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## INTRODUCTION

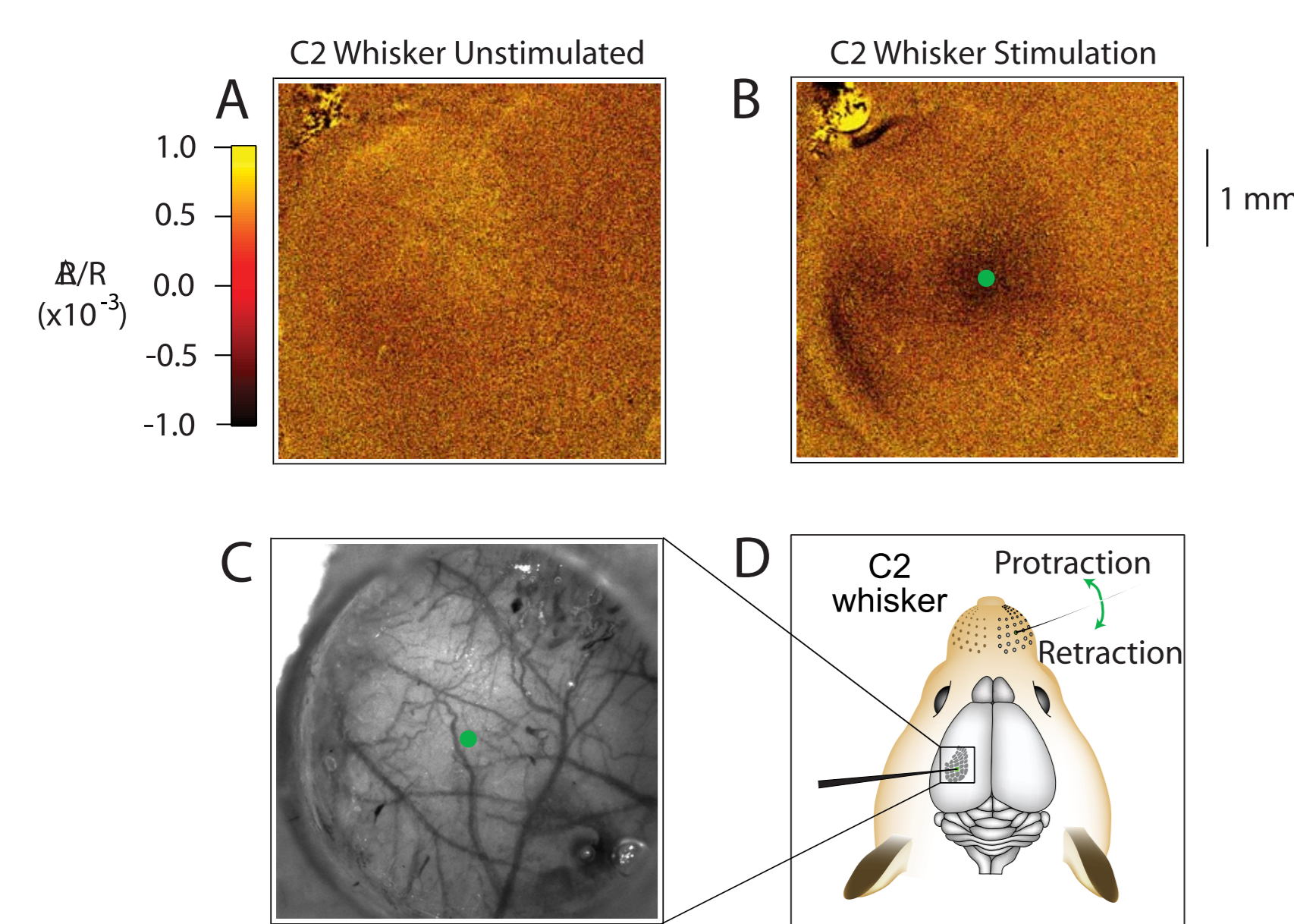
All animals actively sense their environment. Here we use the mouse whisker system to investigate cortical processing during active sensing. Mice make large, rhythmic whisker movements to explore their environment. Sensory information is transferred from the whiskers along the Infra-Orbital Nerves (IONs) to the somatosensory "barrel" cortex via the brain stem and thalamus. We investigate two questions:

1. How synchronous is cortical neuronal activity during behaviour?
2. Where does the cortical activity during behaviour originate?

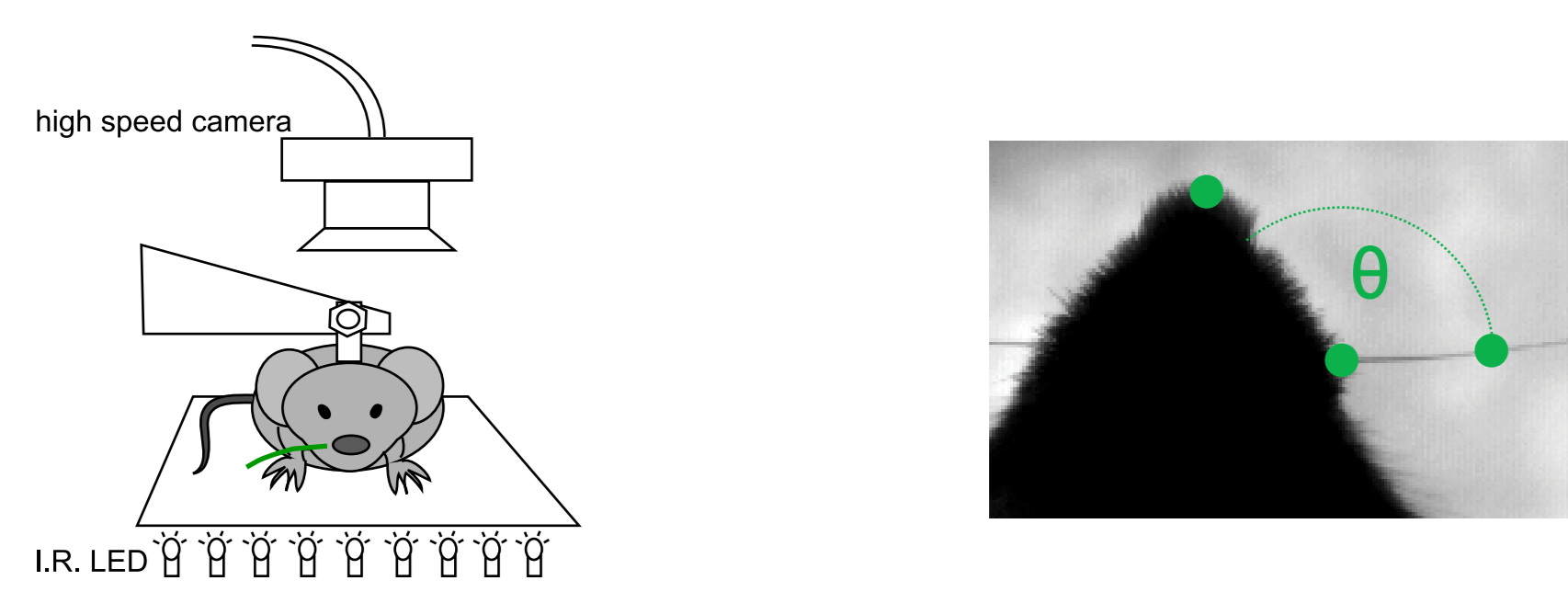
## METHODS

We identified the location of the C2 whisker barrel column with **intrinsic optical imaging**. We then combined **whole-cell** membrane potential recordings (Vm) from layer 2/3 neurons while quantifying whisker movement with high-speed filming in behaving, head-fixed mice.

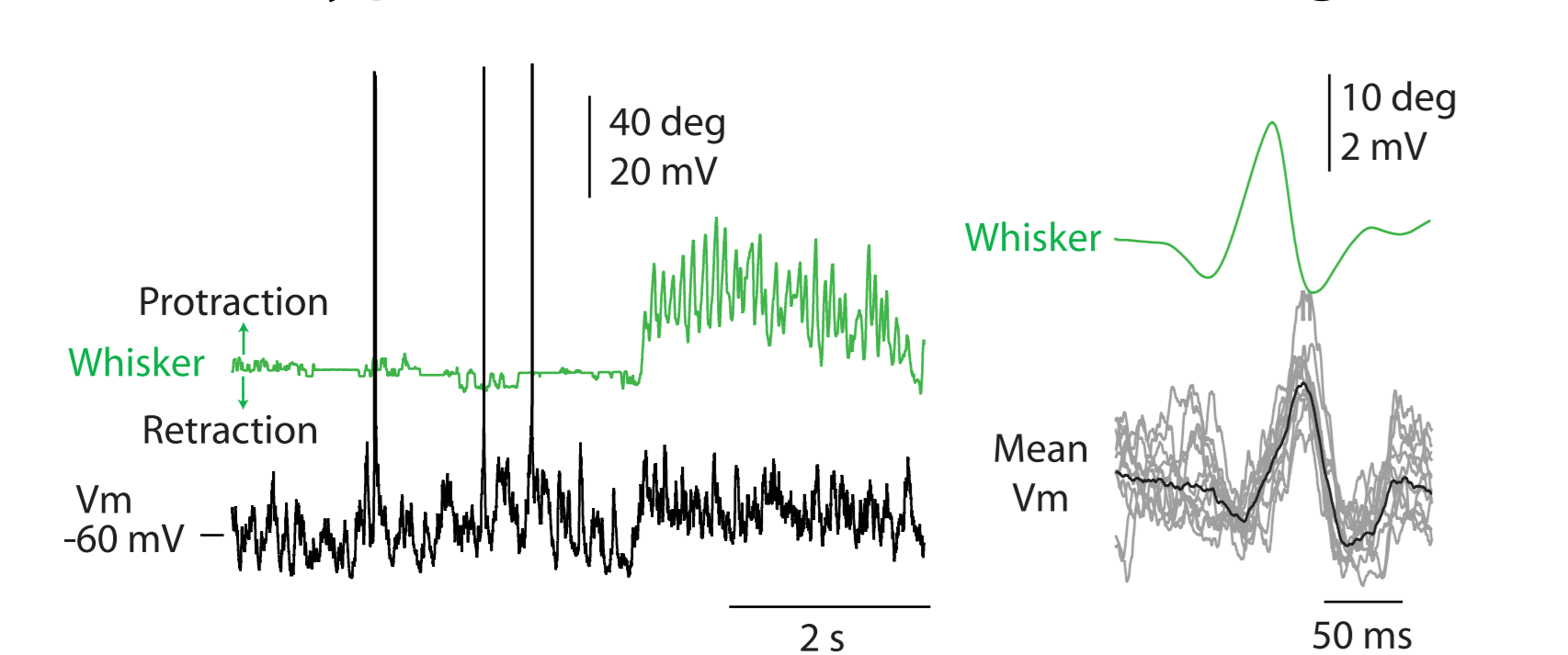
### Intrinsic Optical Imaging



### High Speed Filming of Whisker Position



### Typical Whole-Cell Recording

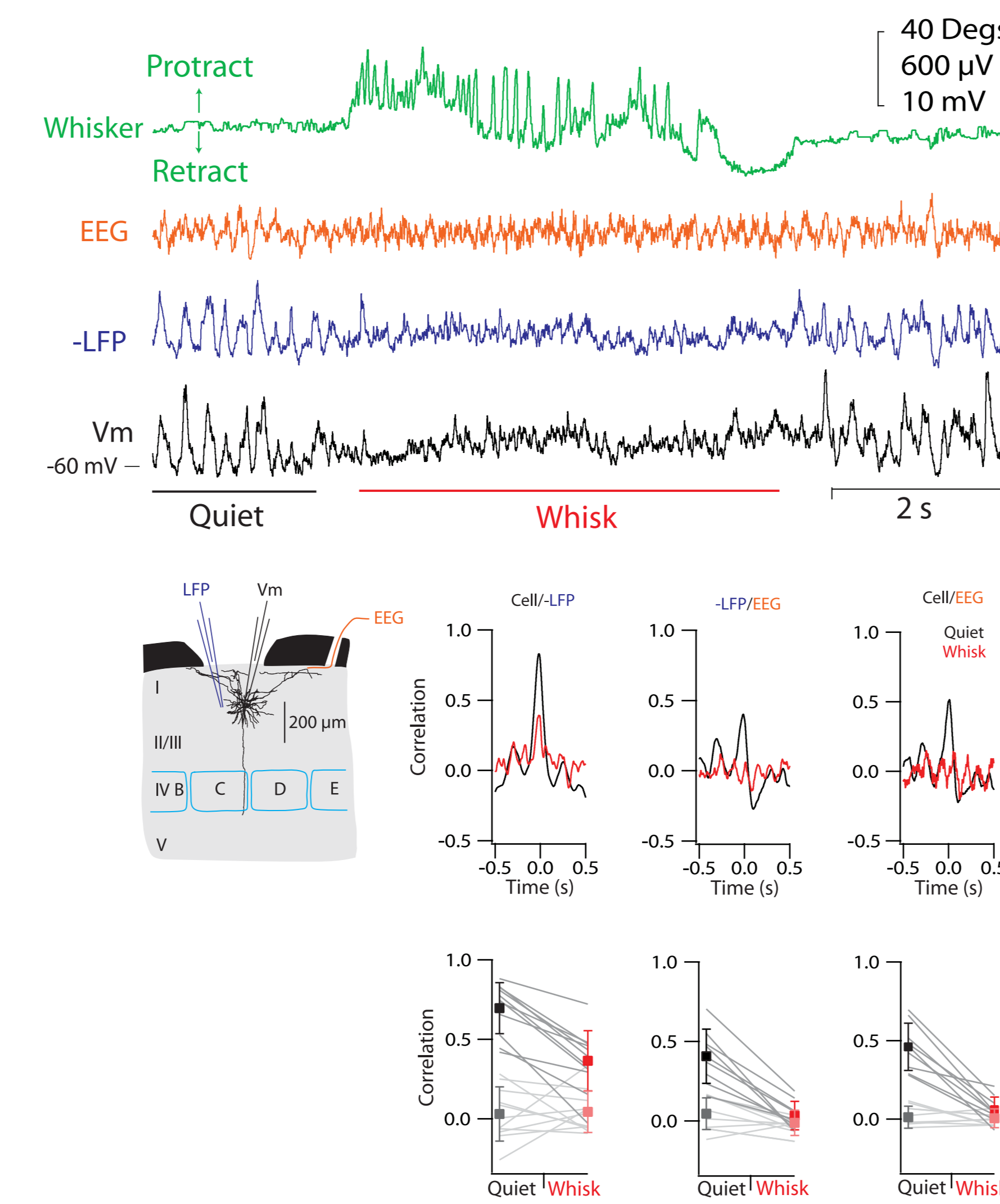


## CONCLUSIONS

- Cortical neurons show slow, large amplitude Vm oscillations during quiet waking.
- During whisking, cortical neurons undergo a state change, with a reduction in the power of low frequency oscillations.
- Nearby cortical neurons are more correlated during quiet waking than whisking.
- The cortical state change during whisking is generated centrally in the CNS.

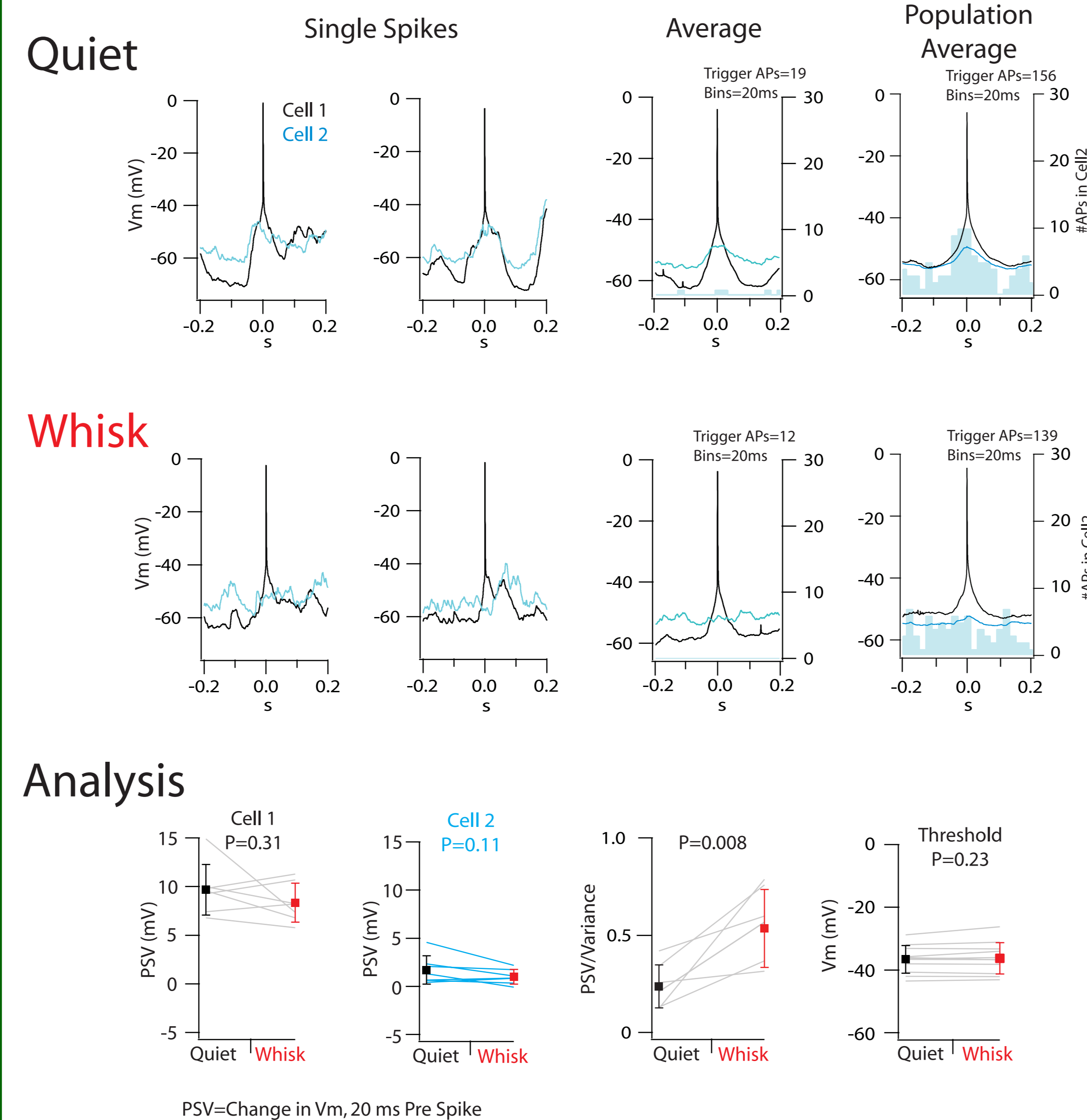
Thanks to Human Frontier Science Programme, Roche and the Swiss National Science Foundation for funding.

## COMBINED WHOLE-CELL, LFP AND EEG RECORDINGS DURING FREE WHISKING AND CORRELATION ANALYSIS



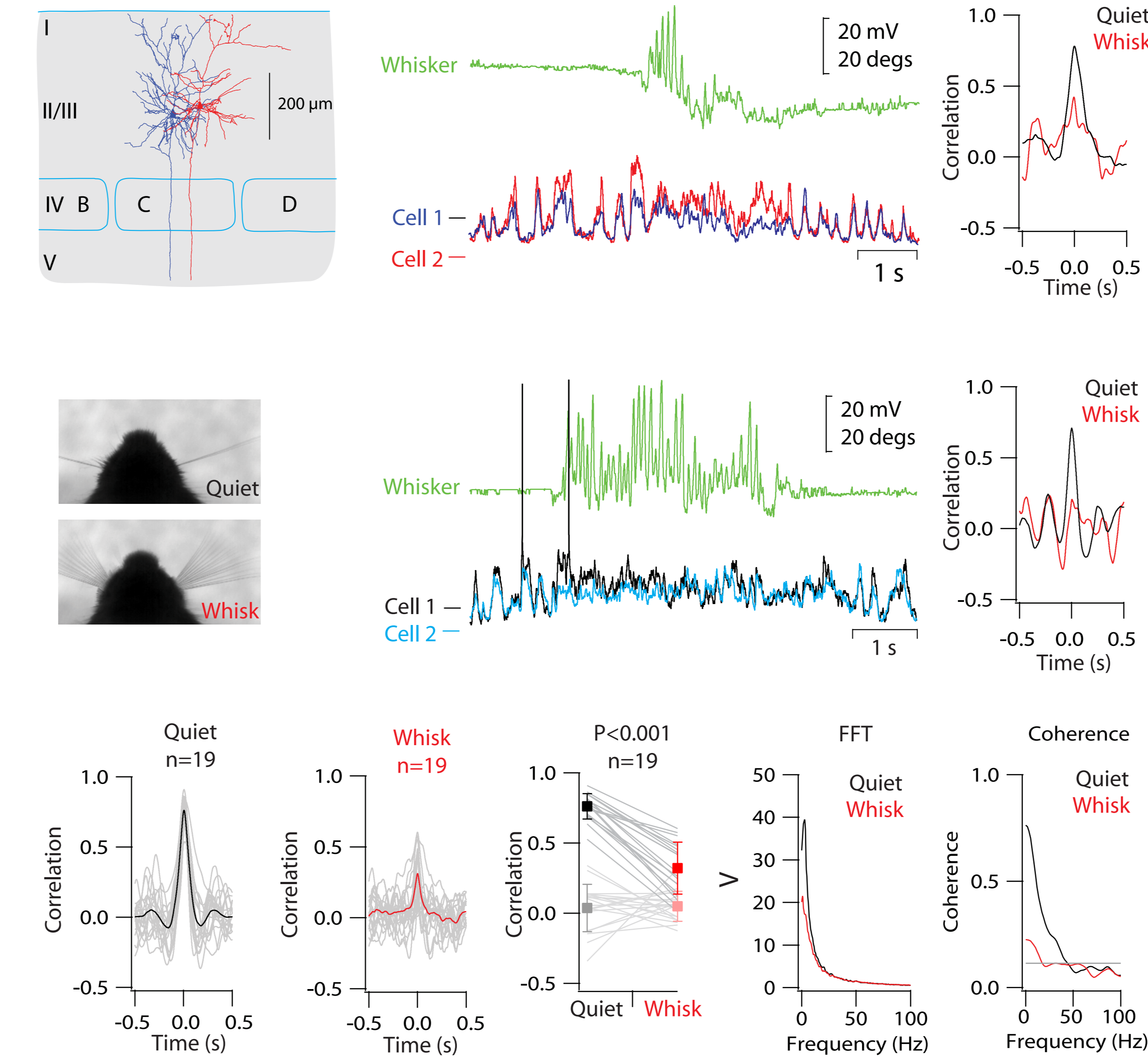
Desynchronisation of neuronal activity during free whisking

## PROPERTIES OF ACTION POTENTIALS IN BEHAVING MICE



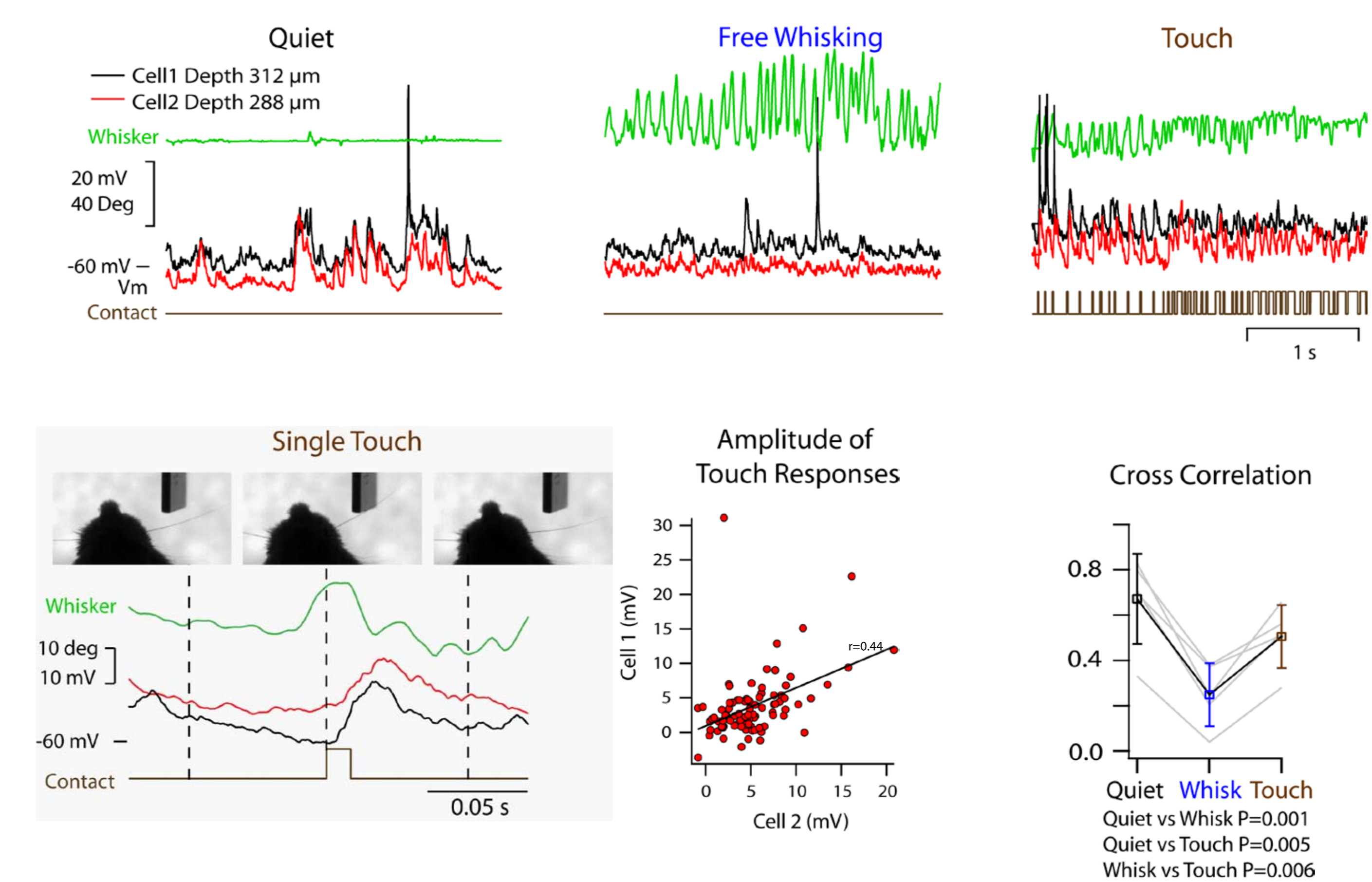
Action Potentials are driven by large, specific inputs during both quiet waking and whisking.

## DUAL WHOLE CELL RECORDINGS AND CORRELATION ANALYSIS DURING FREE WHISKING



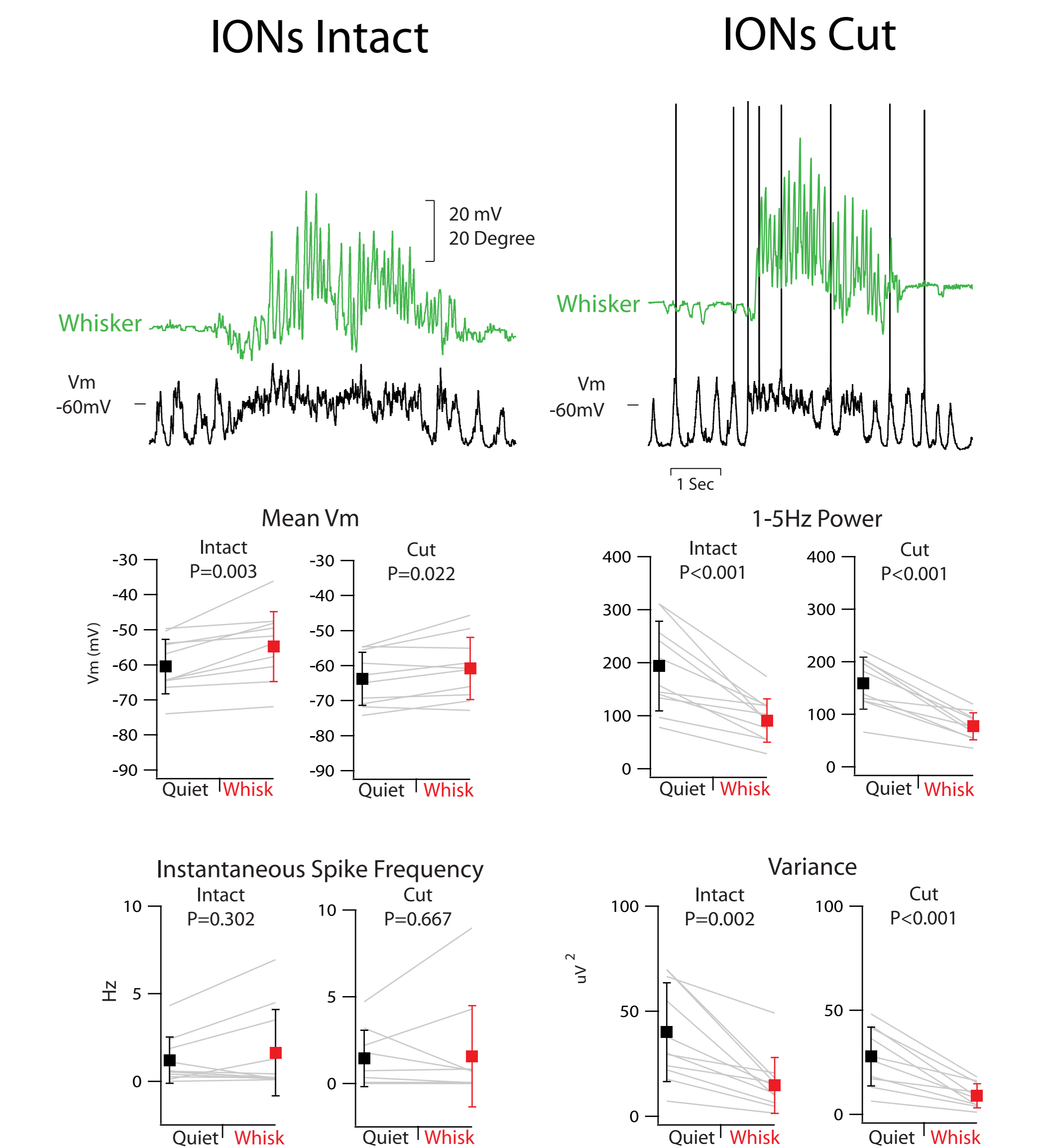
Desynchronisation of the Vm nearby cortical neurons during free whisking

## DUAL WHOLE-CELL RECORDINGS DURING ACTIVE TOUCH



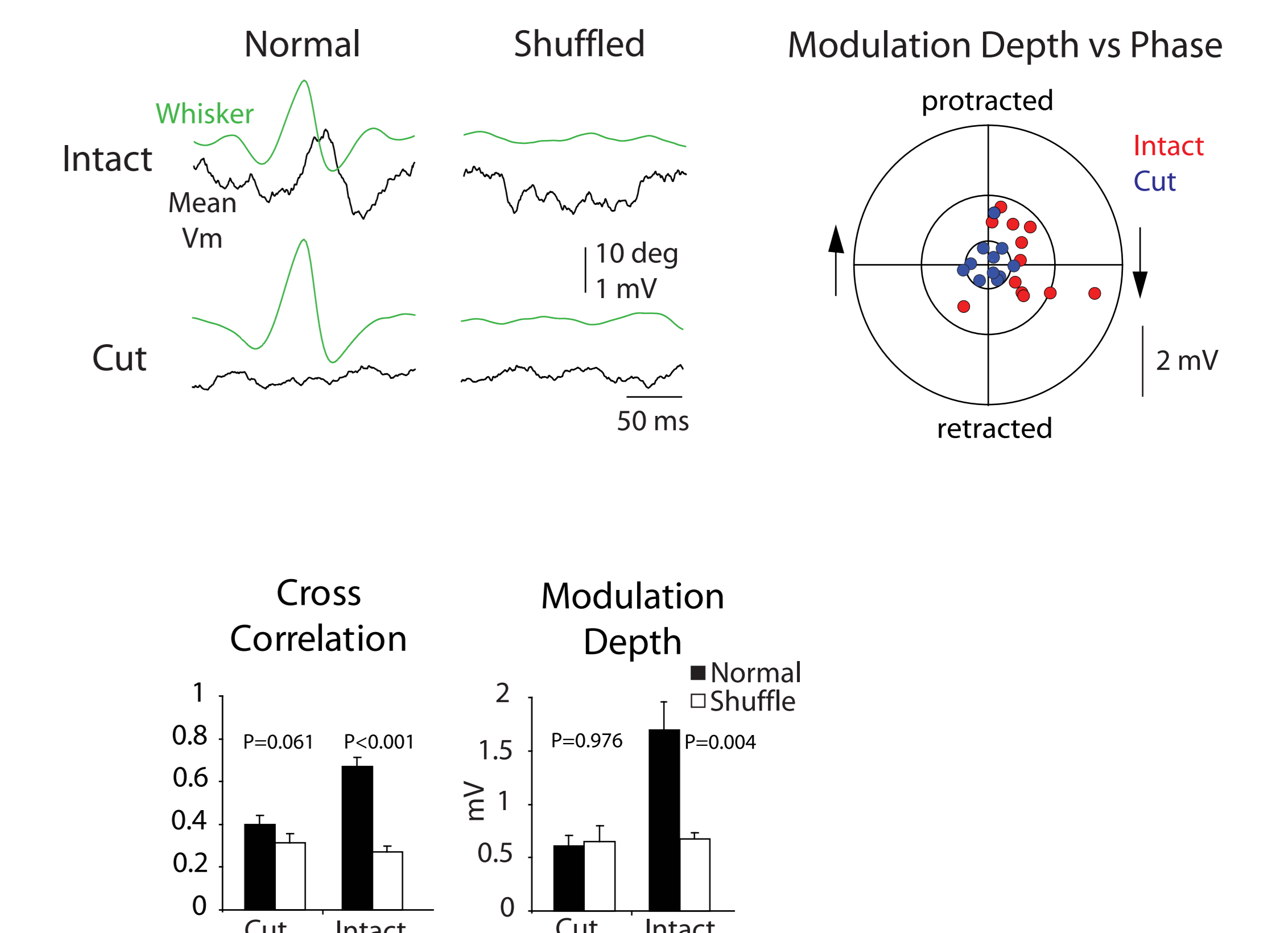
Resynchronisation of nearby cortical neurons during active touch

## WHOLE-CELL RECORDINGS WITH AND WITHOUT BILATERAL INFRAORBITAL NERVE CUT



Cortical state change during whisking is generated centrally within the CNS

## FAST Vm OSCILLATION DYNAMICS WITH AND WITHOUT BILATERAL INFRAORBITAL NERVE CUT



Fast oscillation during free whisking is due to sensory feedback