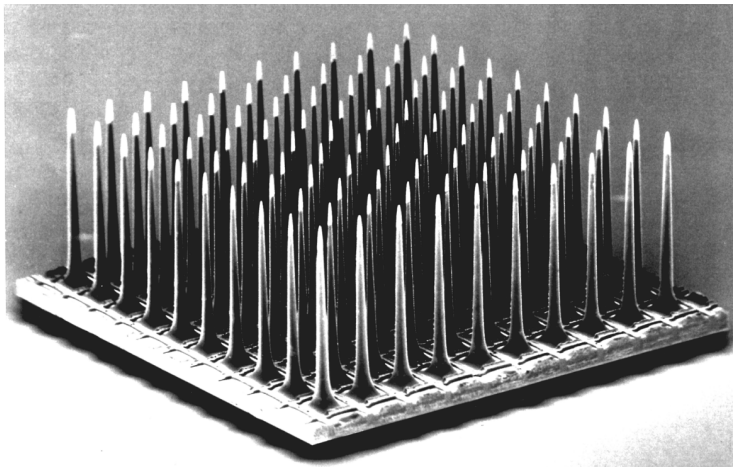


Sachidhanandam, Sreenivasan, Kyriakatos, Kremer & Petersen, 2013



Multichannel extracellular recordings

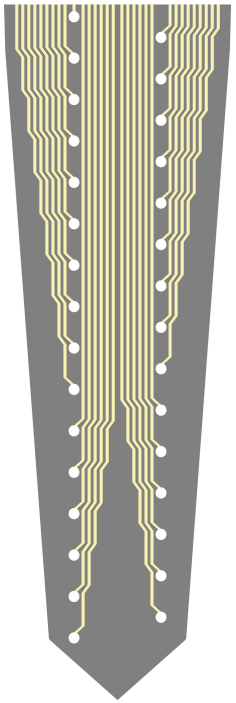
Electrode arrays



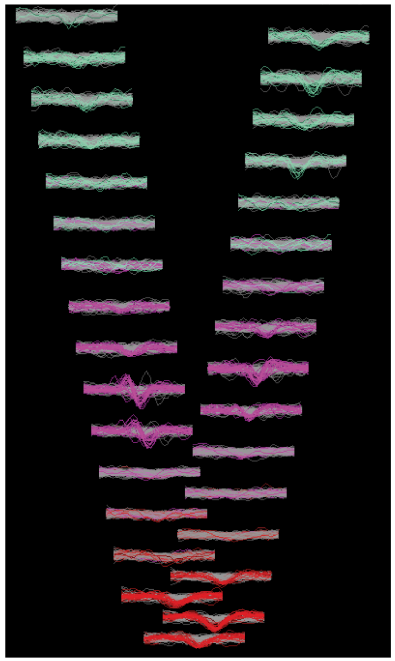
Utah array, Blackrock Microsystems

Hochberg et al., 2012
http://www.youtube.com/watch?v=ogBX18maUiM

Silicon probes

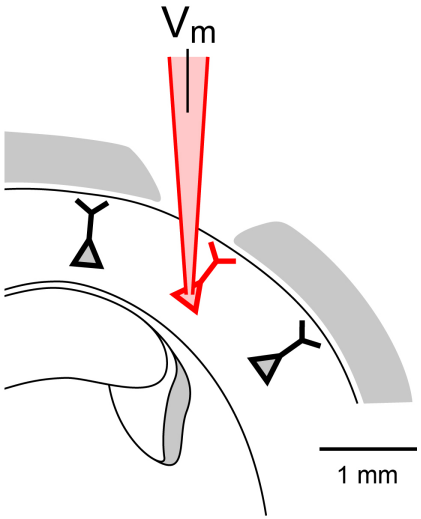


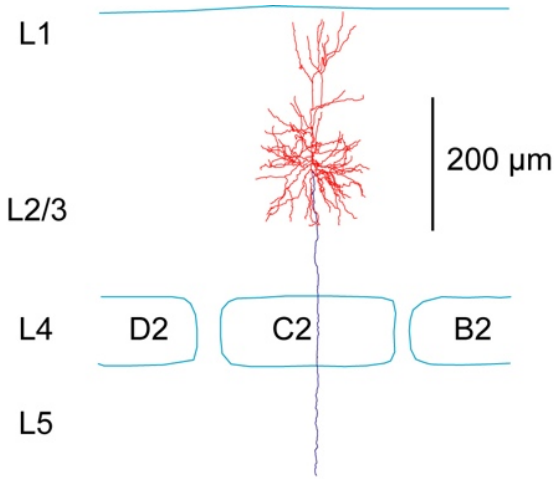
Neuronexus

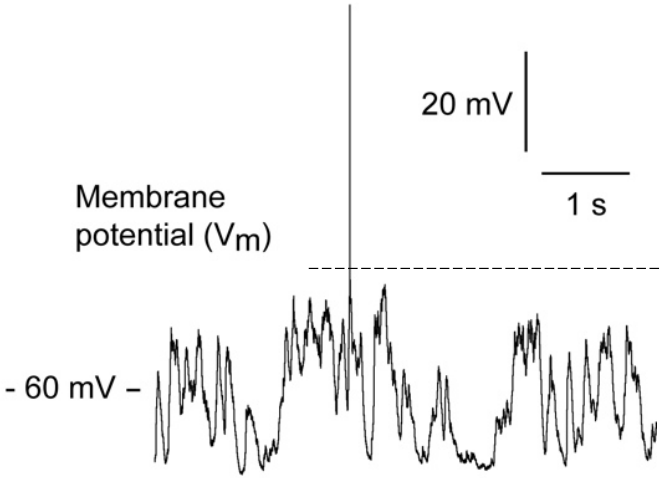


Lapray and Petersen

In vivo whole-cell recordings

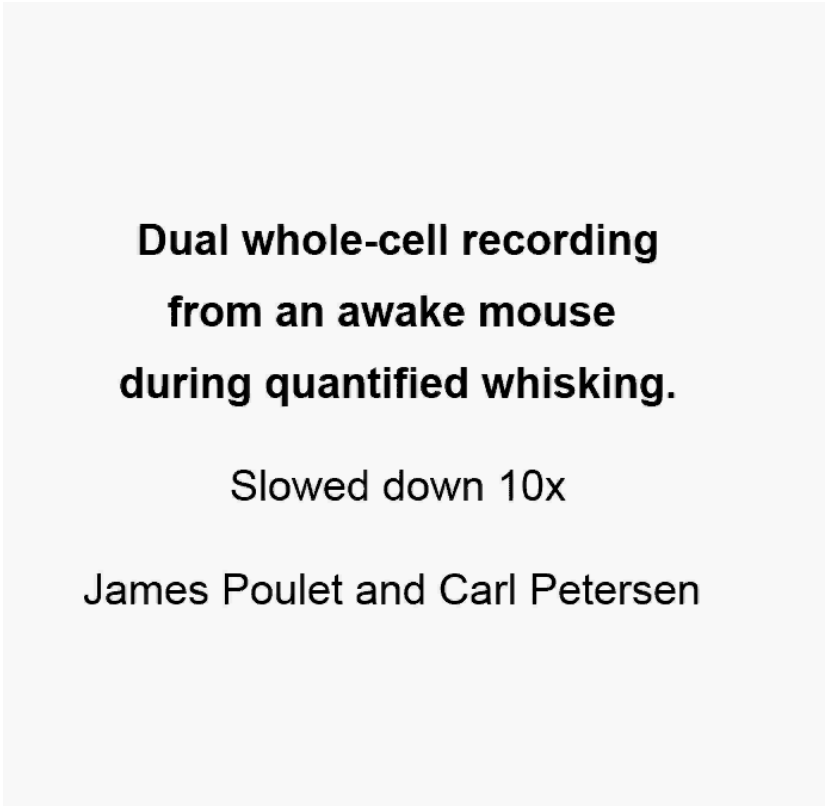






Crochet and Petersen, 2006

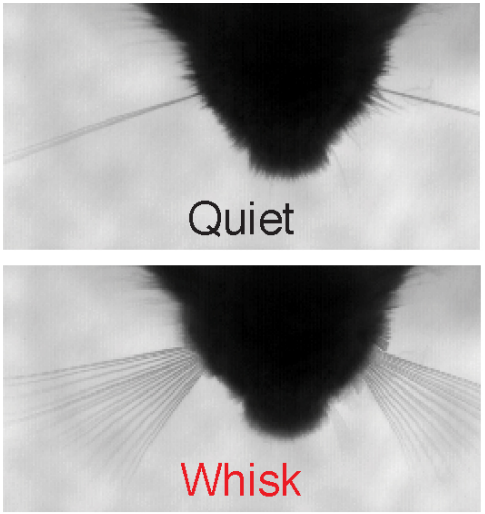
Dual whole-cell recordings



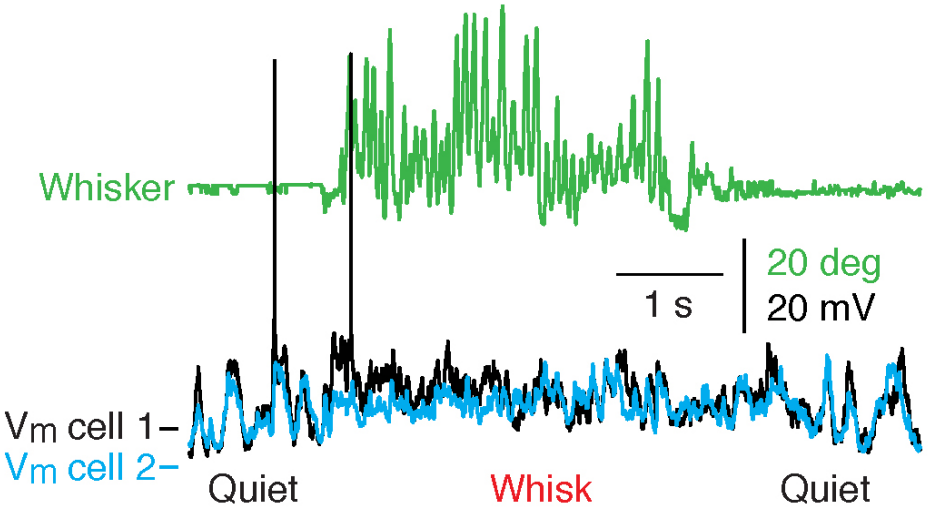
V_m cell 1
V_m cell 2

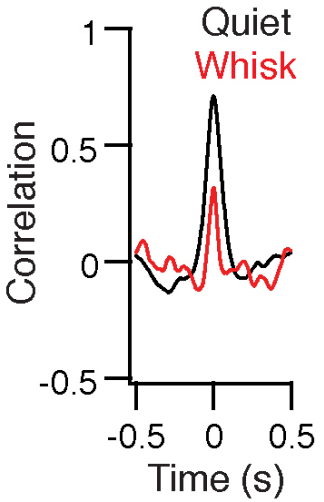
Poulet and Petersen, 2008

Dual whole-cell recordings



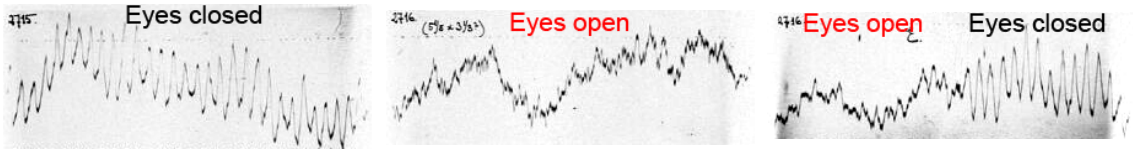
Poulet and Petersen, 2008

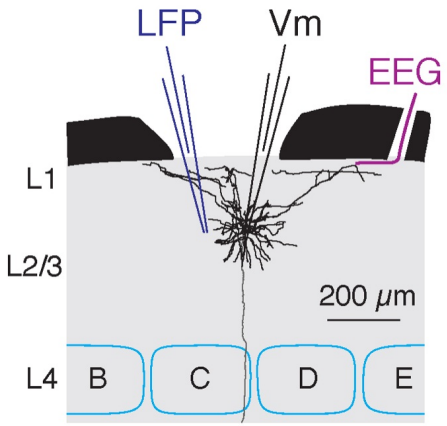




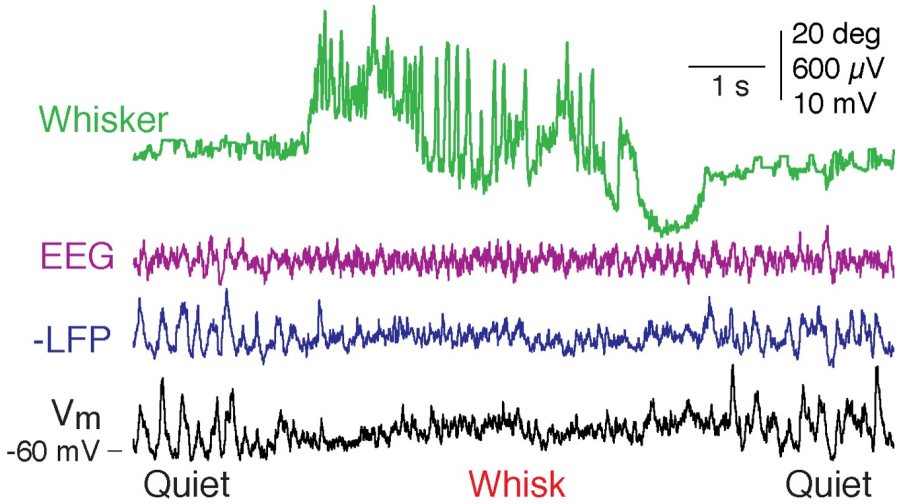
V_m, LFP and EEG

Hans Berger observed brain state changes in human EEG recordings (1929).
He found prominent alpha waves in relaxed subjects with their eyes closed.
These slow oscillations disappeared upon eye opening.

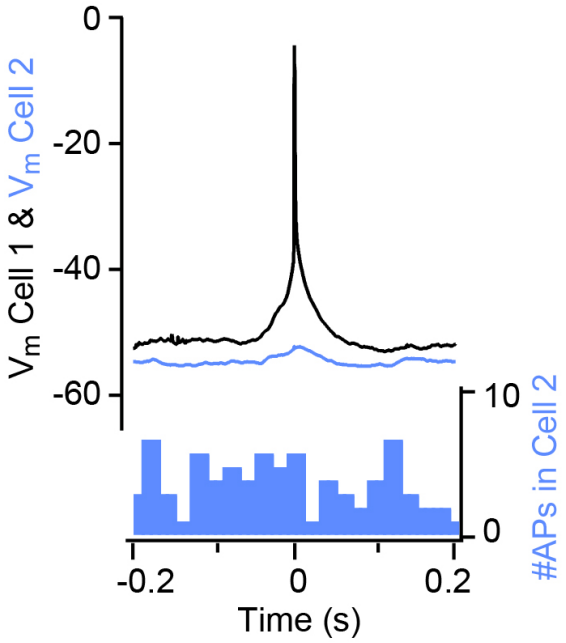




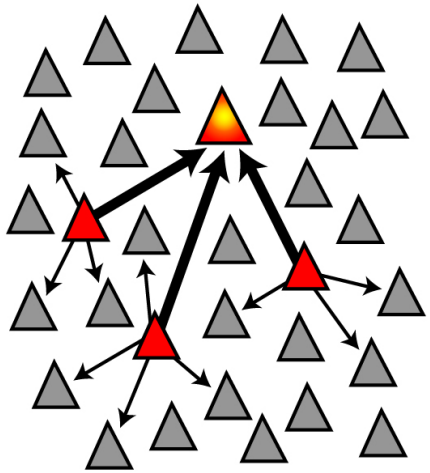
Poulet and Petersen, 2008



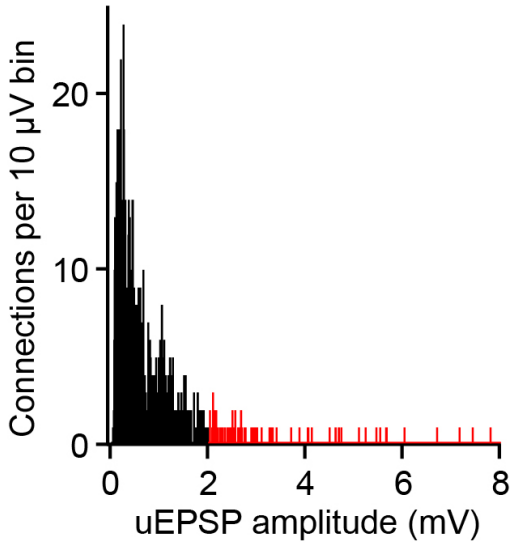
V_m dynamics driving action potential firing



Poulet and Petersen, 2008

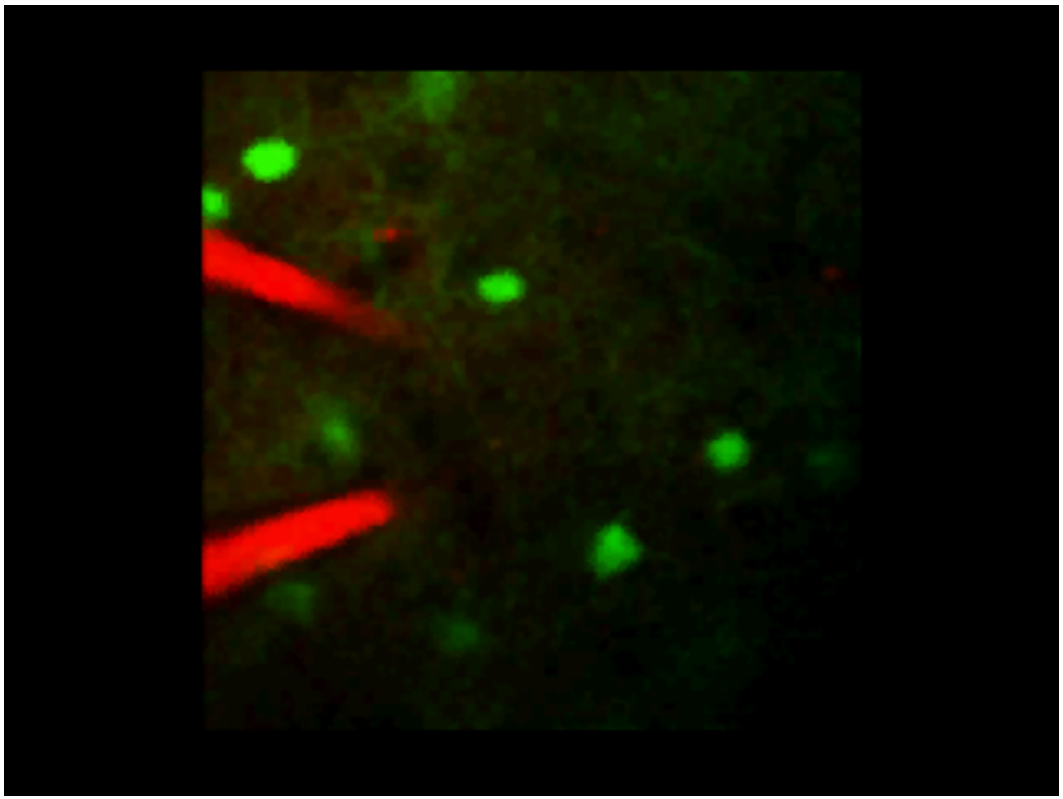


The convergence of a few big uEPSPs could drive highly specific action potential firing.



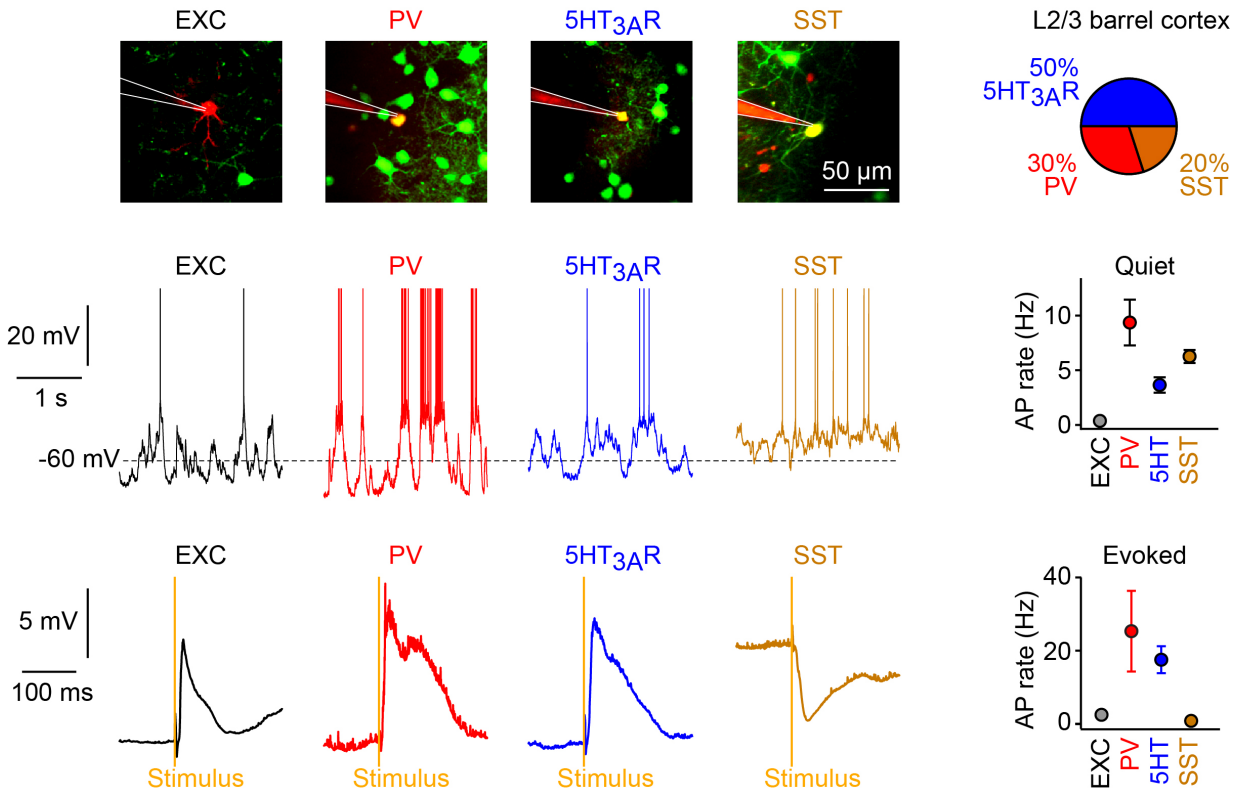
Lefort, Tomm, Sarria and Petersen, 2009

Whole-cell recordings and two-photon imaging



Gentet, Avermann, Matyas, Staiger and Petersen, 2010

Cell-type specific membrane potential dynamics



Gentet, Avermann, Matyas, Staiger and Petersen, 2010
Gentet, Kremer, Taniguchi, Huang, Staiger and Petersen, 2012

In vivo electrophysiology

- Action potentials can be recorded extracellularly in parallel from many neurons at the same time.
- Whole-cell recordings reveal membrane potential dynamics during behavior.
- Whole-cell recordings of specific cell-types through two-photon microscopy and genetics.