

## INTRODUCTION

Recently, spontaneous BOLD fluctuation in MRI has been reported to be correlated between the bilateral somatomotor cortices and other functionally interconnected brain regions [1, 2]. The corpus callosum was suggested as a major anatomical connection underlying such bihemispheric functional connectivity [3, 4]. However, it is not yet clear whether such interhemispheric correlation arises from the unelicited vascular activity or a common neuronal source or the intrinsically connective neural activity [5]. In the current study, using laminar electrophysiological recordings in bilateral rat brain cortices [6], we demonstrated the interhemispheric correlation of spontaneous neuroelectric activities and its dependence on the cortical depth and compared them with the evoked activity.

## METHODS

- Five normal Sprague-Dawley rats (~300g)
- Resting state (10 min, anesthetized with  $\alpha$ -chloralose) and electrical forepaw stimulation (6 min, 1.5 mA, 3 Hz, pulse duration 0.3 ms)
- Recorded at the cortical level for detecting electrophysiological substrates of the resting state fluctuation.
- Sampling rate = 2000 Hz
- Two one-dimensional electrodes spanning through the entire cortical depth (23 contacts with 0.1 mm separation between each contact)
- Simultaneous recordings from both left and right sensorimotor cortices (3.0 mm lateral, 2.0 mm anterior from bregma. See Fig. 1).
- Band-pass filtered between 0.5~50 Hz to remove drift and possible 60 Hz noise.

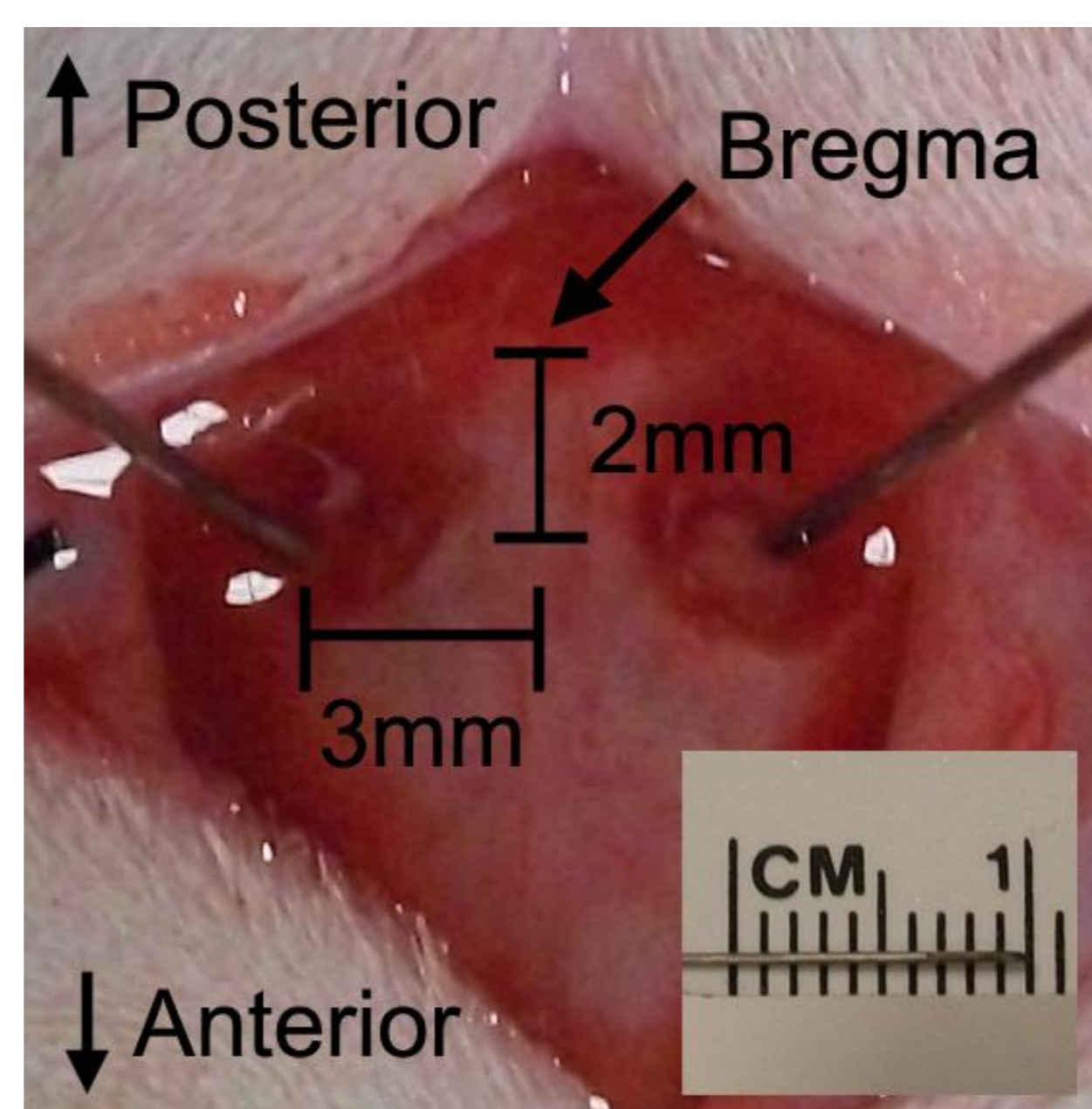


Fig 1. The location of electrodes on bilateral somatosensory cortices.

## RESULTS

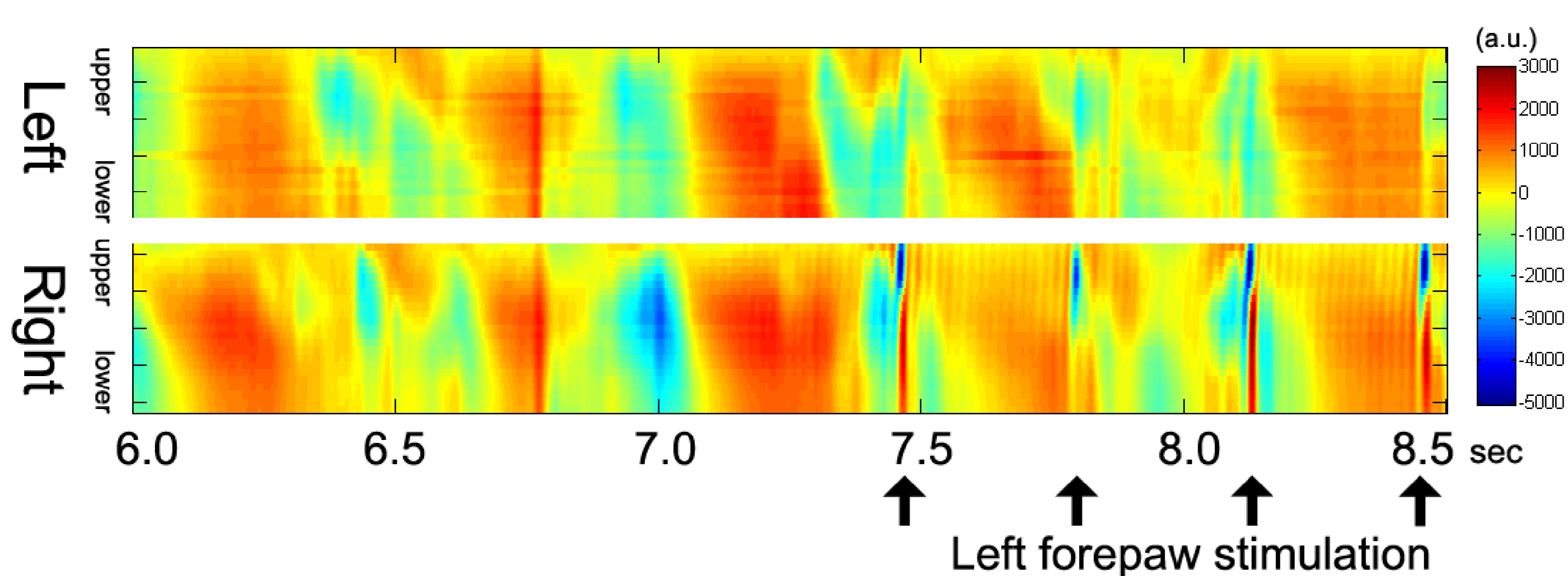


Fig 2. The example of electrophysiological recordings containing both spontaneous and forepaw stimulation-evoked activity.

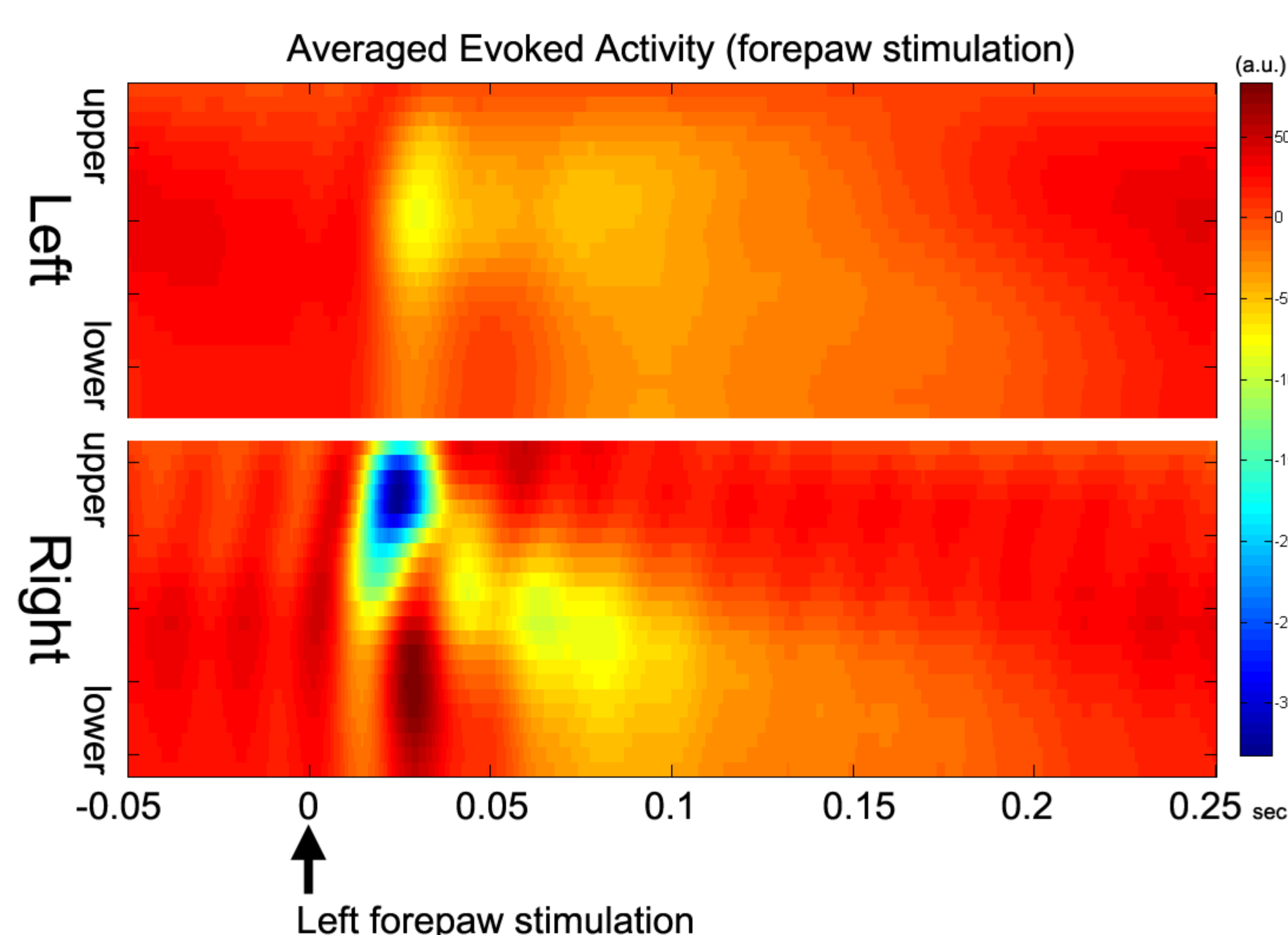


Fig 3. The averaged evoked activity with electrical forepaw stimulation. The evoked response from right forepaw stimulation was comparable. (not shown here)

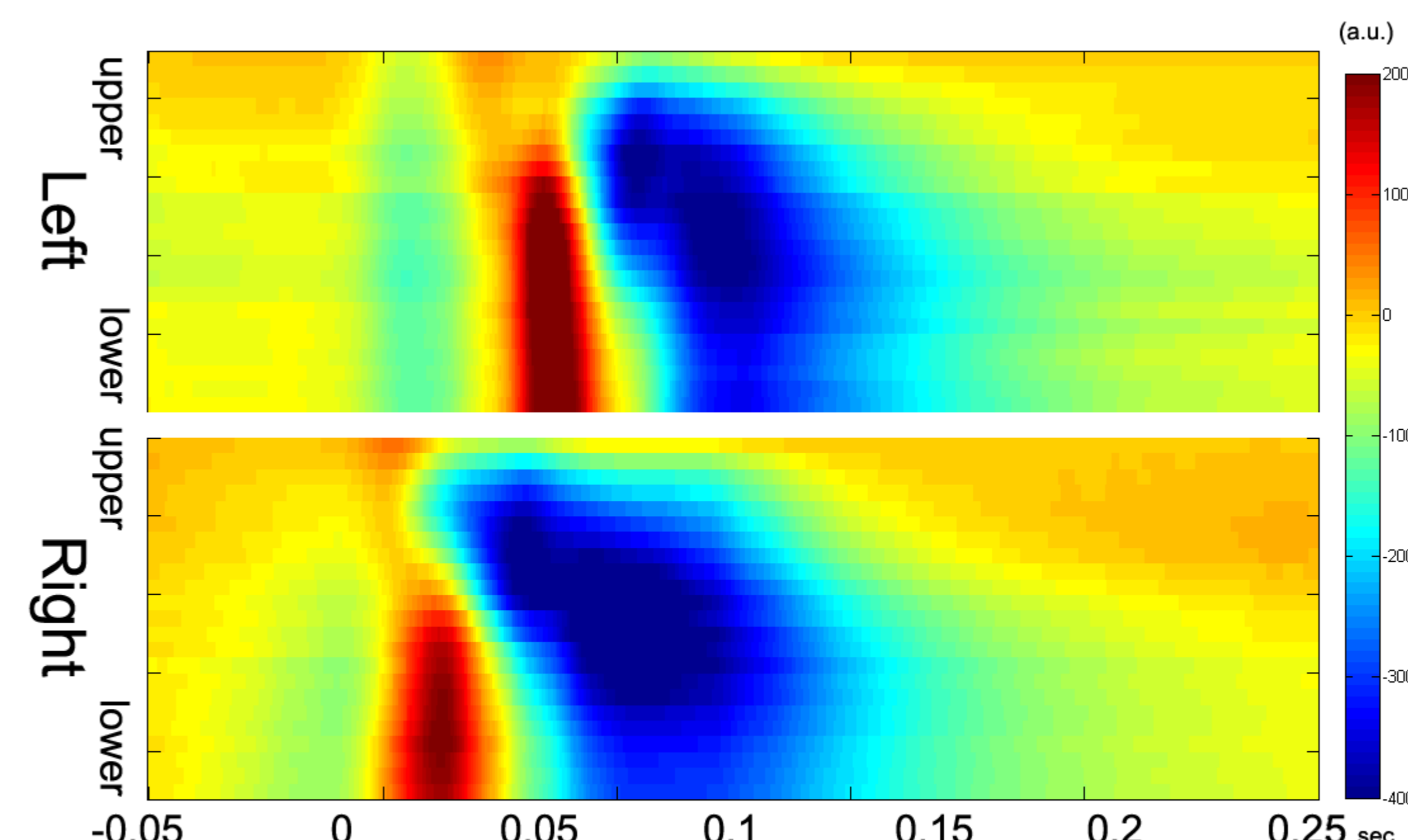


Fig 4. The example of spontaneous activity during resting state.

• Spontaneous activity with amplitude comparable to was observed as shown in Fig 2 and 4. The evoked response was brief, monophasic, and observed in upper layers (layer 4 and above), but spontaneous activity tends to sustain longer and occurs more strongly in lower layers as shown in Fig 4. The spontaneous activity was synchronous with similar amplitude level between bilateral cortices, but the evoked activity wasn't.

• Spontaneous activity during resting state showed layer specific pattern of cross-correlation within and between hemispheres as shown in Fig. 5.

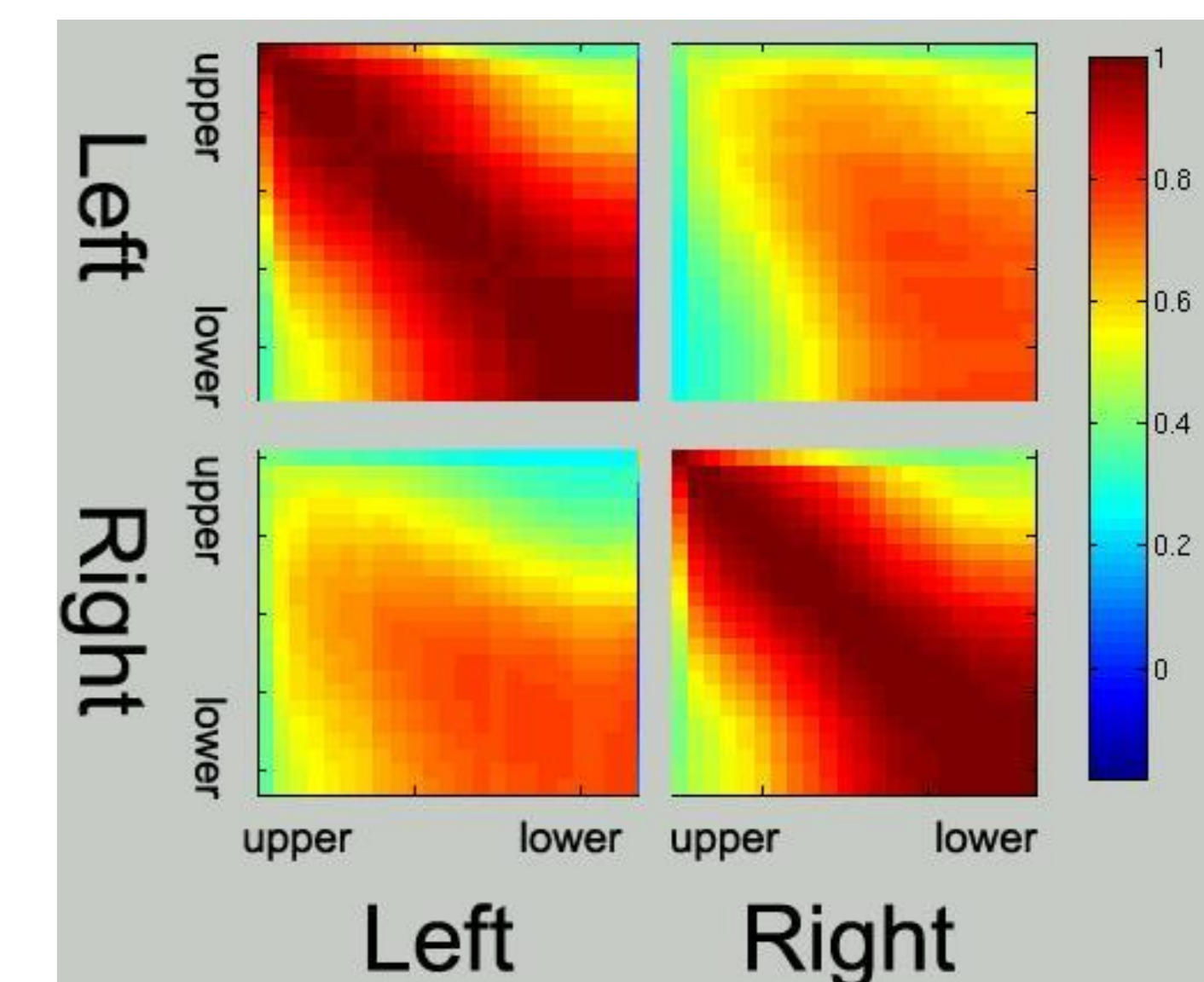


Fig 5. The correlation coefficient between electrophysiological signals from different cortical depths within and between hemispheres.

## DISCUSSION

- Spontaneous activity of comparable amplitude was observed and superimposed on the stimulus-evoked activity.
- Spontaneous activity exhibits different characteristics from the stimulus-evoked activity, and is possibly driven by different neuronal population spanning to deeper cortical layers.
- Spontaneous activity measured by LFP was highly correlated between bilateral cortices in a layer-specific manner, supporting the resting state functional connectivity which has been frequently revealed in spontaneous MRI time courses.
- Future study must address underlying anatomical connections between bilateral cortices and the functional role of the interhemispheric communication in cerebral cortex.

## REFERENCES

- [1] Biswal, B. et al. (1995). 'Functional connectivity in the motor cortex of resting human brain using echo-planar MRI'. *Magnetic Resonance in Medicine*, vol. 34, no. 4, pp. 537-541.
- [2] Lowe, M., et al. (1998). "Functional connectivity in single and multislice echoplanar imaging using resting-state fluctuations." *Neuroimage*, vol. 7, no. 2, pp. 119-132.
- [3] Quigley, M. et al. (2003). 'Role of the corpus callosum in functional connectivity.' *American Journal of Neuroradiology*, vol. 24, no. 2, pp. 208-212.
- [4] Johnston, J. et al. (2008). 'Loss of resting interhemispheric functional connectivity after complete section of the corpus callosum.' *Journal of Neuroscience*, vol. 28, no. 25, pp. 6453-6458.
- [5] Shmuel, A. and D. Leopold (2008). 'Neuronal correlates of spontaneous fluctuations in fMRI signals in monkey visual cortex: Implications for functional connectivity at rest.' *Human Brain Mapping*, vol. 29, no. 7, pp. 751-761.
- [6] Kim, Y. R. et al. (2008). 'Comparison of spontaneous electrophysiological and fMRI fluctuations during rest in rat brain cortex' *16<sup>th</sup> Annual Meetings of International Society of Magnetic Resonance in Medicine*, no. 752.