HARVARD
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Tissue-wide interrogation and intervention of cellular electrophysiology with cell-type specificity

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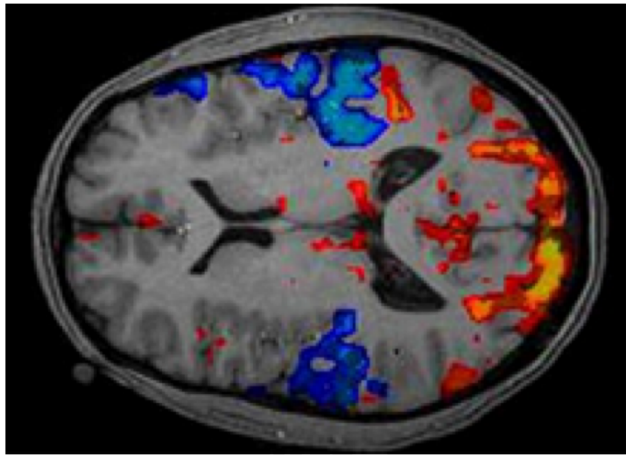
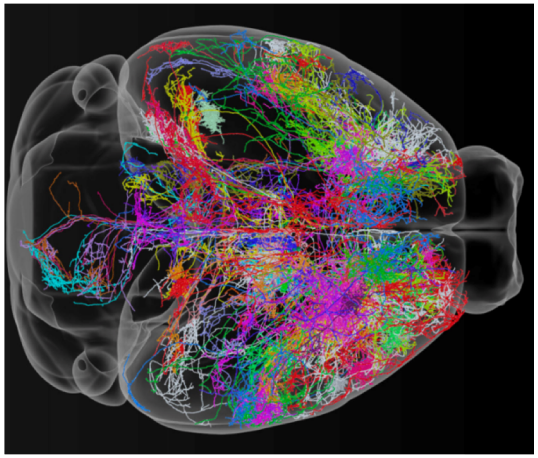
What are challenges?

Single-neuron activities across entire organ



Functionality



Connectivity

- **Brain functions are mostly associated with activities of neurons from multiple, deep brain regions.**
- **Different brain regions are highly innervated together through neural projections. Many connections are based on single neuron.**

Elife, DOI: 10.7554/eLife.10566; Nature Meth. **10**, 413 (2013); Nat. Rev. Neurosci. **8**, 700 (2007)

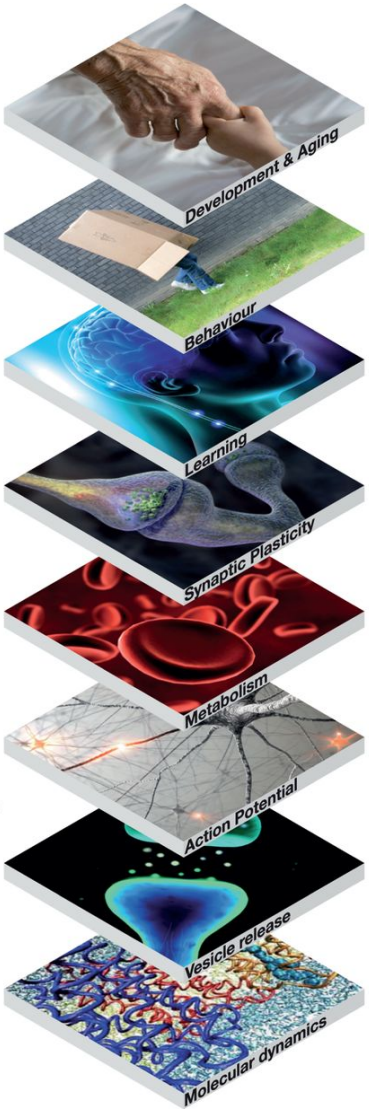
What are challenges?

Spatiotemporal dilemma

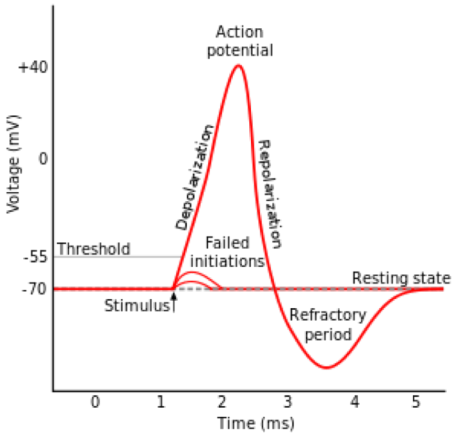
Time Scale

Years (10^7 s)

Milliseconds (10^{-3} s)



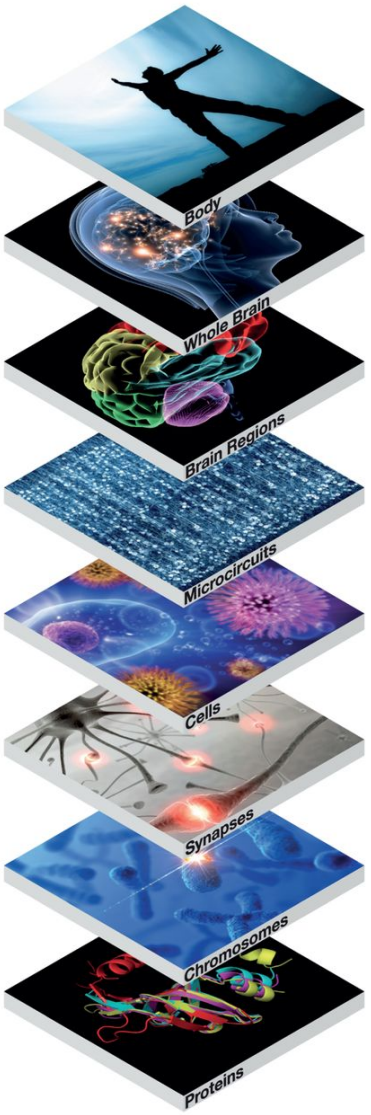
function



Spatial Scale

Metres (10^0 m)

Micrometres (10^{-6} m)

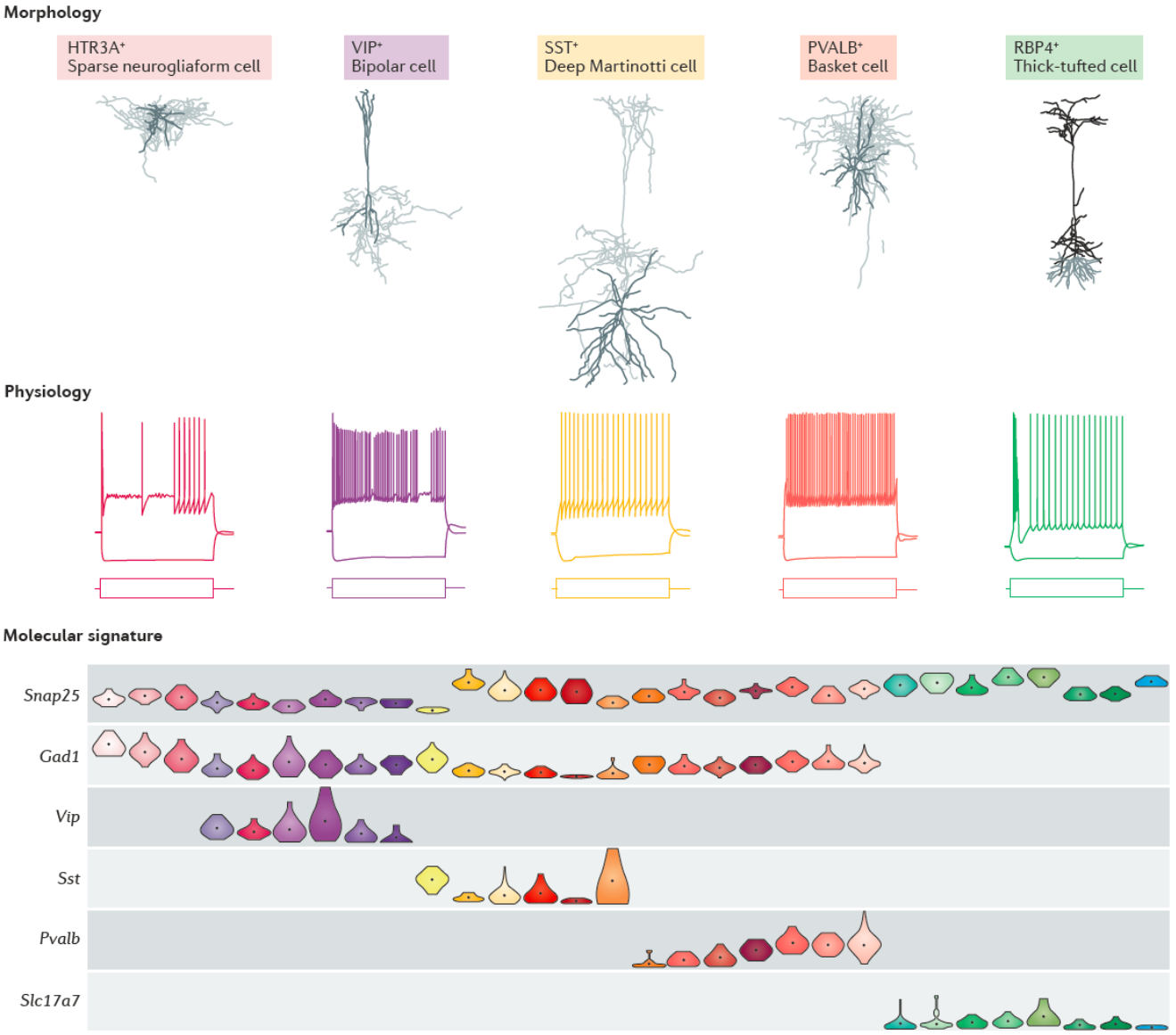


structure

Phil. Trans. R. Soc. B **370**, 20140171 (2017)

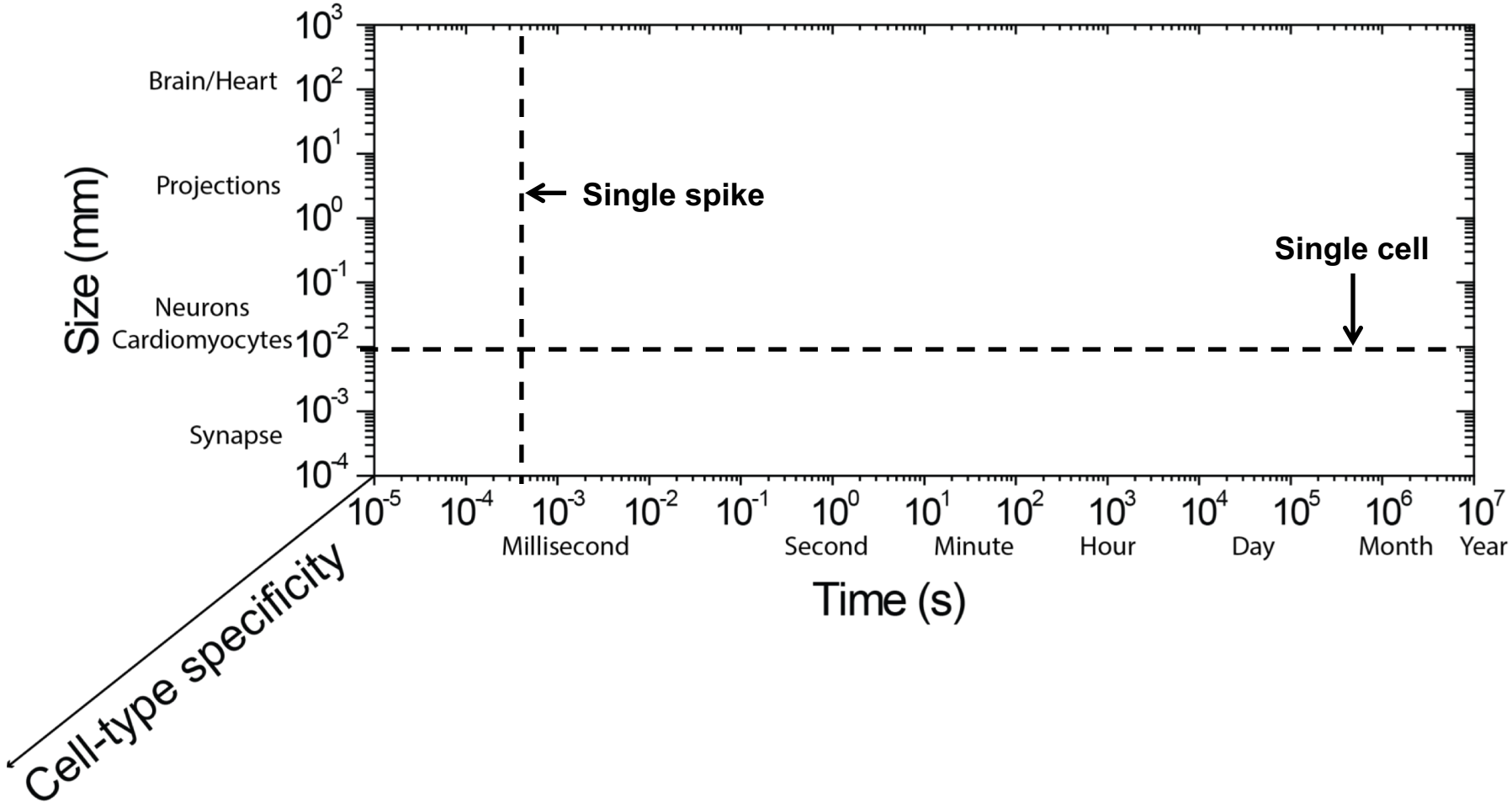
What are challenges?

Different types of cells interweave together

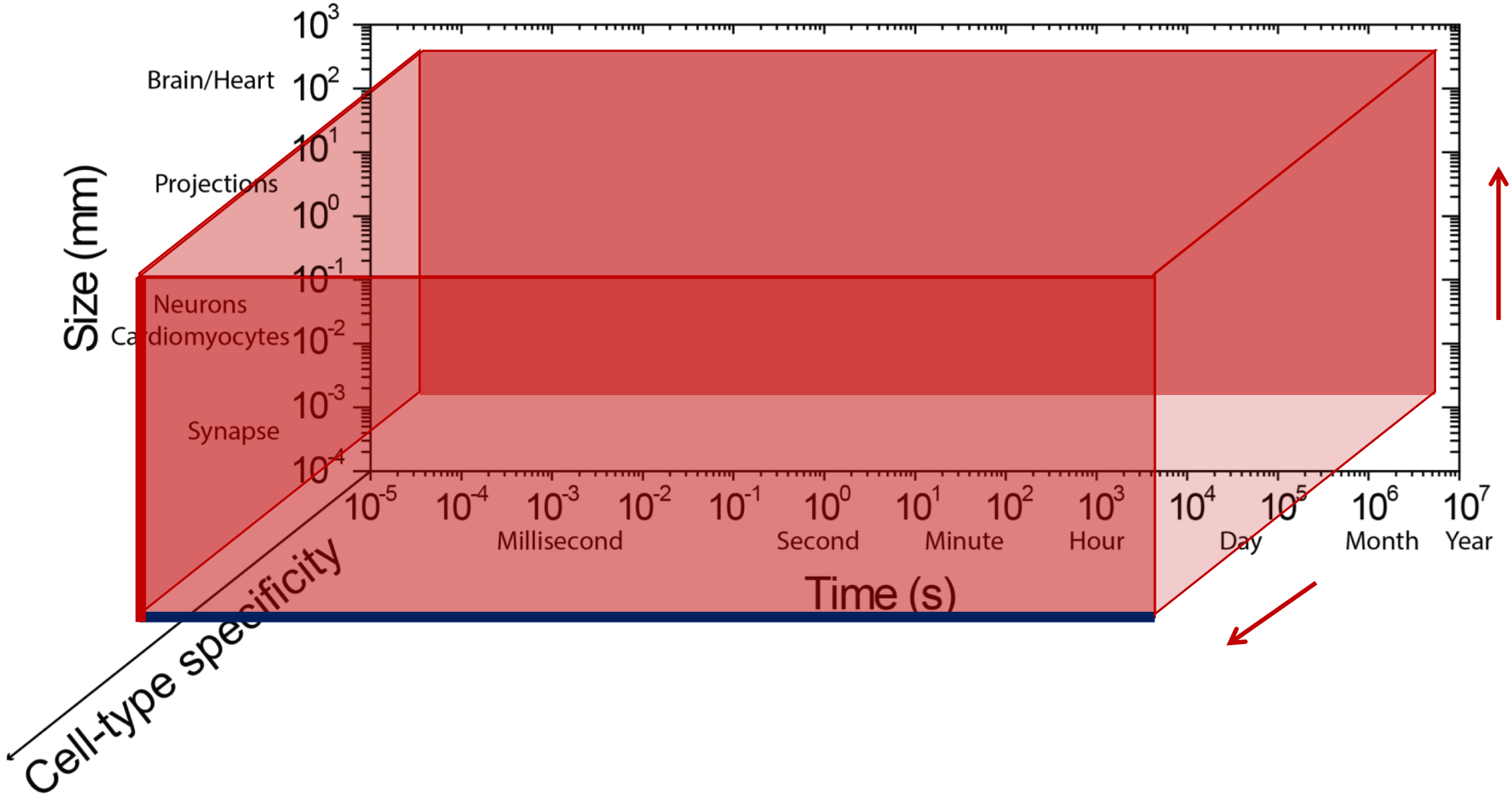


Nat. Rev. Neurosci. **18**, 530 (2017)

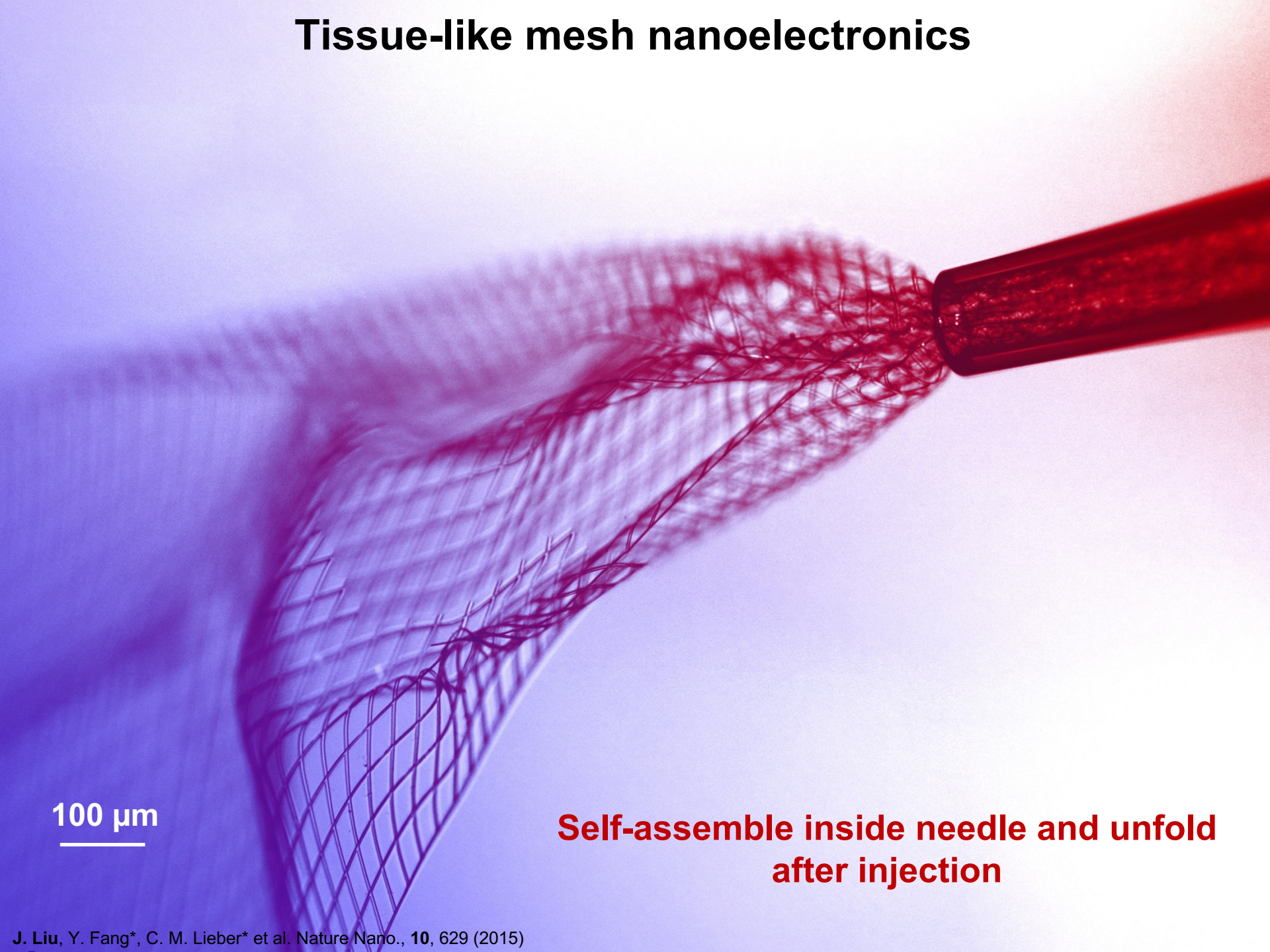
Scalable technologies for tissue interface



Scalable technologies for tissue interface

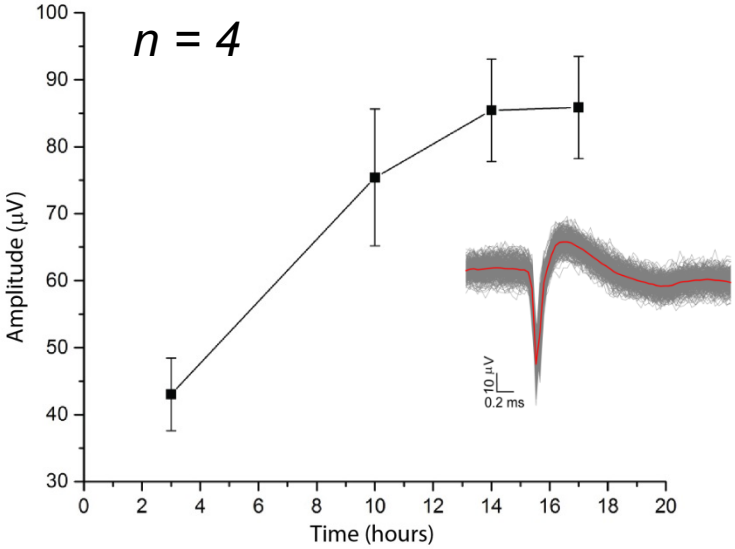


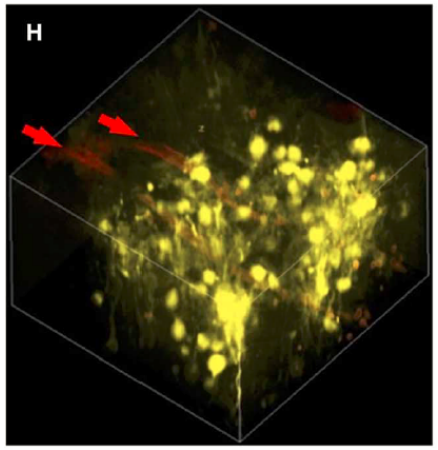
Tissue-like mesh nanoelectronics

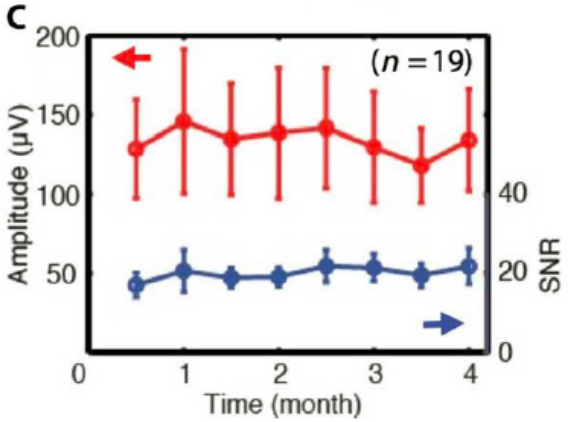


J. Liu, Y. Fang*, C. M. Lieber* et al. Nature Nano., **10**, 629 (2015)

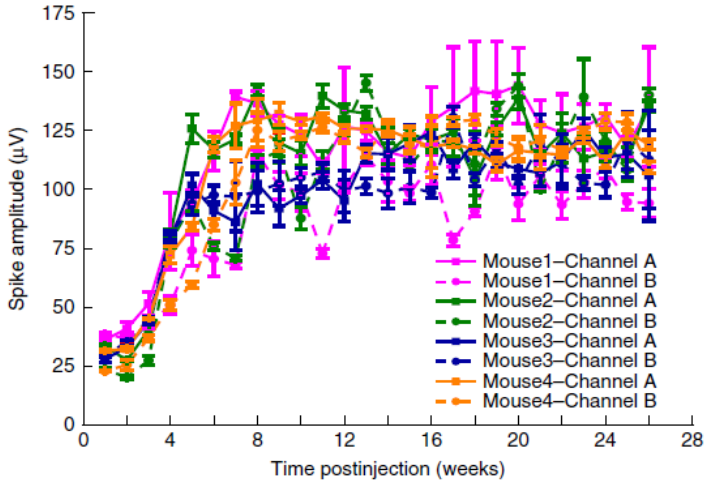
Long-term single-cell electrophysiology in behaving animal

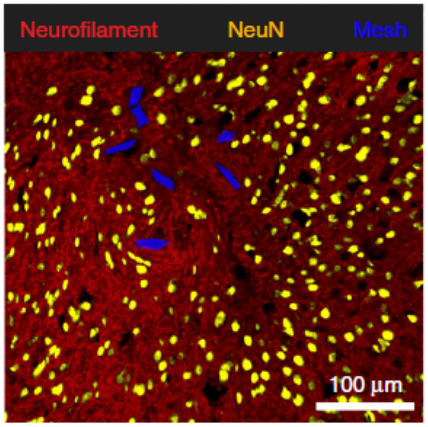


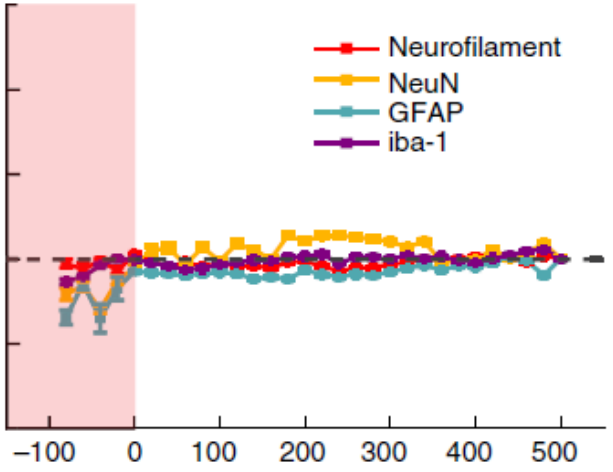




Sci. Adv., **3**, e1601966 (2017)



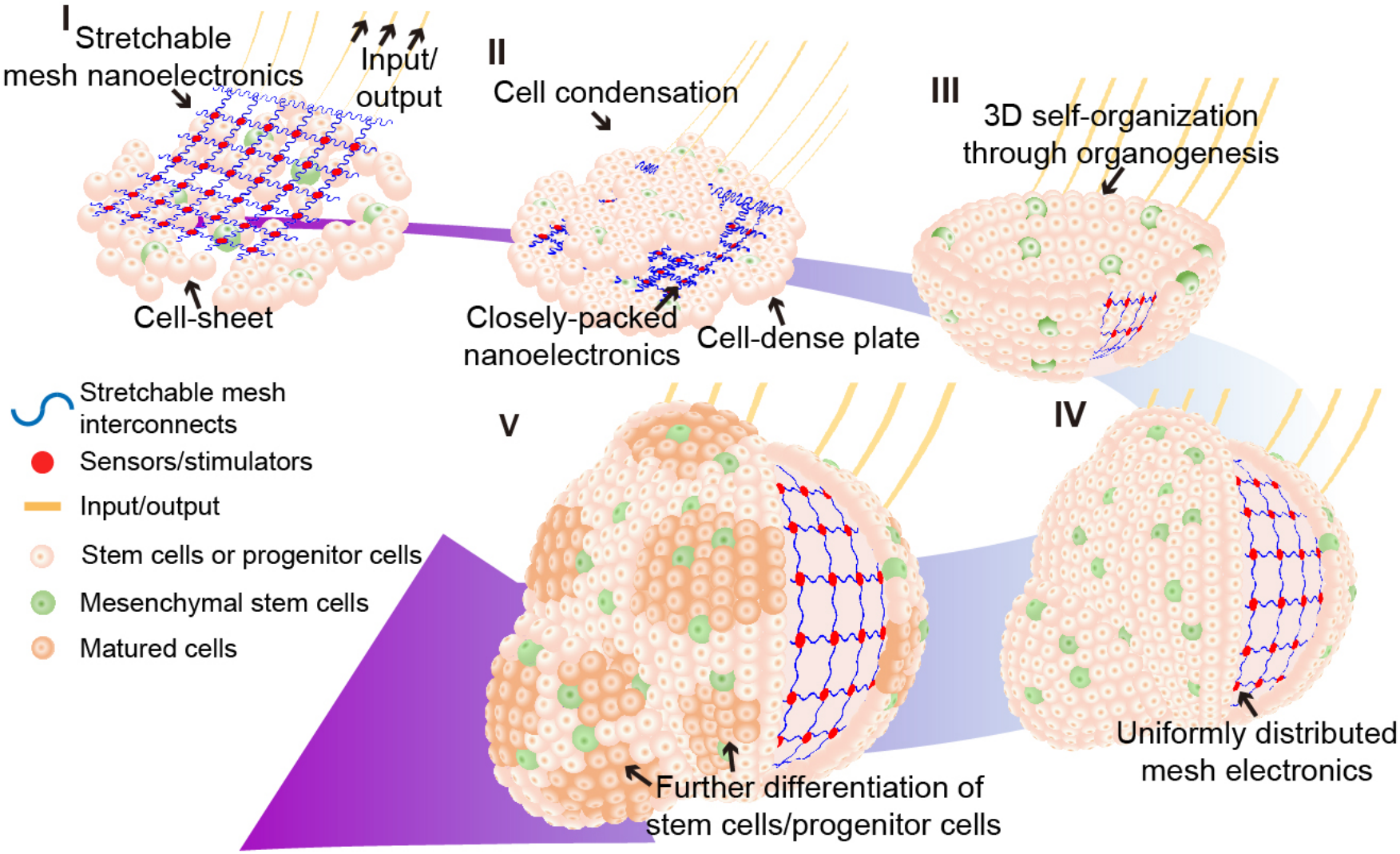




Nat. Methods **13**, 875 (2016)

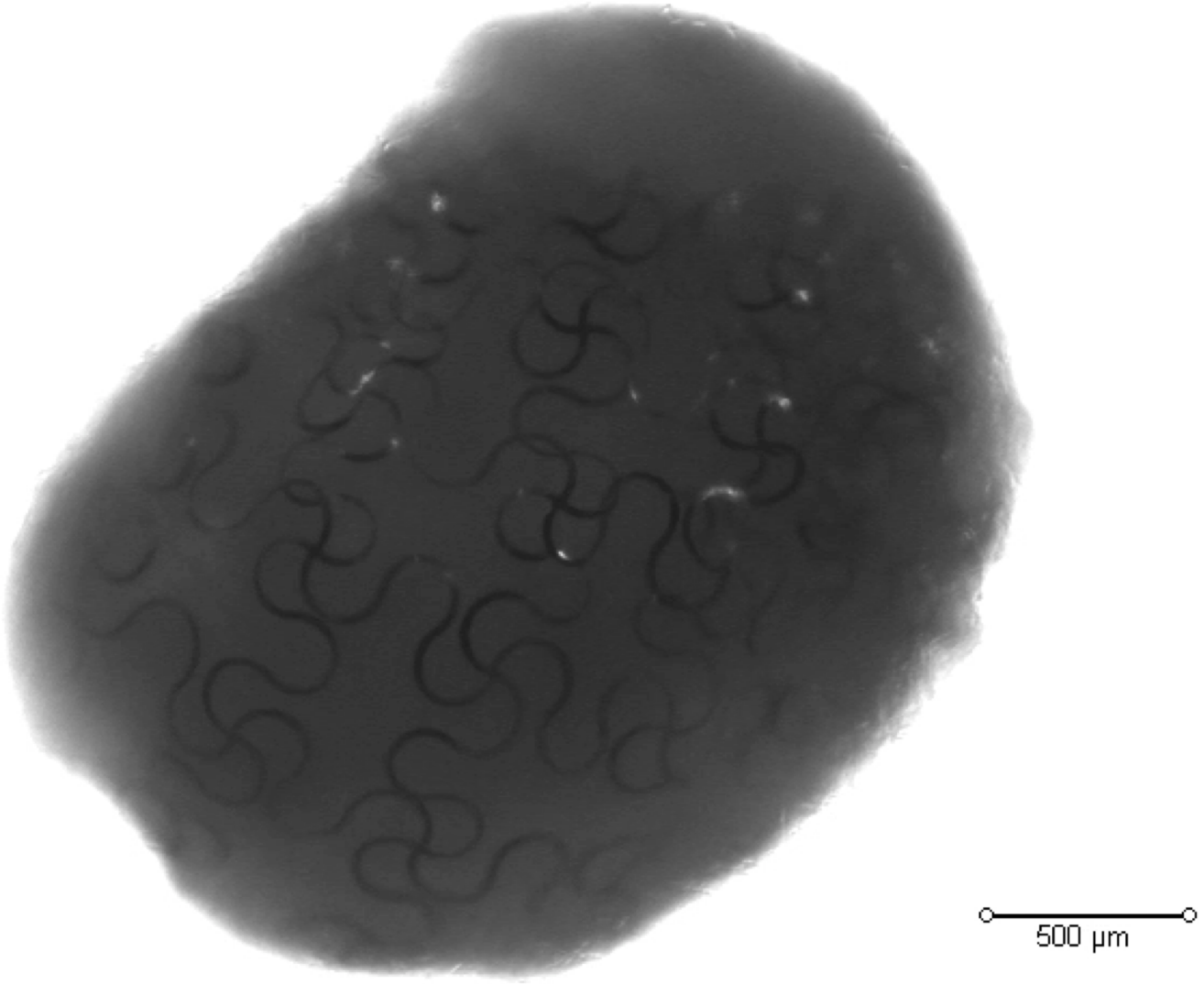
Proc. Natl. Acad. Sci. USA **114**, 5894 (2017)

Cyborg organoid model

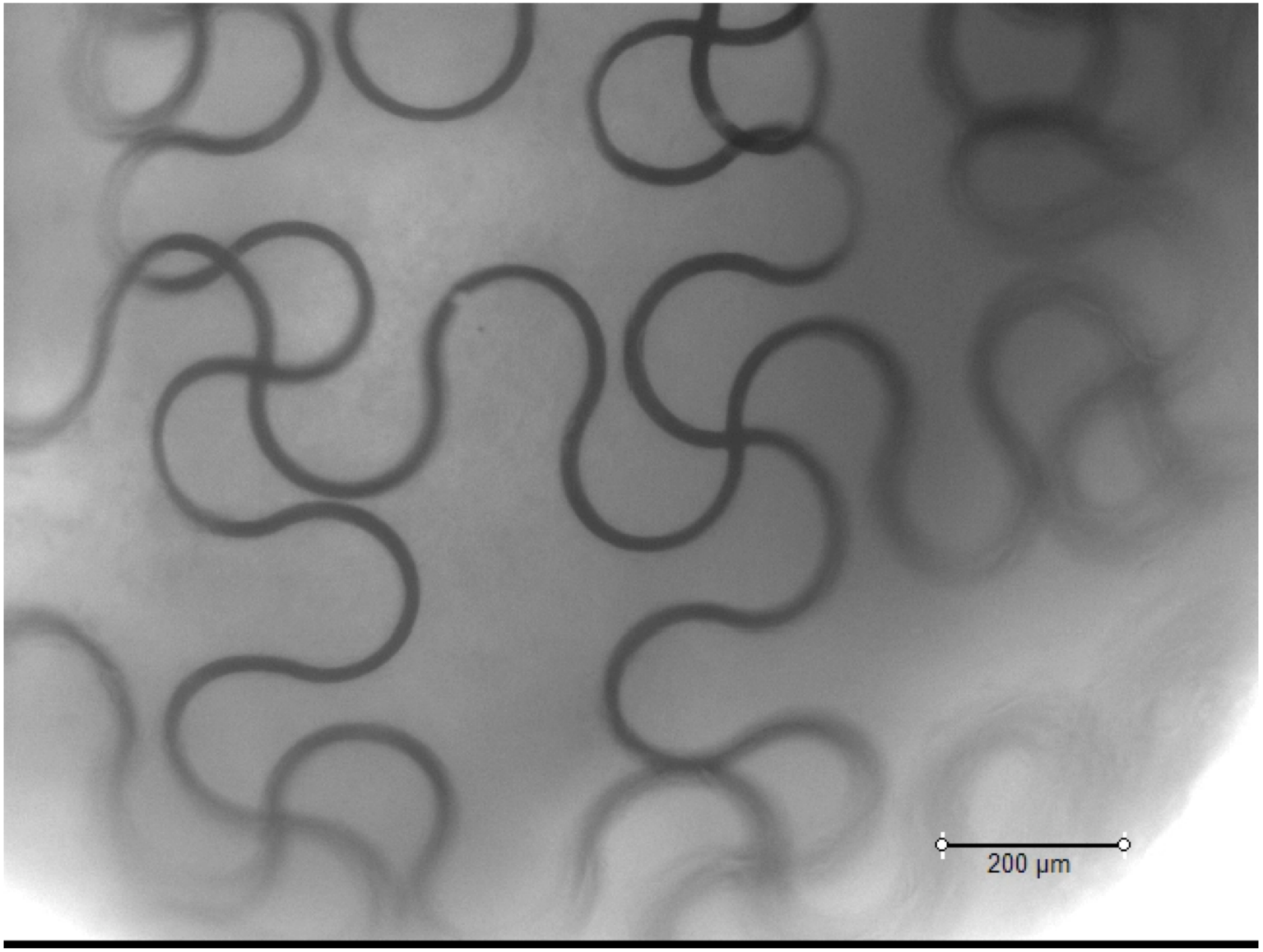


Qiang Li, Kewang Nan, Paul Le Floch, Zuwan Lin, Hao Sheng, Jia Liu
bioRxiv 697664; doi: https://doi.org/10.1101/697664

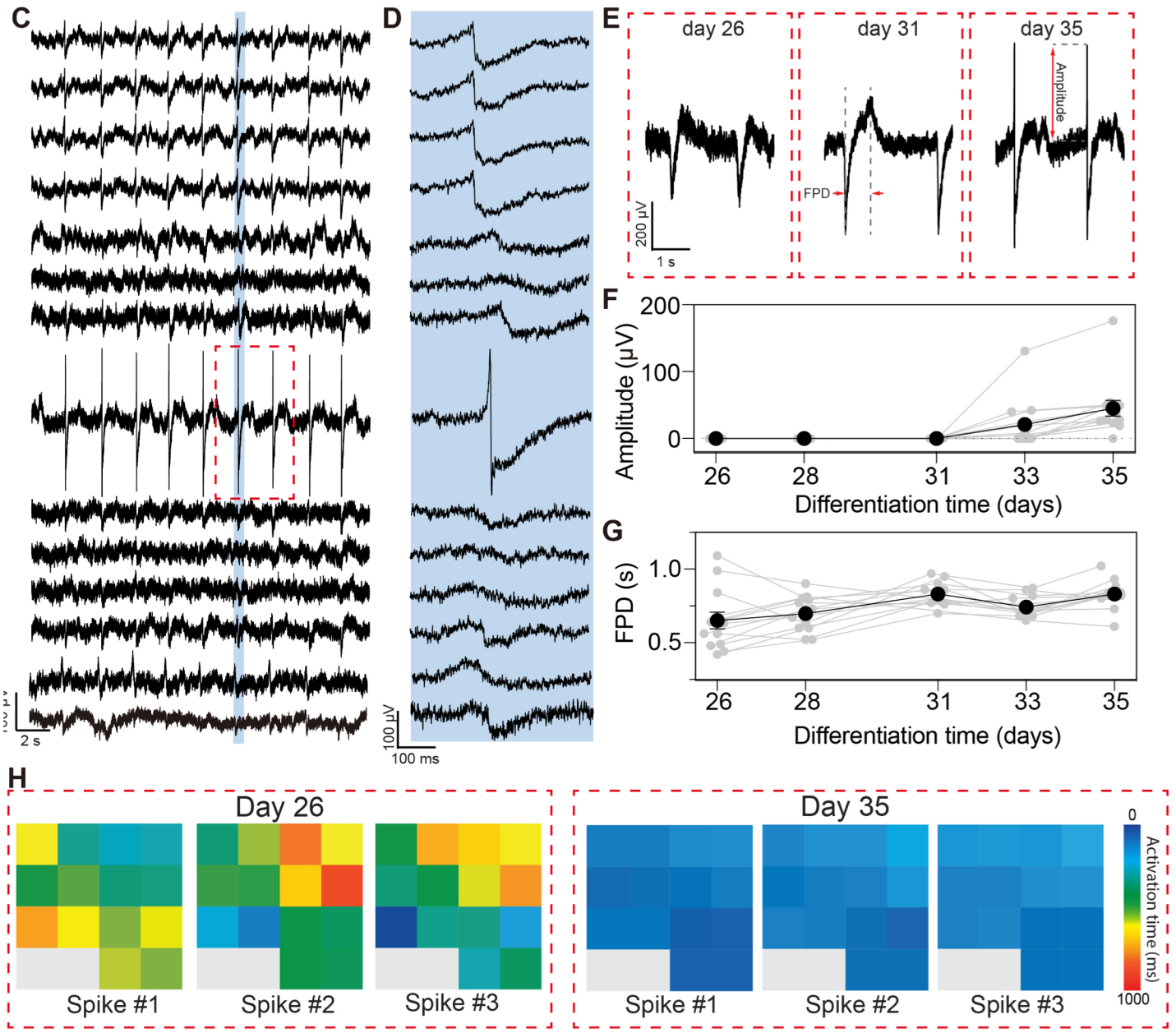
Cyborg organoids



Cyborg organoids



Tissue-wide burst dynamics during tissue development



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